UNITED STATES PATENT AND TRADEMARK OFFICE

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United States Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/995,039	05/26/2015	9042448	31181U	7504

20529 7590 05/06/2015

NATH, GOLDBERG & MEYER
Joshua Goldberg
112 South West Street
Alexandria, VA 22314

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 1099 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Satoru Sakazume, Kanagawa-ken, JAPAN;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/995,039	11/29/2010	Satoru Sakazume	31181U	7504

20529 7590 04/30/2015

NATH, GOLDBERG & MEYER
Joshua Goldberg
112 South West Street
Alexandria, VA 22314

EXAMINER	
PICON-FELICIANO, ANA J	

ART UNIT	PAPER NUMBER
2482	

NOTIFICATION DATE	DELIVERY MODE
04/30/2015	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

USPTO@nathlaw.com

Response to Rule 312 Communication	Application No.	Applicant(s)
	12/995,039	SAKAZUME, SATORU
	Examiner	Art Unit
	ANA PICON-FELICIANO	2482

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address –

1. ☒ The amendment filed on *21 April 2015* under 37 CFR 1.312 has been considered, and has been:

   a) ☒ entered.

   b) ☐ entered as directed to matters of form not affecting the scope of the invention.

   c) ☐ disapproved because the amendment was filed after the payment of the issue fee.
   Any amendment filed after the date the issue fee is paid must be accompanied by a petition under 37 CFR 1.313(c)(1) and the required fee to withdraw the application from issue.

   d) ☐ disapproved. See explanation below.

   e) ☐ entered in part. See explanation below.

/CHRISTOPHER S KELLEY/ Supervisory Patent Examiner, Art Unit 2482	/ANA PICON-FELICIANO/ Examiner, Art Unit 2482

OK TO ENTER: /A.F./

04/23/2015

Mail Stop ISSUE FEE
Attorney Docket No.: 31181U

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Satoru SAKAZUME		Conf. No.:	7504
Appl. No.:	12/995,039	Examiner:	Ana J. PICON-FELICIANO
Filing Date:	November 29, 2010	Art Unit:	2482

Title: **MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYSTEM, MOVING PICTURE REENCODING METHOD, AND MOVING PICTURE REENCODING PROGRAM**

AMENDMENT AFTER ALLOWANCE UNDER 37 C.F.R. § 1.312

Commissioner for Patents
Attn: Examiner Aronovich
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Examiner Aronovich:

In response to the Notice of Allowance, mailed on January 22, 2015, applicant respectfully requests this amendment be considered to correct a typographical error in the specification. Prior to payment of the Issue Fee, please enter the following changes:

Amendments to the Specification begin on page 2 of this paper.

Remarks begin on page 3 of this paper.

A **Conclusion** appears at page 4 of this paper.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

20529 7590 01/22/2015
NATH, GOLDBERG & MEYER
Joshua Goldberg
112 South West Street
Alexandria, VA 22314

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/995,039	11/29/2010	Satoru Sakazume	31181U	7504

TITLE OF INVENTION: MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYTEM, MOVING PICTURE REENCODING METHOD, AND

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	04/22/2015

EXAMINER	ART UNIT	CLASS-SUBCLASS
PICON-FELICIANO, ANA J	2482	375-240120

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Nath, Goldberg & Meyer
2 Jerald L. Meyer
3 Stanley N. Protigal

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: JVC KENWOOD CORPORATION

(B) RESIDENCE: (CITY and STATE OR COUNTRY): YOKOHAMA-SHI, KANAGAWA, JAPAN

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:
- ☒ Issue Fee
- ☐ Publication Fee (No small entity discount permitted)
- ☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ☐ A check is enclosed.
- ☒ Payment by credit card. Form PTO-2038 is attached.
- ☐ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ☐ Applicant certifying micro entity status. See 37 CFR 1.29 — NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
- ☐ Applicant asserting small entity status. See 37 CFR 1.27 — NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
- ☐ Applicant changing to regular undiscounted fee status. — NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Jerald L. Meyer/ Date April 21, 2015

Typed or printed name Jerald L. Meyer Registration No. 41,194

PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Electronic Patent Application Fee Transmittal

Application Number:	12995039
Filing Date:	29-Nov-2010
Title of Invention:	MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYTEM, MOVING PICTURE REENCODING METHOD, AND
First Named Inventor/Applicant Name:	Satoru Sakazume
Filer:	Stanley Protigal/Amanda Suazo
Attorney Docket Number:	31181U

Filed as Large Entity

Filing Fees for U.S. National Stage under 35 USC 371

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Utility Appl Issue Fee	1501	1	960	960

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**960**

Electronic Acknowledgement Receipt	
EFS ID:	22112843
Application Number:	12995039
International Application Number:	
Confirmation Number:	7504
Title of Invention:	MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYTEM, MOVING PICTURE REENCODING METHOD, AND
First Named Inventor/Applicant Name:	Satoru Sakazume
Customer Number:	20529
Filer:	Stanley Protigal/Amanda Suazo
Filer Authorized By:	Stanley Protigal
Attorney Docket Number:	31181U
Receipt Date:	21-APR-2015
Filing Date:	29-NOV-2010
Time Stamp:	15:32:17
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$960
RAM confirmation Number	2065
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		312Amendment.pdf	29598 155c8aa380335ba3aa98759238de02422b068eea	yes	4

Multipart Description/PDF files in .zip description

Document Description	Start	End
Amendment after Notice of Allowance (Rule 312)	1	1
Specification	2	2
Applicant Arguments/Remarks Made in an Amendment	3	4

Warnings:

Information:

2	Issue Fee Payment (PTO-85B)	IFPayment.pdf	121203 4aab2274d1afdc95bb2174dc9b26d09e396c2fa3	no	1

Warnings:

Information:

3	Fee Worksheet (SB06)	fee-info.pdf	30725 a3fcceb6a1032a0c232b945e45c7b8e65ca23c2e	no	2

Warnings:

Information:

Total Files Size (in bytes):	181526

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Mail Stop ISSUE FEE
Attorney Docket No.: 31181U

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Satoru SAKAZUME		Conf. No.:	7504
Appl. No.:	12/995,039	Examiner:	Ana J. PICON-FELICIANO
Filing Date:	November 29, 2010	Art Unit:	2482

Title: **MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYSTEM, MOVING PICTURE REENCODING METHOD, AND MOVING PICTURE REENCODING PROGRAM**

AMENDMENT AFTER ALLOWANCE UNDER 37 C.F.R. § 1.312

Commissioner for Patents
Attn: Examiner Aronovich
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Examiner Aronovich:

In response to the Notice of Allowance, mailed on January 22, 2015, applicant respectfully requests this amendment be considered to correct a typographical error in the specification. Prior to payment of the Issue Fee, please enter the following changes:

Amendments to the Specification begin on page 2 of this paper.

Remarks begin on page 3 of this paper.

A **Conclusion** appears at page 4 of this paper.

AMENDMENTS TO THE SPECIFICATION:

Please amend paragraph [0122] as follows:

In Fig. 10, there is a first encoder 102 including a first predictor 402, a first encoder element 403, a first decoder element 404, an intra-predictor 405, a first predictive picture buffer 406, a first reference picture buffer 407, a motion estimator 408, a motion compensator 409, an adder 410, and a deblocker 411. This configuration affords to implement an equivalent function to MPEG-4 AVC specified to standardize under the ISO/IEC SC29 WG11 as a typical motion picture encoding. However, this specific configuration of the first encoder 102 is an example, so there may well be any example else subject to functions of the first encoder 102 to be implemented. For instance, there may be an example compliant with MPEG-2 employed in digital broadcasting or the like, or an example compliant with MPEG-4 SVC being a scalable extension of MPEG-4 AVC. There may be use of a pre-super-resolution encoder element based on a wavelet transform, as typified by ~~JPRG2000~~ JPEG2000.

REMARKS

The above amendment to the specification has been made to correct a typographical error .

No new matter has been added.

Accordingly, the Examiner is respectfully requested to enter the above amendment before the payment of the Issue Fee.

Favorable consideration is respectfully requested.

CONCLUSION

The Examiner is welcomed to telephone the undersigned attorney if any questions or comments should arise.

Respectfully submitted,

NATH, GOLDBERG & MEYER

Date: April 21, 2015

/Jerald L. Meyer/

Jerald L. Meyer, Reg. No. 41,194
Customer No. 20529

NATH, GOLDBERG & MEYER
112 S. West Street, Alexandria, VA 22314
TEL: (703) 548-6284; FAX: (703) 683-8396
JLM/als

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

20529 7590 01/22/2015

NATH, GOLDBERG & MEYER
Joshua Goldberg
112 South West Street
Alexandria, VA 22314

EXAMINER
PICON-FELICIANO, ANA J

ART UNIT	PAPER NUMBER
2482	

DATE MAILED: 01/22/2015

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/995,039	11/29/2010	Satoru Sakazume	31181U	7504

TITLE OF INVENTION: MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYTEM, MOVING PICTURE REENCODING METHOD, AND

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	04/22/2015

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

20529 7590 01/22/2015
NATH, GOLDBERG & MEYER
Joshua Goldberg
112 South West Street
Alexandria, VA 22314

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/995,039	11/29/2010	Satoru Sakazume	31181U	7504

TITLE OF INVENTION: MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, ~~MOVING PICTURE REENCODING SYTEM, MOVING PICTURE REENCODING METHOD, AND~~

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	04/22/2015

EXAMINER	ART UNIT	CLASS-SUBCLASS
PICON-FELICIANO, ANA J	2482	375-240120

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
- ❑ Issue Fee
- ❑ Publication Fee (No small entity discount permitted)
- ❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ❑ A check is enclosed.
- ❑ Payment by credit card. Form PTO-2038 is attached.
- ❑ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ❑ Applicant certifying micro entity status. See 37 CFR 1.29 — NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
- ❑ Applicant asserting small entity status. See 37 CFR 1.27 — NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
- ❑ Applicant changing to regular undiscounted fee status. — NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/995,039	11/29/2010	Satoru Sakazume	31181U	7504

20529 7590 01/22/2015

NATH, GOLDBERG & MEYER
Joshua Goldberg
112 South West Street
Alexandria, VA 22314

EXAMINER	
PICON-FELICIANO, ANA J	

ART UNIT	PAPER NUMBER
2482	

DATE MAILED: 01/22/2015

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 12/995,039	Applicant(s) SAKAZUME, SATORU	
	Examiner ANA PICON-FELICIANO	Art Unit 2482	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *September 15, 2014*.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on_____.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *7-9*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov .
4. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☒ All b) ☐ Some *c) ☐ None of the:
   1. ☒ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☒ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
5. ☒ Examiner's Amendment/Comment
6. ☒ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/ANA PICON-FELICIANO/ Examiner, Art Unit 2482	/CHRISTOPHER S KELLEY/ Supervisory Patent Examiner, Art Unit 2482

DETAILED ACTION

1. The present application is being examined under the pre-AIA first to invent provisions.

2. This action is in response to applicant's amendment received on **September 15, 2014**.

3. **Claims 2-26** are still pending in this application.

4. **Claims 2-6 and 10-26** have been withdrawn from consideration.

5. **Claims 7-9** have been amended.

6. **Claim 1** has been canceled.

EXAMINER'S AMENDMENT

7. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Jerald L. Meyer (Reg. No. 41,194) on December 30, 2014.

The application has been amended as follows:

Cancel Claims 2-6 and 10-26.

Allowable Subject Matter

8. Claims 7-9 are allowed.

9. The following is an examiner's statement of reasons for allowance:

Regarding claims 7-9, the closest prior art of record **Wan et al. (US 6,580,754 B1)**, **ONG CHIN PHEK et al.(JP 2007-316161 A)**, and **Holcomb et al.(US 7,379,496 B2)** do not teach nor suggest in detail a moving picture encoding system that makes an encoding of a sequence of moving pictures with a resolution higher than a standard resolution using moving pictures contents which include a sequence of moving pictures with the standard resolution and do not include a sequence of moving pictures with a resolution higher than the standard resolution, the moving picture encoding system comprising: a first encoder configured to work on a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution; a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution; a second super-resolution enlarger configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a second super-resolution enlargement to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution; a third resolution converter configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a third resolution conversion

to create a set of resolution converted enlarged decoded pictures with a resolution higher than the standard resolution; and a third encoder configured to have the set of super-resolution enlarged pictures from the first super-resolution enlarger as a set of encoding target pictures, employing the set of super- resolution enlarged decoded pictures from the second super-resolution enlarger and the set of resolution converted enlarged decoded pictures from the third resolution converter as sets of reference pictures, to implement thereon a third combination of processes for a prediction and an encoding to create a third sequence of encoded bits, wherein a spatial resolution of the set of super-resolution enlarged pictures, that of the set of super-resolution enlarged decoded pictures, and that of the set of resolution converted enlarged decoded pictures are made equal; and wherein the third encoder controls a selection of a set of reference pictures and creates a set of data on the selection of the set of reference pictures to identify a selected set of reference pictures during the process for prediction of the third combination.

Wan et al. (US 6,580,754 B1) discloses an optimal system for determining whether simulcast coding (**400**) or spatial scalability coding (**100**) should be used to encode video for clients with a specific communication link. Operating points (A′, B′, C′) for both simulcast coding and spatial scalability are also determined. Adaptive switching (**3130, 3140**) is provided, with the operating points and decision boundaries being used to guide the switching to optimize the quality of the higher-resolution data based on a bit allocation to the associated lower-resolution data. A system for determining the point (A′, C′) of equal quality in both layers of simulcast and spatial scalability coding is also

provided. The proportion of bits allocated to the base layer to achieve equal quality is essentially independent of the total bit rate for both simulcast and spatial scalability.

ONG CHIN PHEK et al.(JP 2007-316161 A) discloses a method and apparatus of super resolution processing in which the resolution and quality of an image sequence are improved, and a grid artifact is reduced. Interpolation is performed to create a high resolution estimated image, alignment is performed to create an aligned image, the high resolution estimated image is smeared and the smeared image and the aligned image are subtracted to create the residual image, the deficient residue is interpolated by using the residual value of a nondeficient peripheral image, a smoothing image and reverse projection image are combined to create an enhancement coefficient, the enhancement coefficient is updated to the high resolution estimated image to create a fresh enhancement coefficient, and thereby the residual value of the deficient image is interpolated from the residual value of the peripheral image.

Holcomb et al.(US 7,379,496 B2) discloses a video encoder that performs multi-resolution video coding. For example, the encoder adaptively changes frame sizes to reduce blocking artifacts at low bitrates. A video decoder performs corresponding multi-resolution decoding.

Thus prior art of record taking individually or in combination does not teach nor suggest the above-stated limitation taking wholly in combination with all the elements of each independent claim and the structure shown in the specification.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably

accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ANA PICON-FELICIANO whose telephone number is (571)272-5252. The examiner can normally be reached on Monday-Friday 9am to 5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Christopher Kelley can be reached on 571-272-7331. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/ANA PICON-FELICIANO/
Examiner, Art Unit 2482

/CHRISTOPHER S KELLEY/
Supervisory Patent Examiner, Art Unit 2482

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12995039	SAKAZUME, SATORU
	Examiner	**Art Unit**
	ANA PICON-FELICIANO	2482

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	09/10/2013	05/07/2014	12/30/2014						
	1	-	N	-						
	2	÷	N	-						
	3	÷	N	-						
	4	÷	N	-						
	5	÷	N	-						
	6	÷	N	-						
	7	÷	✓	=						
	8	÷	✓	=						
	9	÷	✓	=						
	10	÷	N	-						
	11	÷	N	-						
	12	÷	N	-						
	13	÷	N	-						
	14	÷	N	-						
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	16	÷	N	-						
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	21	÷	N	-						
	22	÷	N	-						
	23	÷	N	-						
	24	÷	N	-						
	25	÷	N	-						
	26	÷	N	-						

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1	12/995039.app.	US-PGPUB; USPAT	OR	ON	2014/12/15 14:51
L22	2500	(("20110176604") or ("20140140407") or ("6792045") or ("20010010707") or ("20130163673") or ("20130182776") or ("20130170558") or ("20130163676") or ("20110007823") or ("20070263731") or ("6785464") or ("20110229046") or ("6483945") or ("20070116130") or ("20110002382") or ("20060262861") or ("7715477") or ("7656950") or ("20070230914") or ("20110096226") or ("6271774") or ("20040264566") or ("20110292995") or ("20020181595") or ("5987179") or ("5828421") or ("20110229028") or ("8036268") or ("20140294081") or ("8023561") or ("7386049") or ("20040022318") or ("20020061184") or ("8145006") or ("20040017853") or ("20140044177") or ("5969768") or ("20040017852") or ("20130163661") or ("20090110056") or ("7394851") or ("20090010559") or ("20130170544") or ("7397858") or ("6574274") or ("6310915") or ("6959042") or ("6795499") or ("7925108") or ("20040141653") or ("8213516") or ("7460719") or ("6141059") or ("8660183") or ("20100054338") or ("20080260026") or ("8023754") or ("20130163679") or ("20060126952") or ("20130170564") or ("20120294355") or ("20110216836") or ("20100189418") or ("20060013297") or ("20120013717") or ("20070077023") or ("7139316") or ("20040264580") or ("20070153894") or ("20070153895") or ("20090016437") or ("20070160141") or ("6915018") or ("20070153912") or ("20140177706") or ("20070153893") or ("20070153911") or ("7366240") or ("20070153913") or ("20120195365") or ("6567471") or ("20130170746") or ("7711051") or ("20040080669") or ("7643690") or ("20110157470") or ("8223847") or ("8798143") or ("20070058729") or ("20110142129") or ("20070047662") or ("7957628") or ("20070047661") or ("20070165715") or ("6393059") or ("6687296") or ("8559526") or ("20100086048") or ("20020136295") or ("20010006562") or ("20080095228") or ("6456661") or ("20030067989") or ("20080031328") or ("20110280311") or	US-PGPUB; USPAT	OR	OFF	2014/12/15 14:53

		("6480630") or ("6466624") or ("7212576") or ("20030142872") or ("20020001411") or ("20090168866") or ("20040228409") or ("20060274075") or ("8019169") or ("6549720") or ("7072491") or ("6990244") or ("7555041") or ("20020159755") or ("20110075738") or ("6160844") or ("20080240503") or ("20050276325") or ("6141447") or ("6801574") or ("20040008774") or ("20090141810") or ("20140219338") or ("8811471")).PN. or (("20100290537") or ("7075984") or ("20130271651") or ("20140269912") or ("20010048719") or ("20070154185") or ("20010021260") or ("8340191") or ("20070160153") or ("20110211122") or ("6580755") or ("20120294369") or ("8170097") or ("8872881") or ("20050002458") or ("8135234") or ("6055012") or ("6427027") or ("6459812") or ("6389173") or ("20100061445") or ("20060291570") or ("20130089135") or ("7933494") or ("6097842") or ("20020081094") or ("6414999") or ("20060072672") or ("20030128292") or ("20090202162") or ("20110064321") or ("20020059643") or ("6154495") or ("20110194604") or ("20100150229") or ("20140211844") or ("7272185") or ("20130089154") or ("20130083847") or ("6477202") or ("20060256868") or ("20030142747") or ("20070053444") or ("20040170330") or ("8428116") or ("20020034254") or ("20080152020") or ("20050226325") or ("20010053182") or ("20060072673") or ("8243820") or ("20100220939") or ("20040086189") or ("20030080980") or ("20050084159") or ("20050084160") or ("20050084164") or ("6707778") or ("20060204112") or ("6301428") or ("20120262630") or ("6330284") or ("20070058948") or ("6961471") or ("20040086190") or ("5473380") or ("20050084165") or ("20050084163") or ("20050089230") or ("20110164676") or ("20110280316") or ("20110249738") or ("6339619") or ("20050254577") or ("20070230568") or ("8116576") or ("20020181793") or ("20050084162") or ("7298911") or ("7184600") or ("6950556") or ("8179420") or ("20060023964") or ("6038256") or ("20090103603") or ("20130077674") or ("6339620") or ("6621933") or ("20030053704") or ("20020090135") or ("20140003508") or ("7116827") or ("6934416") or ("6567561") or ("6754268") or ("20060045467") or ("20120002728") or ("20030038982") or ("20080205508") or ("6310962") or ("6621865") or ("6987887") or ("20030002583") or ("7209635") or ("6546138") or ("7031532") or ("20070110163") or ("20060034522") or ("6292585") or ("6353684") or ("6975768")				

		or ("20140219346") or ("6330364") or ("6307967") or ("6343156") or ("20060174303") or ("20090122859") or ("8014633") or ("20010033619") or ("6088486") or ("20010028404") or ("6879724") or ("20130058414") or ("20030202592") or ("20130058403") or ("8385427") or ("20060088098") or ("5699117") or ("20090257684") or ("20060165167")).PN. or (("20100166079") or ("7697609") or ("20010021303") or ("6956971") or ("20140211843") or ("RE40829") or ("20060133490") or ("RE40828") or ("8731065") or ("20080013626") or ("7148908") or ("5691768") or ("8270494") or ("7126993") or ("20080008237") or ("6795498") or ("20060034369") or ("20030128766") or ("20080095450") or ("8249142") or ("20050018770") or ("20050254010") or ("7675971") or ("20010017891") or ("RE38726") or ("20080013625") or ("6556627") or ("20080232464") or ("20070263719") or ("20080013627") or ("5937095") or ("20060045188") or ("20030016755") or ("20140003519") or ("5475435") or ("7920634") or ("7305040") or ("7859956") or ("RE41180") or ("20050002454") or ("20060120466") or ("6546189") or ("8879627") or ("20090285307") or ("20060280244") or ("6563876") or ("20090141809") or ("6349154") or ("6094457") or ("7606124") or ("8681865") or ("20140328391") or ("RE39367") or ("8467459") or ("6956600") or ("6654421") or ("20080019438") or ("20050286640") or ("8634473") or ("8320450") or ("20090268805") or ("20120269275") or ("6192083") or ("8493513") or ("20090207844") or ("7415160") or ("6462783") or ("8306113") or ("8855198") or ("8422806") or ("20120014432") or ("20060193384") or ("20070009024") or ("7746931") or ("7518630") or ("20080019444") or ("20070286283") or ("8358701") or ("20110158322") or ("20090103619") or ("6130913") or ("20080253450") or ("20120294367") or ("6724977") or ("7469007") or ("7957465") or ("7301999") or ("20020168006") or ("6560282") or ("8681873") or ("20060233252") or ("20090252425") or ("5796438") or ("8170118") or ("20120075436") or ("20060233259") or ("20020172428") or ("20060140264") or ("7889937") or ("20070263087") or ("6636640") or ("8687690") or ("20060146931") or ("20120014434") or ("20090168900") or ("8295347") or ("8780272") or ("6125140") or ("20060215765") or ("5270813") or ("20080043832") or ("20030185456") or ("7956930") or ("6181743") or					

		("20100226437") or ("7173970") or ("20140321560") or ("20040170395") or ("8442120") or ("6157396") or ("20100142614") or ("8406292") or ("8638849") or ("8619865") or ("20100202511") or ("20080253448") or ("8107528") or ("20050244070") or ("6999513") or ("8588308") or ("6853378") or ("20080130758") or ("20040131118")).PN. or (("20060140276") or ("20060182176") or ("8036266") or ("5598222") or ("7496236") or ("6122433") or ("20080037628") or ("6597858") or ("20050111541") or ("20020067768") or ("8724698") or ("6493389") or ("5815209") or ("20110176616") or ("7970220") or ("20070200923") or ("6047100") or ("20080240255") or ("7529298") or ("20090274217") or ("5907374") or ("8811492") or ("20020110192") or ("6058240") or ("20100246683") or ("5883678") or ("20040234145") or ("7957610") or ("20140003504") or ("20010031002") or ("20070002946") or ("5253056") or ("20140112389") or ("20020176508") or ("20080075164") or ("20120063692") or ("20030063668") or ("7609900") or ("20080044156") or ("20120275512") or ("6262770") or ("6577679") or ("6064748") or ("20070247529") or ("8121191") or ("20110038417") or ("6782132") or ("20020037161") or ("20080144720") or ("6587506") or ("20060171463") or ("20090080533") or ("20120328019") or ("20080069244") or ("8494294") or ("6724436") or ("20080152013") or ("7539347") or ("20080044157") or ("20080111897") or ("5614952") or ("20080144714") or ("20130051458") or ("20050008328") or ("7573938") or ("20130038686") or ("8126050") or ("20090245384") or ("6567470") or ("20060280250") or ("8243813") or ("7359558") or ("20040252901") or ("5614957") or ("20130300923") or ("20060133491") or ("20020118750") or ("20100272184") or ("20020030684") or ("7865024") or ("6763067") or ("6490321") or ("20070206678") or ("8254458") or ("8774542") or ("20020114391") or ("20030133502") or ("20110211642") or ("7317837") or ("20020122492") or ("20020122486") or ("20050117643") or ("7295611") or ("5696560") or ("20060093032") or ("5802240") or ("20020136461") or ("20130107941") or ("8811481") or ("5414469") or ("20030103562") or ("20130294502") or ("20120275515") or ("20140269927") or ("7376341") or ("20100046636") or ("20050063466") or ("20010008544") or ("20050254692") or ("20010005400") or ("6748018") or ("6441754") or					

		("20100150238") or ("20110243252") or ("7010215") or ("20050238332") or ("20090323811") or ("8149913") or ("7830409") or ("8121189") or ("20020186774") or ("20090285302") or ("6025878") or ("8902314") or ("6400768") or ("20140023143") or ("8644632") or ("6307594") or ("6535558") or ("6025880") or ("20050163230")).PN. or (("5978035") or ("20100124278") or ("5764296") or ("6510177") or ("20020021843") or ("20100220785") or ("20120027078") or ("20050163231") or ("20010050958") or ("7555042") or ("5767800") or ("7978920") or ("6249547") or ("6198851") or ("20060109900") or ("20030156647") or ("20030067984") or ("5623308") or ("20010048721") or ("7558465") or ("20030012561") or ("20140133567") or ("8199808") or ("20030161404") or ("20060062300") or ("20080063081") or ("20100208801") or ("20130010863") or ("20110164570") or ("20050271140") or ("20090316787") or ("20020135608") or ("20090010333") or ("6563954") or ("6587508") or ("7003036") or ("20020094025") or ("20060262216") or ("20070211798") or ("6522693") or ("20020054638") or ("6256451") or ("20020090136") or ("20140072035") or ("8131135") or ("7027512") or ("20030169814") or ("20040101049") or ("7292782") or ("20140028797") or ("6025876") or ("20090116820") or ("20080002239") or ("20140153639") or ("6917648") or ("5867625") or ("20030133512") or ("20070025438") or ("8457155") or ("20060133475") or ("20020037049") or ("20100322316") or ("6480628") or ("6683911") or ("20120294373") or ("20060227868") or ("20020191959") or ("8107531") or ("7483577") or ("8260122") or ("20050249289") or ("20050259733") or ("8488671") or ("20090263108") or ("20070274688") or ("20050243919") or ("8436889") or ("7058129") or ("6421465") or ("8005148") or ("20130128981") or ("7254174") or ("20100002767") or ("8885710") or ("20030012552") or ("7181131") or ("20090185621") or ("20110063409") or ("20110235714") or ("6934339") or ("20130089156") or ("20120177126") or ("20040228413") or ("6396874") or ("6760377") or ("6621866") or ("20020196852") or ("20100188581") or ("20120082227") or ("7400685") or ("7403567") or ("6408096") or ("7289564") or ("20040190624") or ("20120163476") or ("7853088") or ("20130208793") or ("20120314965") or ("7639882") or ("7978762") or ("20120230393") or ("20080008245") or ("8311104") or ("6408099") or ("7177356") or						

		("20090034625") or ("20130287098") or ("20080304567") or ("8532174") or ("7483625") or ("20010016009") or ("20060215757") or ("7302002") or ("20090232223") or ("5635985") or ("6940909") or ("6901109") or ("6928234") or ("20060029129") or ("20070140664")).PN. or (("20060140269") or ("20140023145") or ("6535559") or ("20070110323") or ("20020009150") or ("20040013399") or ("8107571") or ("20110170556") or ("20090225853") or ("20070041441") or ("6697428") or ("7903732") or ("20120230440") or ("20020021752") or ("5767898") or ("20140328400") or ("20140184741") or ("20100135394") or ("6618442") or ("20080219356") or ("6643328") or ("6075556") or ("20060165298") or ("8116376") or ("8395991") or ("20100067580") or ("20010021221") or ("20050063473") or ("7639289") or ("20130028333") or ("8325797") or ("20080117975") or ("6959045") or ("20090180702") or ("7974345") or ("8063894") or ("20140192895") or ("20090323820") or ("20010001016") or ("20080089404") or ("6700935") or ("20140161174") or ("20120057639") or ("7447264") or ("6041160") or ("20050232500") or ("20040141553") or ("20120230441") or ("20060285819") or ("7437055") or ("6452973") or ("20030093817") or ("6219043") or ("20080267287") or ("5982444") or ("20100150231") or ("20110102627") or ("20120076200") or ("20100191832") or ("20080232452") or ("7457529") or ("20090238535") or ("20070098079") or ("20060285589") or ("20070286289") or ("20090129759") or ("8054880") or ("20010055336") or ("20100020883") or ("20100150239") or ("6611624") or ("8213508") or ("20130230095") or ("20140286415") or ("20080122862") or ("8275036") or ("20020006165") or ("8391364") or ("5196931") or ("20060256232") or ("20010001621") or ("7650062") or ("6167084") or ("20020054641") or ("20010048768") or ("5742343") or ("20140247877") or ("7889934") or ("7020382") or ("7847861") or ("20100080291") or ("20100142836") or ("20120230439") or ("8335256") or ("20120051439") or ("5864368") or ("7970221") or ("20120063511") or ("20120057638") or ("8238431") or ("20120069912") or ("20110310979") or ("6895049") or ("6058143") or ("20020164152") or ("5828787") or ("20010021273") or ("20140016710") or ("20130089155") or ("20080025407") or ("20040208481") or ("20080025414") or ("20030215011") or ("20080279275") or							

		("20060159429") or ("20130051456") or ("5835149") or ("20040228403") or ("6650706") or ("7995897") or ("20050152457") or ("6654417") or ("20100271463") or ("5771357") or ("6061402") or ("20070003149") or ("20050229231") or ("20040223548") or ("20140098890")).PN. or (("8243803") or ("6959041") or ("6266448") or ("7817866") or ("20120213286") or ("5227878") or ("6414991") or ("20080062287") or ("20140098887") or ("6829301") or ("5926573") or ("20080124057") or ("20090252231") or ("20130279601") or ("8472731") or ("6026232") or ("20070122045") or ("20040151341") or ("8229000") or ("20070268968") or ("20140286414") or ("8266251") or ("6674796") or ("7809065") or ("20080240236") or ("20090196346") or ("7817865") or ("20080063378") or ("5376971") or ("5576766") or ("6529555") or ("7203236") or ("20090268811") or ("20060204221") or ("6836513") or ("6754272") or ("6167089") or ("20120128072") or ("20090092186") or ("8831367") or ("20070258009") or ("20130039411") or ("20050196052") or ("20010040926") or ("20090245375") or ("20080043839") or ("20130089267") or ("20100260268") or ("20070127846") or ("8780991") or ("20070147804") or ("20040190614") or ("20110170615") or ("6459736") or ("8644381") or ("20030202604") or ("7920630") or ("20060285586") or ("5410307") or ("20050057687") or ("20070253488") or ("20090196517") or ("20050053133") or ("20130287093") or ("20090028245") or ("8320469") or ("20050232497") or ("20060203099") or ("20050084167") or ("20140285616") or ("6577682") or ("8023568") or ("5196933") or ("8428142") or ("8363936") or ("7379498") or ("20070248165") or ("8503804") or ("7711050") or ("20090168886") or ("8532194") or ("20060203917") or ("20090028239") or ("20020159528") or ("20080089428") or ("8345158") or ("20120027087") or ("5786858") or ("20080056383") or ("20140132843") or ("20060215759") or ("20100086225") or ("20120133736") or ("20140301463") or ("6526099") or ("20090323826") or ("20100195721") or ("20100322315") or ("6272254") or ("20100165205") or ("8374255") or ("6493385") or ("6895052") or ("20020126752") or ("20130195169") or ("20020154697") or ("20070269192") or ("6862319") or ("20050031033") or ("7236687") or ("7423672") or ("5416522") or ("6584154") or ("8254465") or ("20060061497") or ("6028639") or ("7738776") or ("20120069909") or							

		("20090003447") or ("20110298974") or ("8320468") or ("20070086666") or ("6959116") or ("20060165180") or ("20130188708") or ("5684714") or ("7027507") or ("8300706") or ("20070133680") or ("20050238105") or ("20040150747")).PN. or (("5446498") or ("7266148") or ("6671323") or ("7412102") or ("7180944") or ("5485279") or ("7558324") or ("5623424") or ("20060233248") or ("20090002379") or ("20140185691") or ("20060159430") or ("20030169817") or ("8189666") or ("20040141732") or ("20120314771") or ("7822123") or ("6100932") or ("6983019") or ("8121195") or ("20140072039") or ("7120194") or ("5832124") or ("20080037656") or ("20010036319") or ("8155210") or ("7218842") or ("6973131") or ("20050190292") or ("20020122495") or ("20090022218") or ("20120063516") or ("20090092191") or ("20110170001") or ("5956088") or ("8538181") or ("20110051808") or ("20130287114") or ("6041068") or ("20140016711") or ("7801223") or ("6898245") or ("5010392") or ("20140192870") or ("8358692") or ("6081295") or ("20090103816") or ("7680187") or ("20090245383") or ("20090136145") or ("20050135687") or ("5412428") or ("20070297507") or ("8279941") or ("20050123282") or ("7362804") or ("20080170627") or ("20050128307") or ("20090190662") or ("20120121016") or ("7123657") or ("20070291852") or ("20090034626") or ("20110305275") or ("20140233633") or ("20060188023") or ("20050047501") or ("20100226567") or ("20130016790") or ("20070206930") or ("20110268185") or ("20090052543") or ("8681868") or ("7876477") or ("20030138050") or ("20100254453") or ("8160155") or ("8249169") or ("20070230566") or ("20090003446") or ("20070140350") or ("20080062187") or ("6983015") or ("7075991") or ("20060133507") or ("20090028427") or ("20120014451") or ("20110310972") or ("20040096114") or ("20050047507") or ("8817889") or ("20060104356") or ("7551672") or ("20090202000") or ("5699474") or ("20050089232") or ("8064527") or ("8144764") or ("20100061451") or ("20130136190") or ("20040179619") or ("8155209") or ("20110182354") or ("20030067637") or ("8311105") or ("20060039473") or ("20080063071") or ("7869503") or ("20120281763") or ("5532744") or ("20130129237") or ("6057893") or ("5897219") or ("20100329351") or ("20130044813") or ("20050105814") or ("8817870") or ("20060120449") or ("20010040700") or						

		("8711934") or ("6023553") or ("20140301451") or ("20050238104") or ("20100329331") or ("20100118948") or ("8139150") or ("6519288") or ("7197070") or ("20070189395") or ("7236526")).PN. or ((("6038257") or ("20080063072") or ("20060013308") or ("20070195879") or ("7224890") or ("20140119440") or ("20090310676") or ("20070177813") or ("20060072668") or ("20100046610") or ("20070274393") or ("20050025250") or ("20040161035") or ("8306126") or ("20110280310") or ("20110044387") or ("20110007818") or ("7672522") or ("20110216823") or ("8189665") or ("20030007692") or ("8891539") or ("8165196") or ("8582659") or ("20070297514") or ("20060126948") or ("20060120453") or ("20110013889") or ("20080095232") or ("20030108099") or ("20100254456") or ("20020064230") or ("20080069225") or ("20090110068") or ("20070206932") or ("20100046611") or ("20100329330") or ("20120144143") or ("6650707") or ("6968005") or ("20120237132") or ("7627041") or ("6104753") or ("20050105617") or ("7702017") or ("20080101457") or ("20120219063") or ("20100061456") or ("20080075171") or ("7751473") or ("20030099290") or ("6148033") or ("8160134") or ("20100215093") or ("20120147964") or ("20060233528") or ("20030113097") or ("20120183065") or ("7545864") or ("7428019") or ("20100111188") or ("8855199") or ("5510787") or ("20100002761") or ("6445738") or ("6369852") or ("5978034") or ("20140003505") or ("8175167") or ("20070036218") or ("7420616") or ("8243802") or ("6788347") or ("8213503") or ("20140314148") or ("20110064322") or ("20120033739") or ("20050152452") or ("7711052") or ("7839933") or ("20060039475") or ("20110216822") or ("20090220010") or ("20110075733") or ("20140294091") or ("20040028129") or ("20050036548") or ("5027206") or ("20110080949") or ("20100182511") or ("20020135607") or ("20100166074") or ("7330509") or ("8670646") or ("20090161762") or ("20140301657") or ("20050025249") or ("20110228840") or ("5802315") or ("5881244") or ("5805225") or ("8792562") or ("6160889") or ("20050243923") or ("6842539") or ("20100296572") or ("6993076") or ("20130108248") or ("20020064226") or ("20050100093") or ("20070263722") or ("20060222076") or ("20100020871") or ("20070177669") or ("20070189392") or ("20140086327") or ("20050254582") or ("20100098352") or ("8345762") or ("5812787") or ("20050265457") or					

		("6954499") or ("20050207620") or ("20100202535") or ("20110216825") or ("20040228404") or ("20050053150") or ("6507615")).PN. or (("20120200663") or ("20070177675") or ("7151799") or ("20090034615") or ("20110293008") or ("20120027082") or ("20080007613") or ("20110090959") or ("6982762") or ("20060072669") or ("20110299600") or ("8855204") or ("20040268222") or ("8041187") or ("20140119441") or ("20100079608") or ("20070121720") or ("20110222599") or ("20020150383") or ("7986732") or ("8520141") or ("20090154816") or ("20140092991") or ("6600785") or ("20020001348") or ("20050053302") or ("20140098892") or ("8184700") or ("5479209") or ("7650061") or ("7697607") or ("8446962") or ("8149917") or ("20060140271") or ("20100150394") or ("8107744") or ("20110216830") or ("5510842") or ("5128754") or ("20090141814") or ("20110142131") or ("20110216824") or ("8208549") or ("20080291997") or ("20100034254") or ("20010026589") or ("20130202044") or ("20070058712") or ("6628714") or ("20120183061") or ("20060062297") or ("8385413") or ("7251368") or ("6532242") or ("8693538") or ("6084909") or ("20050058206") or ("20010026587") or ("20130202031") or ("6301304") or ("7263129") or ("20140119451") or ("20060159168") or ("20140092992") or ("8451895") or ("8503536") or ("20100027621") or ("20050201469") or ("20070273750") or ("8345992") or ("20100034269") or ("20100061446") or ("7308029") or ("20110293017") or ("20050123038") or ("20140085415") or ("8155193") or ("6192188") or ("20100290523") or ("20130188709") or ("4701783") or ("20100290758") or ("20110293016") or ("20020039384") or ("20060233235") or ("8718137") or ("8300688") or ("20070147789") or ("20020118953") or ("7072571") or ("20060018378") or ("20060120463") or ("20130279579") or ("7800690") or ("8374236") or ("8279939") or ("20090034627") or ("20130114715") or ("8098729") or ("20010036230") or ("20100104022") or ("20120069905") or ("20100027897") or ("5767799") or ("20100027971") or ("20060126728") or ("20140010294") or ("6650705") or ("8345749") or ("20130064299") or ("20060034372") or ("20070189377") or ("20090268816") or ("20060203918") or ("7333542") or ("7835440") or ("20100061447") or ("6370192") or ("20060233263") or ("20120219061") or ("20050169377") or ("7333715") or ("20120063517") or ("20070052847") or					

		("20020136297") or ("6125143") or ("20110255594") or ("7020202") or ("20140233640")).PN. or (("6980732") or ("8532468") or ("8290057") or ("20100195735") or ("20020181597") or ("8233709") or ("7421127") or ("7068847") or ("20130070846") or ("7424203") or ("8270492") or ("20060078056") or ("7035337") or ("20060233256") or ("20040218668") or ("7646812") or ("6944226") or ("7499495") or ("7369709") or ("20060227871") or ("8270493") or ("20080079743") or ("20140010516") or ("6697425") or ("20100080534") or ("20120320977") or ("20050084015") or ("6208745") or ("20060133499") or ("20120236115") or ("20070217297") or ("20020113898") or ("8355619") or ("20080247461") or ("20110199535") or ("20110150080") or ("5122873") or ("20060133477") or ("6870886") or ("8098738") or ("20040252982") or ("20120300843") or ("20080267299") or ("20090180550") or ("7787539") or ("6990146") or ("20060007298") or ("20050249202") or ("20090296808") or ("20020041632") or ("20020196858") or ("6345388") or ("7039108") or ("20080170624") or ("6850571") or ("20120076208") or ("20070160300") or ("6771823") or ("8036267") or ("20140294070") or ("8068541") or ("20020172505") or ("6885707") or ("5510840") or ("20120128070") or ("7970057") or ("20140301436") or ("20060140277") or ("20110150413") or ("20140146887") or ("20060233249") or ("20050074172") or ("8582663") or ("20040105499") or ("7054366") or ("20090074070") or ("8085851") or ("5574504") or ("7865062") or ("20060227872") or ("8406294") or ("7016419") or ("20030021345") or ("20130114741") or ("8442114") or ("20130010866") or ("8223842") or ("20070177812") or ("20060029283") or ("20070230574") or ("20060190625") or ("20070217296") or ("20140133556") or ("6240137") or ("7961786") or ("20020005909") or ("7697036") or ("20020163967") or ("20130156101") or ("8254455") or ("7646967") or ("5854858") or ("7602849") or ("20110228841") or ("20080250470") or ("8233541") or ("7580613") or ("20120207220") or ("6504576") or ("20110150084") or ("RE40415") or ("20030206584") or ("20100166060") or ("8634700") or ("20050025461") or ("20070223909") or ("7899121") or ("7477688") or ("6421144") or ("8369397") or ("20040091159") or ("7492820") or ("20070081814") or ("20080170793") or ("20100020866") or ("20090225869") or ("20070140355") or					

		("4703361") or ("20100061464") or ("20100080294") or ("4689673")).PN. or (("20070189398") or ("20090180551") or ("20060029131") or ("20060133677") or ("20090129471") or ("20050058198") or ("20080062306") or ("8428124") or ("20120099648") or ("6456656") or ("20110274171") or ("8396124") or ("5715009") or ("7489342") or ("20140286416") or ("6198767") or ("8520736") or ("8903184") or ("8619854") or ("8774269") or ("20010013951") or ("8553777") or ("5515107") or ("20100322311") or ("RE42589") or ("20110299825") or ("20020154700") or ("8340510") or ("5767986") or ("7756205") or ("20140092964") or ("8184702") or ("20080056380") or ("20080019446") or ("20130034159") or ("7903737") or ("20030099293") or ("20090180553") or ("4743959") or ("20140010304") or ("5612900") or ("20080056379") or ("8422801") or ("20040218671") or ("20080137731") or ("5694173") or ("20080130756") or ("7746933") or ("20030021583") or ("5886794") or ("20050157798") or ("6321026") or ("20060146143") or ("20060029130") or ("6724434") or ("20070286281") or ("20140165125") or ("20100067577") or ("7227895") or ("20080205528") or ("6526178") or ("20140072030") or ("20140334556") or ("20060034371") or ("20100039555") or ("6385248") or ("20130034156") or ("20020060818") or ("6864997") or ("20030118243") or ("20090238264") or ("8165217") or ("20080205517") or ("20040252758") or ("20140294063") or ("20020001344") or ("20080056378") or ("7406124") or ("20010041054") or ("20060083299") or ("20080123972") or ("20070237222") or ("20060029132") or ("8194733") or ("20130101026") or ("8514936") or ("8811493") or ("20140092963") or ("6058362") or ("20020154696") or ("6987805") or ("20070171971") or ("6873368") or ("5596321") or ("20130182775") or ("20140098883") or ("20080137732") or ("7796690") or ("20040264578") or ("20080107401") or ("20120213287") or ("20070009039") or ("20130308711") or ("6690881") or ("6940906") or ("20140092961") or ("8625958") or ("20080187045") or ("7116714") or ("20080130740") or ("8611418") or ("20080123737") or ("6295089") or ("6914939") or ("20040218678") or ("8086087") or ("20110274180") or ("8625959") or ("20080151068") or ("7924919") or ("20080205516") or ("20050157936") or ("20090010331") or ("20050036549") or ("20070076801") or ("20050058197") or						

		("20040190610") or ("20090245385") or ("20110075726")).PN. or (("20020080875") or ("20070147502") or ("20130003833") or ("8718132") or ("20100283869") or ("20040086040") or ("20080123736") or ("20050069039") or ("8265144") or ("20140362927") or ("8170111") or ("20030103604") or ("6148032") or ("8194143") or ("20130272430") or ("20130064284") or ("5502493") or ("20020176703") or ("8767822") or ("20050069210") or ("20050141620") or ("8532187") or ("6668018") or ("RE43238") or ("20060146934") or ("20010017974") or ("8711933") or ("RE43021") or ("20050147395") or ("20040202250") or ("20040218677") or ("20140294062") or ("20060039677") or ("20080304562") or ("7586985") or ("7477833") or ("6029126") or ("20050163478") or ("6625320") or ("8428139") or ("20120314776") or ("7391811") or ("7936823") or ("5691775") or ("20080130746") or ("20130279599") or ("8830262") or ("20050100318") or ("20130294522") or ("8660189") or ("20140286397") or ("8320459") or ("8774268") or ("6466623") or ("20130279589") or ("7660487") or ("8270469") or ("5819004") or ("7590294") or ("20050093869") or ("5331414") or ("RE43043") or ("7215871") or ("8179969") or ("20100008415") or ("RE33547") or ("20140161172") or ("20110064142") or ("20070183494") or ("7970058") or ("8195024") or ("20090074053") or ("20020071485") or ("8649434") or ("20020191116") or ("6101313") or ("8571107") or ("20090129470") or ("RE43111") or ("6522694") or ("20080212683") or ("6122321") or ("20020114392") or ("8335252") or ("20020181588") or ("20130070859") or ("7724818") or ("8036272") or ("8243824") or ("20140036033") or ("20110044386") or ("20020181945") or ("20120033730") or ("20090080534") or ("20070053665") or ("6856760") or ("20070064800") or ("20130315306") or ("20140092977") or ("20110274172") or ("20130223541") or ("7215706") or ("7813428") or ("5831688") or ("6141448") or ("8780998") or ("20070177519") or ("20120057635") or ("8009934") or ("7936821") or ("20110103470") or ("20050018915") or ("8340140") or ("5038389") or ("20130163660") or ("7688897") or ("20100266012") or ("5666461") or ("8553764") or ("7986731") or ("8249155") or ("20090116554") or ("7995649") or ("20080144057") or ("8638847") or ("20080002767") or ("20130016769") or ("20110026607") or ("20040146107") or						

		("7146056") or ("5991503") or ("6115689")).PN. or (("20030156198") or ("20140092976") or ("20070280350") or ("20140098881") or ("20030169933") or ("8526492") or ("20030108103") or ("20030086622") or ("20110268175") or ("20080219393") or ("8554061") or ("8755445") or ("20020001346") or ("20140105286") or ("20140133572") or ("20050078756") or ("20130089152") or ("20140003539") or ("5282049") or ("20140133578") or ("20140086333") or ("20020009141") or ("20070253486") or ("20140341278") or ("20110103471") or ("20130114680") or ("20080117988") or ("7804899") or ("20010005447") or ("20080095234") or ("20120093227") or ("20140133561") or ("8045622") or ("20070247549") or ("6957350") or ("5343250") or ("20040012510") or ("20050195899") or ("20040264937") or ("20080080621") or ("20140161181") or ("20090097551") or ("20080144711") or ("20100189181") or ("7263126") or ("20080131079") or ("4652935") or ("7706445") or ("20050100092") or ("8189680") or ("20110216826") or ("20080118218") or ("20060233246") or ("7400684") or ("20080144719") or ("20080118224") or ("7016337") or ("20070291841") or ("6539166") or ("20060192698") or ("20140133577") or ("8340190") or ("8446945") or ("20130266068") or ("20080123970") or ("8279928") or ("20140111614") or ("8160135") or ("8902976") or ("20070248163") or ("6940911") or ("8682089") or ("20090097555") or ("6826308") or ("8831107") or ("20060222069") or ("8644672") or ("20050147174") or ("20110081046") or ("5689307") or ("20100208827") or ("7864849") or ("7453938") or ("7860170") or ("6788227") or ("20120224635") or ("20140341275") or ("7995658") or ("20140301479") or ("6097439") or ("20110122943") or ("8804845") or ("20020044603") or ("20130114718") or ("20010022891") or ("5862140") or ("8615038") or ("8428143") or ("20080152007") or ("20130188743") or ("7936822") or ("8199832") or ("20130287110") or ("8073053") or ("20140269920") or ("7970056") or ("5526131") or ("20130202162") or ("20080063073") or ("6175592") or ("7864863") or ("20080317125") or ("7352877") or ("7593467") or ("20080144718") or ("4989089") or ("7224842") or ("20140198842") or ("20020154698") or ("5838874") or ("5940130") or ("8718139") or ("8229274") or ("6754440") or ("20140177711") or ("20120243603") or ("8760495") or				

		("7725008") or ("20050083218") or ("7142601")).PN. or (("20060146138") or ("6128340") or ("20110176562") or ("20130315299") or ("20120189054") or ("8085842") or ("20020031184") or ("RE40079") or ("8559505") or ("7593433") or ("20130235152") or ("20120243604") or ("20060083303") or ("7728878") or ("20040218816") or ("20050152458") or ("6421749") or ("20100310155") or ("4369464") or ("8155460") or ("8731374") or ("8442119") or ("8571108") or ("7206347") or ("6665345") or ("7728877") or ("20120224628") or ("8189658") or ("20090010337") or ("20130182774") or ("20140185681") or ("20040146108") or ("8325816") or ("20090116558") or ("20040125204") or ("20070286577") or ("8655087") or ("8428118") or ("8144765") or ("7760803") or ("5913031") or ("20110058793") or ("20090051808") or ("8837594") or ("20130329956") or ("20030194140") or ("6356667") or ("20090034633") or ("5793425") or ("5703646") or ("20020051493") or ("7961791") or ("20080166059") or ("8369400") or ("8331434") or ("20080089410") or ("20100086059") or ("20130336384") or ("8270819") or ("20060029365") or ("7953282") or ("6424795") or ("20130089265") or ("20020110197") or ("20080232473") or ("7197072") or ("6917310") or ("20060133479") or ("8355439") or ("20100080293") or ("20110286513") or ("20080192830") or ("20040027452") or ("20060222068") or ("7852353") or ("6014171") or ("20100046635") or ("7961785") or ("5737023") or ("20090279608") or ("8073313") or ("7995896") or ("20120229670") or ("20120263225") or ("20020141503") or ("20080285644") or ("6498814") or ("7801411") or ("20140086342") or ("20020157102") or ("5861905") or ("8290062") or ("20070104270") or ("20020037111") or ("6256346") or ("20070189382") or ("20050180505") or ("6339617") or ("6944224") or ("5691767") or ("20030007556") or ("20140362921") or ("20060074692") or ("20080069209") or ("20090244392") or ("20110249749") or ("20080069226") or ("20100220789") or ("20070121722") or ("20100208799") or ("20100080472") or ("6404814") or ("20100091845") or ("20140079117") or ("6201927") or ("7933335") or ("20100135395") or ("20060120610") or ("20060133484") or ("6608935") or ("6021199") or ("20040008766") or ("5815604") or ("6192154") or ("20090190655") or ("20130163674") or ("20090060034") or ("20070198931") or					

		("20060013311") or ("6028634")).PN. or (("20100091843") or ("5974185") or ("20130188738") or ("20120189219") or ("8619852") or ("5825927") or ("20060098215") or ("7787540") or ("20130182769") or ("20090129467") or ("20040119842") or ("5532752") or ("20080151991") or ("20020118760") or ("20120044322") or ("8165392") or ("6339659") or ("8306119") or ("8170108") or ("20040184531") or ("6600783") or ("8526489") or ("7864841") or ("7660356") or ("5452006") or ("8275033") or ("8331438") or ("20100172593") or ("6941020") or ("20130336399") or ("6922442") or ("20140192886") or ("20110249743") or ("20140119450") or ("20130343459") or ("20050207501") or ("20130279564") or ("8073059") or ("8611427") or ("20070274384") or ("7079580") or ("7483488") or ("6519285") or ("20060256860") or ("20130235927") or ("20130272398") or ("6775326") or ("20040047417") or ("20140079115") or ("20130315311") or ("5686965") or ("7039112") or ("20070183755") or ("20020061143") or ("20070116126") or ("20140140414") or ("5727091") or ("6549671") or ("8155206") or ("8520729") or ("20090310680") or ("20050063471") or ("8467454") or ("20100080292") or ("20100158116") or ("8542746") or ("20090116555") or ("8526491") or ("8401076") or ("6996282") or ("6845129") or ("20120300850") or ("8369409") or ("20080043831") or ("20060285592") or ("6263150") or ("6091855") or ("20030012276") or ("6674802") or ("8417088") or ("20090190844") or ("20080101473") or ("7817899") or ("6236760") or ("20140362922") or ("20090046092") or ("20060146141") or ("20090296811") or ("8300700") or ("8194734") or ("8054885") or ("7742523") or ("7333515") or ("8150182") or ("20020046308") or ("7782950") or ("7986847") or ("5818531") or ("20080196061") or ("7680182") or ("20130077821") or ("7782948") or ("6614935") or ("20110280303") or ("6549668") or ("6529550") or ("20050008240") or ("20020006273") or ("20140119671") or ("4743965") or ("20070177677") or ("20060133503") or ("20060082474") or ("6057884") or ("7782947") or ("8681872") or ("8259800") or ("20100111169") or ("20070098301") or ("20060088094") or ("20080253447") or ("7782943") or ("6931064") or ("20050089102") or ("20130279575") or ("7974340") or ("20050047506") or ("20130182766") or ("20090168880") or ("20100303151") or ("20100074334") or ("7627034") or ("6456663")).PN. or				

		(("7065141") or ("6182034") or ("20090010332") or ("5533138") or ("6560283") or ("6148140") or ("5974224") or ("20050147375") or ("20110019084") or ("20100220781") or ("8090025") or ("20110019747") or ("20050041742") or ("8559523") or ("20070030911") or ("20060115001") or ("8897376") or ("20130287090") or ("7944966") or ("8699569") or ("20140098891") or ("20050123056") or ("20040252981") or ("20140321530") or ("20070296826") or ("20050201471") or ("20090147847") or ("7782949") or ("8644386") or ("6535557") or ("8798162") or ("20030007559") or ("RE44091") or ("5703966") or ("8477838") or ("20060222070") or ("20060210184") or ("5477397") or ("5821986") or ("6584273") or ("7515631") or ("20120230394") or ("8199834") or ("20030184453") or ("20120287987") or ("8306112") or ("6628712") or ("20050254649") or ("20100103297") or ("5929914") or ("8041194") or ("20070291840") or ("7782946") or ("8432972") or ("4827339") or ("20080008453") or ("20080152241") or ("20060165182") or ("8184690") or ("20040047423") or ("6829373") or ("20140092966") or ("RE43686") or ("6219381") or ("20130272407") or ("8780973") or ("8014448") or ("6366615") or ("20090175355") or ("8170100") or ("7474841") or ("5798796") or ("6904094") or ("6999673") or ("20130182760") or ("20130114702") or ("RE40679") or ("6078617") or ("5754698") or ("5828788") or ("8542933") or ("7978766") or ("20070041444") or ("20070019925") or ("20080205852") or ("20090010553") or ("20100091885") or ("20070109409") or ("8358702") or ("20120294362") or ("8320462") or ("8854486") or ("20080123751") or ("8811483") or ("5668598") or ("20140328414") or ("8457207") or ("6385243") or ("20090219994") or ("8315475") or ("7092576") or ("5523793") or ("20090316782") or ("20080069246") or ("7671894") or ("20100091883") or ("20070110154") or ("20120320986") or ("20140362911") or ("20090022412") or ("20110150082") or ("7542510") or ("7710462") or ("6650708") or ("20130243103") or ("8300694") or ("20060268982") or ("20060239636") or ("20110261888") or ("20040263361") or ("20100027659") or ("20100027682") or ("20130188686") or ("20080240250") or ("20130148731") or ("20050041734") or ("20080123738") or ("20020101928") or ("20020154886") or ("8644628") or ("20070217513") or ("20030058946")).PN. or (("20140098858") or ("20110150083")					

		or ("20010001614") or ("20140098860") or ("6810154") or ("7495704") or ("8326064") or ("20140105302") or ("20100026883") or ("20100027660") or ("20100027653") or ("7295767") or ("6314188") or ("20100026882") or ("20100272188") or ("20080175491") or ("20060114993") or ("7136415") or ("20040202372") or ("20040066851") or ("20100027654") or ("8345745") or ("8823821") or ("20060262651") or ("6067320") or ("20100026884") or ("20080285938") or ("7280708") or ("20100316360") or ("20100316362") or ("20100316135") or ("8165212") or ("6501862") or ("8160153") or ("20140085418") or ("20100316136") or ("20070297505") or ("5986707") or ("6408030") or ("7970053") or ("6553072") or ("20050013372") or ("20120039386") or ("20090304292") or ("8218623") or ("20120063695") or ("20070030356") or ("20100164995") or ("7822279") or ("20140247883") or ("8576920") or ("20050185719") or ("20130128959") or ("7873224") or ("8229004") or ("6256608") or ("20090010338") or ("20050185715") or ("8031768") or ("8295348") or ("8817887") or ("20020101921") or ("8155461") or ("20020110195") or ("5847763") or ("20030156640") or ("8396116") or ("7782944") or ("20040223549") or ("6393197") or ("20120195376") or ("20030231863") or ("20070171986") or ("8565319") or ("6025886") or ("20110150331") or ("20110019744") or ("20040008893") or ("20140079119") or ("20070268971") or ("20140092978") or ("8374248") or ("8467446") or ("20130322535") or ("20100316361") or ("20040120403") or ("20130039415") or ("8014619") or ("8472518") or ("20080159636") or ("8428144") or ("20030215012") or ("6665340") or ("6415055") or ("8085850") or ("7532670") or ("20040105501") or ("7558319") or ("20040008788") or ("20120026288") or ("8902975") or ("20130215291") or ("20100329337") or ("8750390") or ("8139637") or ("6850567") or ("20110026606") or ("8300690") or ("20090168894") or ("20080219347") or ("6332003") or ("20100020870") or ("8477837") or ("20070291849") or ("20130156104") or ("20100128787") or ("20080199147") or ("6839386") or ("5751888") or ("20040013202") or ("7792190") or ("20110194619") or ("20020186769") or ("20070189385") or ("20050008079") or ("5737019") or ("20100296585") or ("20060271990") or ("6658057") or ("7782945")).PN. or (("7970054") or ("20060048193") or ("20140233653") or ("20120269266") or ("20140294088") or ("20080152313") or						

		("8611688") or ("6621979") or ("20090232199") or ("20110032856") or ("20100013948") or ("8483273") or ("5946040") or ("7006576") or ("20080260034") or ("7263125") or ("6052384") or ("20070269182") or ("20070206917") or ("20060098952") or ("8494044") or ("8571113") or ("8184694") or ("20090180532") or ("8670626") or ("5838678") or ("20120147968") or ("20100128778") or ("20060133498") or ("20070076794") or ("7933327") or ("20140056356") or ("20070081731") or ("20140269919") or ("20080240590") or ("7469011") or ("20120183060") or ("20110051809") or ("8331440") or ("6741651") or ("8364019") or ("8218640") or ("20080075168") or ("20120224641") or ("20110142138") or ("20080175326") or ("7760802") or ("20070223575") or ("8488891") or ("20100215100") or ("5832120") or ("20050201461") or ("8340173") or ("20080310739") or ("5414527") or ("20040240560") or ("8494043") or ("8548261") or ("5774206") or ("7551835") or ("20070014346") or ("20090262803") or ("20030174770") or ("20140192903") or ("20140092959") or ("20130003862") or ("20140153640") or ("20140016697") or ("20030190059") or ("20080212682") or ("20140241439") or ("5847771") or ("20050105618") or ("20050190845") or ("8554002") or ("20100027664") or ("7302001") or ("20140098853") or ("20050094728") or ("20130077880") or ("20120201304") or ("20100091884") or ("5003377") or ("20130135431") or ("6665344") or ("8817872") or ("8391622") or ("20070092145") or ("20060159176") or ("20070147494") or ("20080069528") or ("20060239359") or ("20010046263") or ("8462844") or ("6633676") or ("20030169931") or ("20100246684") or ("20090214178") or ("20060055798") or ("20130201279") or ("7127110") or ("20090060040") or ("6240380") or ("4727421") or ("6539120") or ("20040218672") or ("8611419") or ("20050111544") or ("20030206588") or ("20050195897") or ("20140218473") or ("20040066854") or ("6020934") or ("20130235936") or ("8184698") or ("5668599") or ("20120099649") or ("5543847") or ("20120050475") or ("20070086518") or ("8494045") or ("6377748") or ("20110142130") or ("6229849") or ("20130322544") or ("6011869") or ("20140185673") or ("8150163") or ("20080037637")).PN. or (("20120201308") or ("5878166") or ("20080019398") or ("20040213551") or ("8532412") or ("20060159174") or ("8270482") or ("8401085") or					

		("20090141808") or ("20130142256") or ("20110216837") or ("20060259536") or ("7881387") or ("6373905") or ("8411744") or ("20140126640") or ("20110002397") or ("20080232470") or ("7020284") or ("20140010469") or ("8699583") or ("6438139") or ("6608867") or ("8401077")).PN.				
L23	18	(("20110176604") or ("20140140407") or ("6792045") or ("20010010707") or ("20130163673") or ("20130182776") or ("20130170558") or ("20130163676") or ("20110007823") or ("20070263731") or ("6785464") or ("20110229046") or ("6483945") or ("20070116130") or ("20110002382") or ("20060262861") or ("7715477") or ("7656950")).PN.	US-PGPUB; USPAT	OR	OFF	2014/12/15 15:07
L24	13	l23 and resolution	US-PGPUB; USPAT	OR	ON	2014/12/15 15:07
L25	13	l24 and resolution	US-PGPUB; USPAT	OR	ON	2014/12/15 15:11
L26	321	l22 and ((encod$4 or cod$4) with ((low or standard) near2 resolution))	US-PGPUB; USPAT	OR	ON	2014/12/15 15:12
L27	224	l22 and ((encod$4 or cod$4) with ((low or standard) near2 resolution)) and @ad<"20080530"	US-PGPUB; USPAT	OR	ON	2014/12/15 15:13
L30	468	l22 and (control$4 with reference) and @ad<"20080530"	US-PGPUB; USPAT	OR	ON	2014/12/15 16:18
L31	180	l22 and ((control$4 with reference) same predict$4) and @ad<"20080530"	US-PGPUB; USPAT	OR	ON	2014/12/15 16:18
L32	1865	(H04N19/00436 OR H04N19/00472 OR H04N19/00521 OR H04N19/00757 OR H04N19/00781 OR H04N19/00884 OR H04N19/0089).CPC.	US-PGPUB; USPAT; USOCR	OR	ON	2014/12/15 16:46
L34	9750	375/240.12,240.18,E7.243,E7.226.ccls.	US-PGPUB; USPAT	OR	ON	2014/12/15 16:46
L36	35	l32 and ((control$4 with reference) same predict$4) and @ad<"20080530"	US-PGPUB; USPAT	OR	ON	2014/12/15 16:46
L37	8	l32 and ((encod$4 or cod$4) with ((low or standard) near2 resolution)) and @ad<"20080530"	US-PGPUB; USPAT	OR	ON	2014/12/15 16:46
L38	267	l34 and ((encod$4 or cod$4) with ((low or standard) near2 resolution)) and @ad<"20080530"	US-PGPUB; USPAT	OR	ON	2014/12/15 16:46
L39	378	l34 and ((control$4 with reference) same predict$4) and @ad<"20080530"	US-PGPUB; USPAT	OR	ON	2014/12/15 16:46
L40	8054	(H04N19/00436 OR H04N19/00472 OR H04N19/00521 OR H04N19/00757 OR H04N19/00781 OR H04N19/00884 OR H04N19/0089).CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/12/15 16:47
L41	8	l40 and ((encod$4 or cod$4) with ((low or standard) near2 resolution)) and @ad<"20080530"	US-PGPUB; USPAT	OR	ON	2014/12/15 16:47
L42	35	l40 and ((control$4 with reference) same predict$4) and @ad<"20080530"	US-PGPUB; USPAT	OR	ON	2014/12/15 16:47

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Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12995039	SAKAZUME, SATORU
	Examiner	**Art Unit**
	ANA PICON-FELICIANO	2482

CPC								
Symbol							**Type**	**Version**
H04N		19	/	59			F	2014-11-01
H04N		19	/	70			I	2014-11-01
H04N		19	/	61			I	2014-11-01
H04N		19	/	80			I	2014-11-01
H04N		19	/	33			I	2014-11-01
H04N		19	/	436			I	2014-11-01
H04N		19	/	40			I	2014-11-01
			/					
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CPC Combination Sets								
Symbol							**Type**	**Set**	**Ranking**	**Version**
			/							
			/							

/ANA PICON-FELICIANO/ Examiner.Art Unit 2482	12/30/2014	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	3	
/CHRISTOPHER S KELLEY/ Supervisory Patent Examiner.Art Unit 2482	01/05/2015	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	7	13

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12995039	SAKAZUME, SATORU
	Examiner	**Art Unit**
	ANA PICON-FELICIANO	2482

US ORIGINAL CLASSIFICATION		INTERNATIONAL CLASSIFICATION										
CLASS	SUBCLASS	CLAIMED					NON-CLAIMED					
375	240.120	H	0	4	N	7 / 12 (2006.0)						

CROSS REFERENCE(S)					
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				
375	240.18	E07.243	E07.226		

/ANA PICON-FELICIANO/ Examiner.Art Unit 2482	12/30/2014	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	3	
/CHRISTOPHER S KELLEY/ Supervisory Patent Examiner.Art Unit 2482	01/05/2015	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	7	13

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12995039	SAKAZUME, SATORU
	Examiner	**Art Unit**
	ANA PICON-FELICIANO	2482

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1		17												
	2		18												
	3		19												
	4		20												
	5		21												
	6		22												
1	7		23												
2	8		24												
3	9		25												
	10		26												
	11														
	12														
	13														
	14														
	15														
	16														

/ANA PICON-FELICIANO/ Examiner.Art Unit 2482	12/30/2014	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	3	
/CHRISTOPHER S KELLEY/ Supervisory Patent Examiner.Art Unit 2482	01/05/2015	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	7	13

EAST Search History

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1892	(H04N19/00436 OR H04N19/00472 OR H04N19/00521 OR H04N19/00757 OR H04N19/00781 OR H04N19/00884 OR H04N19/0089).CPC.	US-PGPUB; USPAT; UPAD	OR	ON	2014/12/30 18:35
L2	9786	375/240.12,240.18,E7.243,E7.226.ccls.	US-PGPUB; USPAT; UPAD	OR	ON	2014/12/30 18:36
L3	35	l1 and ((control$4 with reference) same predict$4) and @ad<"20080530"	US-PGPUB; USPAT; UPAD	OR	ON	2014/12/30 18:36
L4	8	l1 and ((encod$4 or cod$4) with ((low or standard) near2 resolution)) and @ad<"20080530"	US-PGPUB; USPAT; UPAD	OR	ON	2014/12/30 18:36
L5	267	l2 and ((encod$4 or cod$4) with ((low or standard) near2 resolution)) and @ad<"20080530"	US-PGPUB; USPAT; UPAD	OR	ON	2014/12/30 18:37
L7	378	l2 and ((control$4 with reference) same predict$4) and @ad<"20080530"	US-PGPUB; USPAT; UPAD	OR	ON	2014/12/30 18:38
L8	1892	(H04N19/00436 OR H04N19/00472 OR H04N19/00521 OR H04N19/00757 OR H04N19/00781 OR H04N19/00884 OR H04N19/0089).CPC.	US-PGPUB; USPAT; UPAD	OR	ON	2014/12/30 18:38
L9	8	l8 and ((encod$4 or cod$4) with ((low or standard) near2 resolution)) and @ad<"20080530"	US-PGPUB; USPAT; UPAD	OR	ON	2014/12/30 18:38
L11	35	l8 and ((control$4 with reference) same predict$4) and @ad<"20080530"	US-PGPUB; USPAT; UPAD	OR	ON	2014/12/30 18:39
L12	44	((encod$4 or cod$4) with ((low or standard) near2 resolution)) and ((control$4 with reference) same predict$4) and @ad<"20080530"	US-PGPUB; USPAT; UPAD	OR	ON	2014/12/30 18:39
L13	97	video and (superresolution or super-resolution) and (scalable or scalability) and enhancement and base	US-PGPUB; USPAT; UPAD	OR	ON	2014/12/30 18:40
L14	1	(super$1resolution near2 (enlarger and converter)) and encoder and (first near2 resolution) and (second near2 resolution)	US-PGPUB; USPAT; UPAD	OR	ON	2014/12/30 18:40

L15	60	super$1resolution and encoder and (first near2 resolution) and (second near2 resolution)	US-PGPUB; USPAT; UPAD	OR	ON	2014/12/30 18:40
L16	97	video and (superresolution or super-resolution) and (scalable or scalability) and enhancement and base	US-PGPUB; USPAT; UPAD	OR	ON	2014/12/30 18:40
L17	1	(pixel near2 insert$4) and filter$4 and (pixel near2 thin$4) and resolution and position$$ and interpolat$4 and enlarg$6 and repetition	US-PGPUB; USPAT; UPAD	OR	ON	2014/12/30 18:41

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12995039	SAKAZUME, SATORU
	Examiner	Art Unit
	ANA PICON-FELICIANO	2482

CPC- SEARCHED		
Symbol	Date	Examiner
H04N	1/16/2014	AP
H04N(Update)	5/1/2014	AP
H04N(Search Update)	12/15/2014	AP

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner
H04N 7/50,7/26244,7/26271,7/26015,7/26031,19/00436,19/00472,19/00521,19/00757,19/00781,19/00884,19/0089	1/16/2014	AP
H04N 19/00436,19/00472,19/00521,19/00757,19/00781,19/00884,19/0089(Update)	5/1/2014	AP
H04N 19/00436,19/00472,19/00521,19/00757,19/00781,19/00884,19/0089(Update)	12/15/2014	AP

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
375	240.12,240.18,E7.243,E7.226	7/23/2013	AP
375	240.12,240.18,E7.243,E7.226(Update)	5/1/2014	AP
375	240.12,240.18,E7.243,E7.226(Update)	12/15/2014	AP

SEARCH NOTES		
Search Notes	Date	Examiner
EAST Search on USPC class/subclass	7/23/2013	AP
EAST Search on Assignee	8/28/2013	AP
EAST Search on Inventor	8/29/2013	AP
EAST Search on CPC class/subclass	1/16/2014	AP
EAST Search on keywords	1/24/2014	AP
Consulted Christopher Kelley (SPE Art Unit 2482)	9/10/2013	AP
Consulted Christopher Kelley (SPE Art Unit 2482)	4/29/2014	AP
EAST Search Update on classifications	5/1/2014	AP

SEARCH NOTES		
Search Notes	**Date**	**Examiner**
Consulted Christopher Kelley(SPE Art Unit 2482)	5/7/2014	AP
EAST Search on classifications and keywords	12/15/2014	AP
EAST Search on classifications and keywords	12/30/2014	AP

INTERFERENCE SEARCH			
US Class/ CPC Symbol	**US Subclass / CPC Group**	**Date**	**Examiner**
375	240.12,240.18,E7.243,E7.226	12/30/2014	AP
H04N	19/00436,19/00472,19/00521,19/00757,19/00781,19/00884,19/0089	12/30/2014	AP

Mail Stop Amendment
Attorney Docket No. **31181U**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of:

Satoru SAKAZUME	Confirmation No.: 7504
Application No. **12/995,039**	Group Art Unit: 2482
Filed: November 29, 2010	Examiner: PICON-FELICIANO, Ana J.

For: **MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYSTEM, MOVING PICTURE REENCODING METHOD, AND MOVING PICTURE REENCODING PROGRAM**

REPLY AND AMENDMENT UNDER 37 C.F.R. § 1.111

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

In response to the Office Action mailed May 15, 2014 ("Office Action"), with an accompanying one-month Extension of Time, Applicant respectfully requests reconsideration of the application in view of the following Remarks.

Amendments to the Claims begin on page **2** of this paper.
Remarks begin on page **22** of this paper.
A Conclusion begins on page **28** of this paper.

If an additional extension of time is necessary to prevent abandonment of this application and is not filed herewith, then such extension of time is hereby petitioned for under 37 C.F.R. §1.136(a). Applicant believes that no further fees for net addition of claims are required. Any fees required for further extensions of time and any fees for the net addition of claims are hereby authorized to be charged to Deposit Account No. 14-0112.

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (Canceled)

2. (Withdrawn) A moving picture encoding system comprising:

a first encoder configured to work on a subsequence of a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to work on the subsequence of the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a first resolution converter configured to work on the set of super-resolution enlarged pictures to implement a process for a first resolution conversion to create a set of super-resolution enlarged and converted pictures with the standard resolution; and

a second encoder configured to have the set of super-resolution enlarged and converted pictures from the first resolution converter as a set of encoding target pictures to implement a second combination of processes for a prediction and an encoding to create a second sequence of encoded bits,

wherein the second encoder is configured to have the set of decoded pictures from the first encoder as a set of reference pictures to implement the second combination of processes for the prediction and the encoding to create the second sequence of encoded bits.

3. (Withdrawn) A moving picture encoding system comprising:

a first encoder configured to work on a subsequence of a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to work on the subsequence of the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a first resolution converter configured to work on the set of super-resolution enlarged pictures to implement a process for a first resolution conversion to create a set of super-resolution enlarged and converted pictures with the standard resolution;

a second encoder configured to have the set of super-resolution enlarged and converted pictures from the first resolution converter as a set of encoding target pictures to implement a second combination of processes for a prediction and an encoding to create a second sequence of encoded bits;

a second super-resolution enlarger configured to acquire the set of decoded pictures with the standard resolution from the first encoder to implement thereon a process for a second super-resolution enlargement to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution; and

a second resolution converter configured to work on the set of super-resolution enlarged decoded pictures to implement a process for a second resolution conversion to create a set of super-resolution enlarged and converted decoded pictures with the standard resolution,

wherein the second encoder is configured to have the set of super-resolution enlarged and converted decoded pictures from the second resolution converter as a set of reference pictures to implement the second combination of processes for the prediction and the encoding to create the second sequence of encoded bits.

4. (Withdrawn) The moving picture encoding system according to claim 2, wherein the first super-resolution enlarger comprises:

a positioner configured to work in a processing for super-resolution enlargement, on a combination of a base picture constituting a base therein and one or more observation pictures to be based on, to make a positioning to pixel positions of a desirable high resolution, for an interval-unequal sampling to create nonhomogeneous high resolution pictures;

an interpolator configured to work on nonhomogeneous high resolution pictures created at the positioner, to implement a process for a prescribed nonhomogeneous interpolation to create interpolated pictures with a desirable high resolution;

an estimated picture creator configured to acquire interpolated pictures created at the interpolator, to implement thereon a process for a prescribed reconstruction to create estimated pictures with a desirable resolution; and

a repetition determiner configured to acquire a nonhomogeneous high resolution picture from the positioner and a nonhomogeneous estimated picture from the estimated picture creator, for employment of the acquired pictures to follow a prescribed determination method to determine whether or not a repetition of the processing for super-resolution enlargement is necessary, and work depending on a result thereof, to operate as the repetition is necessary, to provide the interpolator with information for a control to continue the processing, and operate as the repetition is unnecessary, to provide the estimated picture creator with information for a control to output a set of estimated pictures with a high resolution after super-resolution enlargement.

5. (Withdrawn) The moving picture encoding system according to claim 2, comprising a multiplexer configured to operate complying with a prescribed syntax structure to multiplex the first sequence of encoded bits from the first encoder, the second sequence of encoded bits from the second encoder, and information on encoding parameters of respective types used in the encoding at the first encoder and the encoding at the second encoder.

6. (Withdrawn) The moving picture encoding system according to claim 2, comprising:

a first accumulation buffer configured to work in a course before the first encoder and the first super-resolution enlarger, to accumulate subsequences of the sequence of moving pictures with the standard resolution;

a second accumulation buffer configured to work in a course between the first encoder and the second encoder, to accumulate sets of decoded pictures from the first encoder;

an accumulation controller configured to work for detections of buffer accumulation amounts at the first accumulation buffer, the second accumulation buffer, the first encoder, and the second encoder, to control the buffer accumulation amounts; and

a code rate controller configured to work on bases of the detections of buffer accumulation amounts at the accumulation controller, to control code rates at the first encoder and the second encoder.

7. (Currently Amended) A moving picture encoding system that makes an encoding of a sequence of moving pictures with a resolution higher than a standard resolution using moving pictures contents which include a sequence of moving pictures with the standard resolution and do not include a sequence of moving pictures with a resolution higher than the standard resolution, the moving picture encoding system comprising:

a first encoder configured to work on a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a second super-resolution enlarger configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a second super-resolution enlargement to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution;

a third resolution converter configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a third resolution conversion to create a set of resolution converted enlarged decoded pictures with a resolution higher than the standard resolution; and

a third encoder configured to have the set of super-resolution enlarged pictures from the first super-resolution enlarger as a set of encoding target pictures, employing the set of super-resolution enlarged decoded pictures from the second super-resolution enlarger and the set of resolution converted enlarged decoded pictures from the third resolution converter as sets of reference pictures, to implement thereon a third combination of processes for a prediction and an encoding to create a third sequence of encoded bits,

wherein a spatial resolution of the set of super-resolution enlarged pictures, that of the set of super-resolution enlarged decoded pictures, and that of the set of resolution converted enlarged decoded pictures are made equal; and

wherein the third encoder controls a selection of a set of reference pictures and creates a set of data on the selection of the set of reference pictures to identify a selected set of reference pictures during the process for prediction of the third combination.

8. (Currently Amended) A moving picture encoding system that makes an encoding of a sequence of moving pictures with a resolution higher than a standard resolution using moving pictures contents which include a sequence of moving pictures with the standard resolution and do not include a sequence of moving pictures with a resolution higher than the standard resolution, the moving picture encoding system comprising:

a first encoder configured to work on a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a third resolution converter configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a third resolution conversion to create a set of resolution converted enlarged decoded pictures with a resolution higher than the standard resolution; and

a third encoder configured to have the set of super-resolution enlarged pictures from the first super-resolution enlarger as a set of encoding target pictures, employing the set of resolution converted enlarged decoded pictures from the third resolution converter as a set of reference pictures, to implement thereon a third combination of processes for a prediction and an encoding to create a third sequence of encoded bits,

wherein a spatial resolution of the set of super-resolution enlarged pictures, and that of the set of resolution converted enlarged decoded pictures are made equal; and

wherein the third encoder controls a selection of a set of reference pictures and creates a set of data on the selection of the set of reference pictures to identify a selected set of reference pictures during the process for prediction of the third combination.

9. (Currently Amended) A moving picture encoding system that makes an encoding of a sequence of moving pictures with a resolution higher than a standard resolution using moving pictures contents which include a sequence of moving pictures with the standard resolution and do not include a sequence of moving pictures with a resolution higher than the standard resolution, the moving picture encoding system comprising:

a first encoder configured to work on a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a second super-resolution enlarger configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a second super-resolution enlargement to

create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution; and

a third encoder configured to have the set of super-resolution enlarged pictures from the first super-resolution enlarger as a set of encoding target pictures, employing the set of super-resolution enlarged decoded pictures from the second super-resolution enlarger as a set of reference pictures, to implement thereon a third combination of processes for a prediction and an encoding to create a third sequence of encoded bits,

wherein a spatial resolution of the set of super-resolution enlarged pictures, and that of the set of super-resolution enlarged decoded pictures are made equal; and

wherein the third encoder controls a selection of a set of reference pictures and creates a set of data on the selection of the set of reference pictures to identify a selected set of reference pictures during the process for prediction of the third combination.

10. (Withdrawn) A moving picture encoding system comprising:

a first encoder configured to work on a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a first resolution converter configured to work on the set of super-resolution enlarged pictures to implement a process for a first resolution conversion to create a set of super-resolution enlarged and converted pictures with the standard resolution;

a second super-resolution enlarger configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a second super-resolution enlargement to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution;

a second resolution converter configured to work on the set of super-resolution enlarged decoded pictures from the second super-resolution enlarger to implement a process for a second resolution conversion to create a set of super-resolution enlarged and converted decoded pictures with the standard resolution;

a second encoder configured to have the set of super-resolution enlarged and converted pictures from the first resolution converter as a set of encoding target pictures, employing the set of decoded pictures from the first encoder and the set of super-resolution enlarged and converted decoded pictures with the standard resolution from the second resolution converter as sets of reference pictures, to implement thereon a second combination of processes for a prediction and an encoding to create a second sequence of encoded bits;

a third resolution converter configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a third resolution conversion to create a set of resolution converted enlarged decoded pictures with a resolution higher than the standard resolution; and

a third encoder configured to have the set of super-resolution enlarged pictures from the first super-resolution enlarger as a set of encoding target pictures, employing the set of super-resolution enlarged decoded pictures from the second super-resolution enlarger and the set of resolution converted enlarged decoded pictures from the third resolution converter as sets of reference pictures, to implement thereon a third combination of processes for a prediction and an encoding to create a third sequence of encoded bits.

11. (Withdrawn) A moving picture encoding method comprising:

a step of implementing a first combination of processes for an encoding and a decoding on a sequence of moving pictures with a standard resolution, creating a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a step of implementing a process for a first super-resolution enlargement on the sequence of moving pictures with the standard resolution, creating a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a step of implementing a process for a first resolution conversion on the set of super-resolution enlarged pictures, creating a set of super-resolution enlarged and converted pictures with the standard resolution; and

a step of having the set of super-resolution enlarged and converted pictures as a set of encoding target pictures, implementing thereon a second combination of processes for a prediction and an encoding, creating a second sequence of encoded bits,

wherein the step of creating the second sequence of encoding bits further comprises a step of having the set of decoded pictures from the first encoder as a set of reference pictures to implement the second combination of processes for the prediction and the encoding to create the second sequence of encoded bits.

12. (Withdrawn) A recording medium storing a moving picture encoding program configured to have a computer execute:

a step of implementing a first combination of processes for an encoding and a decoding on a sequence of moving pictures with a standard resolution, creating a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a step of implementing a process for a first super-resolution enlargement on the sequence of moving pictures with the standard resolution, creating a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a step of implementing a process for a first resolution conversion on the set of super-resolution enlarged pictures, creating a set of super-resolution enlarged and converted pictures with the standard resolution; and

a step of having the set of super-resolution enlarged and converted pictures as a set of encoding target pictures, implementing thereon a second combination of processes for a prediction and an encoding, creating a second sequence of encoded bits,

wherein the step of creating the second sequence of encoding bits further comprises a step of having the set of decoded pictures from the first encoder as a set of reference pictures to implement the second combination of processes for the prediction and the encoding to create the second sequence of encoded bits.

13. (Withdrawn) A moving picture decoding system comprising:

a demultiplexer configured to work on a sequence of input encoded bits to implement a process for a prescribed demultiplexing to output at least a first and a second sequence of encoded bits;

a first decoder configured to acquire the first sequence of encoded bits obtained with a standard resolution at the demultiplexer to implement thereon a process for a prescribed first decoding to create a sequence of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to acquire the sequence of decoded pictures created with the standard resolution at the first decoder to implement thereon a process for a prescribed super-resolution enlargement to create a sequence of super-resolution enlarged decoded pictures;

a first resolution converter configured to acquire the sequence of super-resolution enlarged decoded pictures created at the first super-resolution enlarger to implement thereon a process for a prescribed resolution conversion to create a sequence of super-resolution decoded pictures with the standard resolution; and

a second decoder configured to acquire the second sequence of encoded bits obtained with the standard resolution at the demultiplexer, the sequence of decoded pictures created with the standard resolution at the first decoder, and the sequence of super-resolution decoded pictures created with the standard resolution at the first resolution converter, to implement thereon a combination of processes for a prescribed prediction and a prescribed second decoding being a decoding with an extension of the standard resolution, to create a sequence of super-resolution pictures decoded with the standard resolution.

14. (Withdrawn) The moving picture decoding system according to claim 13, comprising:

the demultiplexer being configured to work on the sequence of input encoded bits to implement the process for the prescribed demultiplexing to further output a third sequence of encoded bits;

a second resolution converter configured to acquire the sequence of decoded pictures with the standard resolution from the first decoder to implement thereon a process for a

prescribed resolution conversion to create a sequence of enlarged decoded pictures with a high resolution as a resolution higher than the standard resolution; and

a third decoder configured to acquire the third sequence of encoded bits obtained with the high resolution at the demultiplexer, the sequence of super-resolution enlarged decoded pictures created at the first super-resolution enlarger, and the sequence of enlarged decoded pictures with the high resolution from the second resolution converter, to implement thereon a combination of processes for a prescribed prediction and a prescribed third decoding being a decoding with an extension of the high resolution, to create a sequence of super-resolution enlarged pictures as decoded.

15. (Withdrawn) A moving picture reencoding system comprising:

a demultiplexer configured to work on a sequence of input encoded bits to implement a process for a prescribed demultiplexing to output at least a first and a second sequence of encoded bits;

a first decoder configured to acquire the first sequence of encoded bits obtained with a standard resolution at the demultiplexer to implement thereon a process for a prescribed first decoding to create a sequence of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to acquire the sequence of decoded pictures created with the standard resolution at the first decoder to implement thereon a process for a prescribed super-resolution enlargement to create a sequence of super-resolution enlarged decoded pictures;

a first resolution converter configured to acquire the sequence of super-resolution enlarged decoded pictures created at the first super-resolution enlarger to implement thereon a process for a prescribed resolution conversion to create a sequence of super-resolution decoded pictures with the standard resolution;

a second decoder configured to acquire the second sequence of encoded bits obtained with the standard resolution at the demultiplexer, the sequence of decoded pictures created with the standard resolution at the first decoder, and the sequence of super-resolution decoded pictures created with the standard resolution at the first resolution converter, to implement thereon a

process for a prescribed second decoding being a decoding with an extension of the standard resolution, to create a sequence of super-resolution pictures decoded with the standard resolution;

a reencoder configured to acquire from the first decoder information on coefficients of orthogonal transform in a course of decoding thereof, and from the second decoder information on coefficients of orthogonal transform in an extension layer of the standard resolution in a course of decoding thereof, to make a synthesis of respective information on coefficients of orthogonal transform and implement thereon a process for a prescribed entropy encoding to create a sequence of encoded bits as reencoded; and

a multiplexer configured to acquire the sequence of encoded bits reencoded at the reencoder, to implement thereon a process for a multiplexing complying with a prescribed syntax structure, inserting encoding information inclusive of identification information for identification of information on encoding modes and parameters of respective types used, to create a sequence of encoded bits as multiplexed.

16. (Withdrawn) The moving picture reencoding system according to claim 15, wherein the reencoder is configured to acquire the sequence of decoded pictures with the standard resolution from the first decoder, the sequence of super-resolution decoded pictures with the standard resolution from the first resolution converter, and the sequence of super-resolution pictures with the standard resolution from the second decoder, to implement thereon a process for a prescribed encoding to create a sequence of encoded bits as reencoded.

17. (Withdrawn) A moving picture decoding method comprising:

a step of implementing a process for a prescribed demultiplexing on a sequence of input encoded bits, outputting at least a first and a second sequence of encoded bits;

a step of acquiring the first sequence of encoded bits obtained with a standard resolution through the process for the prescribed demultiplexing, implementing thereon a process for a prescribed first decoding, creating a sequence of decoded pictures with the standard resolution;

a step of acquiring the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, implementing thereon a process for a prescribed super-resolution enlargement, creating a sequence of super-resolution enlarged decoded pictures;

a step of acquiring the sequence of super-resolution enlarged decoded pictures created through the process for the prescribed super-resolution enlargement, implementing thereon a process for a prescribed resolution conversion, creating a sequence of super-resolution decoded pictures with the standard resolution; and

a step of acquiring the second sequence of encoded bits obtained with the standard resolution through the process for the prescribed demultiplexing, the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, and the sequence of super-resolution decoded pictures created with the standard resolution through the process for the prescribed resolution conversion, implementing thereon a combination of processes for a prescribed prediction and a prescribed second decoding being a decoding with an extension of the standard resolution, creating a sequence of super-resolution pictures decoded with the standard resolution.

18. (Withdrawn) The moving picture decoding method according to claim 17, comprising:

a step of implementing the process for the prescribed demultiplexing on the sequence of input encoded bits, outputting a third sequence of encoded bits;

a step of acquiring the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, implementing thereon a process for a prescribed resolution conversion, creating a sequence of enlarged decoded pictures with a high resolution as a resolution higher than the standard resolution; and

a step of acquiring the third sequence of encoded bits obtained with the high resolution through the process for the prescribed demultiplexing, the sequence of super-resolution enlarged decoded pictures created through the process for the prescribed super-resolution enlargement, and the sequence of enlarged decoded pictures created with the high resolution through the process for the prescribed resolution conversion, implementing thereon a combination of

processes for a prescribed prediction and a prescribed third decoding being a decoding with an extension of the high resolution, creating a sequence of super-resolution enlarged pictures as decoded.

19. (Withdrawn) A moving picture reencoding method comprising:

a step of implementing a process for a prescribed demultiplexing on a sequence of input encoded bits;

a step of acquiring a first sequence of encoded bits obtained with a standard resolution through the process for the prescribed demultiplexing, implementing thereon a process for a prescribed first decoding, creating a sequence of decoded pictures with the standard resolution;

a step of acquiring the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, implementing thereon a process for a prescribed super-resolution enlargement, creating a sequence of super-resolution enlarged decoded pictures;

a step of acquiring the sequence of super-resolution enlarged decoded pictures created through the process for the prescribed super-resolution enlargement, implementing thereon a process for a prescribed resolution conversion, creating a sequence of super-resolution decoded pictures with the standard resolution;

a step of acquiring a second sequence of encoded bits obtained with the standard resolution through the process for the prescribed demultiplexing, the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, and the sequence of super-resolution decoded pictures created with the standard resolution through the process for the prescribed resolution conversion, implementing thereon a process for a prescribed second decoding being a decoding with an extension of the standard resolution, creating a sequence of super-resolution pictures decoded with the standard resolution;

a step of acquiring information on coefficients of orthogonal transform in a course of decoding in the process for the prescribed first decoding, and information on coefficients of orthogonal transform in an extension layer of the standard resolution in a course of decoding in the process for the prescribed second decoding being a decoding with an extension of the

standard resolution, making a synthesis of respective information on coefficients of orthogonal transform, implementing thereon a process for a prescribed entropy encoding, creating a sequence of encoded bits as reencoded; and

a step of acquiring the sequence of encoded bits as reencoded, implementing thereon a process for a multiplexing complying with a prescribed syntax structure, inserting encoding information inclusive of identification information for identification of information on encoding modes and parameters of respective types used, creating a sequence of encoded bits as multiplexed.

20. (Withdrawn) A recording medium storing a moving picture decoding program configured to have a computer execute:

a step of implementing a process for a prescribed demultiplexing on a sequence of input encoded bits, outputting at least a first and a second sequence of encoded bits;

a step of acquiring the first sequence of encoded bits obtained with a standard resolution through the process for the prescribed demultiplexing, implementing thereon a process for a prescribed first decoding, creating a sequence of decoded pictures with the standard resolution;

a step of acquiring the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, implementing thereon a process for a prescribed super-resolution enlargement, creating a sequence of super-resolution enlarged decoded pictures;

a step of acquiring the sequence of super-resolution enlarged decoded pictures created through the process for the prescribed super-resolution enlargement, implementing thereon a process for a prescribed resolution conversion, creating a sequence of super-resolution decoded pictures with the standard resolution; and

a step of acquiring the second sequence of encoded bits obtained with the standard resolution through the process for the prescribed demultiplexing, the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, and the sequence of super-resolution decoded pictures created with the standard resolution through the process for the prescribed resolution conversion, implementing thereon a

combination of processes for a prescribed prediction and a prescribed second decoding being a decoding with an extension of the standard resolution, creating a sequence of super-resolution pictures decoded with the standard resolution.

21. (Withdrawn) A recording medium storing a moving picture reencoding program configured to have a computer execute:

a step of implementing a process for a prescribed demultiplexing on a sequence of input encoded bits;

a step of acquiring a first sequence of encoded bits obtained with a standard resolution through the process for the prescribed demultiplexing, implementing thereon a process for a prescribed first decoding, creating a sequence of decoded pictures with the standard resolution;

a step of acquiring the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, implementing thereon a process for a prescribed super-resolution enlargement, creating a sequence of super-resolution enlarged decoded pictures;

a step of acquiring the sequence of super-resolution enlarged decoded pictures created through the process for the prescribed super-resolution enlargement, implementing thereon a process for a prescribed resolution conversion, creating a sequence of super-resolution decoded pictures with the standard resolution;

a step of acquiring a second sequence of encoded bits obtained with the standard resolution through the process for the prescribed demultiplexing, the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, and the sequence of super-resolution decoded pictures created with the standard resolution through the process for the prescribed resolution conversion, implementing thereon a process for a prescribed second decoding being a decoding with an extension of the standard resolution, creating a sequence of super-resolution pictures decoded with the standard resolution;

a step of acquiring information on coefficients of orthogonal transform in a course of decoding in the process for the prescribed first decoding, and information on coefficients of orthogonal transform in an extension layer of the standard resolution in a course of decoding in

the process for the prescribed second decoding being a decoding with an extension of the standard resolution, making a synthesis of respective information on coefficients of orthogonal transform, implementing thereon a process for a prescribed entropy encoding, creating a sequence of encoded bits as reencoded; and

a step of acquiring the sequence of encoded bits as reencoded, implementing thereon a process for a multiplexing complying with a prescribed syntax structure, inserting encoding information inclusive of identification information for identification of information on encoding modes and parameters of respective types used, creating a sequence of encoded bits as multiplexed.

22. (Withdrawn) The moving picture encoding system according to claim 3, wherein the first super-resolution enlarger comprises:

a positioner configured to work in a processing for super-resolution enlargement, on a combination of a base picture constituting a base therein and one or more observation pictures to be based on, to make a positioning to pixel positions of a desirable high resolution, for an interval-unequal sampling to create nonhomogeneous high resolution pictures;

an interpolator configured to work on nonhomogeneous high resolution pictures created at the positioner, to implement a process for a prescribed nonhomogeneous interpolation to create interpolated pictures with a desirable high resolution;

an estimated picture creator configured to acquire interpolated pictures created at the interpolator, to implement thereon a process for a prescribed reconstruction to create estimated pictures with a desirable resolution; and

a repetition determiner configured to acquire a nonhomogeneous high resolution picture from the positioner and a nonhomogeneous estimated picture from the estimated picture creator, for employment of the acquired pictures to follow a prescribed determination method to determine whether or not a repetition of the processing for super-resolution enlargement is necessary, and work depending on a result thereof, to operate as the repetition is necessary, to provide the interpolator with information for a control to continue the processing, and operate as the repetition is unnecessary, to provide the estimated picture creator with information for a

control to output a set of estimated pictures with a high resolution after super-resolution enlargement.

23. (Withdrawn) The moving picture encoding system according to claim 3, further comprising a multiplexer configured to operate complying with a prescribed syntax structure to multiplex the first sequence of encoded bits from the first encoder, the second sequence of encoded bits from the second encoder, and information on encoding parameters of respective types used in the encoding at the first encoder and the encoding at the second encoder.

24. (Withdrawn) The moving picture encoding system according to claim 3, further comprising:

a first accumulation buffer configured to work in a course before the first encoder and the first super-resolution enlarger, to accumulate subsequences of the sequence of moving pictures with the standard resolution;

a second accumulation buffer configured to work in a course between the first encoder and the second encoder, to accumulate sets of decoded pictures from the first encoder;

an accumulation controller configured to work for detections of buffer accumulation amounts at the first accumulation buffer, the second accumulation buffer, the first encoder, and the second encoder, to control the buffer accumulation amounts; and

a code rate controller configured to work on bases of the detections of buffer accumulation amounts at the accumulation controller, to control code rates at the first encoder and the second encoder.

25. (Withdrawn) A moving picture encoding method comprising:

a step of implementing a first combination of processes for an encoding and a decoding on a sequence of moving pictures with a standard resolution, creating a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a step of implementing a process for a first super-resolution enlargement on the sequence of moving pictures with the standard resolution, creating a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a step of implementing a process for a first resolution conversion on the set of super-resolution enlarged pictures, creating a set of super-resolution enlarged and converted pictures with the standard resolution;

a step of having the set of super-resolution enlarged and converted pictures as a set of encoding target pictures, implementing thereon a second combination of processes for a prediction and an encoding, creating a second sequence of encoded bits;

a step of acquiring the set of decoded pictures with the standard resolution from the first encoder to implement thereon a process for a second super-resolution enlargement to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution; and

a step of working on the set of super-resolution enlarged decoded pictures to implement a process for a second resolution conversion to create a set of super-resolution enlarged and converted decoded pictures with the standard resolution,

wherein the step of creating the second sequence of encoding bits further comprises a step of having the set of super-resolution enlarged and converted decoded pictures from the second resolution converter as a set of reference pictures to implement the second combination of processes for the prediction and the encoding to create the second sequence of encoded bits.

26. (Withdrawn) A recording medium storing a moving picture encoding program configured to have a computer execute:

a step of implementing a first combination of processes for an encoding and a decoding on a sequence of moving pictures with a standard resolution, creating a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a step of implementing a process for a first super-resolution enlargement on the sequence of moving pictures with the standard resolution, creating a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a step of implementing a process for a first resolution conversion on the set of super-resolution enlarged pictures, creating a set of super-resolution enlarged and converted pictures with the standard resolution;

a step of having the set of super-resolution enlarged and converted pictures as a set of encoding target pictures, implementing thereon a second combination of processes for a prediction and an encoding, creating a second sequence of encoded bits;

a step of acquiring the set of decoded pictures with the standard resolution from the first encoder to implement thereon a process for a second super-resolution enlargement to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution; and

a step of working on the set of super-resolution enlarged decoded pictures to implement a process for a second resolution conversion to create a set of super-resolution enlarged and converted decoded pictures with the standard resolution,

wherein the step of creating the second sequence of encoding bits further comprises a step of having the set of super-resolution enlarged and converted decoded pictures from the second resolution converter as a set of reference pictures to implement the second combination of processes for the prediction and the encoding to create the second sequence of encoded bits.

REMARKS

I. Status of the Claims

Upon entry of the amendments, claims 2-26 will be pending in the present application. Claim 1 is canceled without prejudice to or disclaimer of the subject matter contained therein. Claims 2-6 and 10-26 are withdrawn without prejudice to or disclaimer of the subject matter contained therein. Claims 7-9 have been amended as discussed hereafter. Support for the claim amendments can be found throughout the specification and the claims as originally filed. The claim amendments made are solely for advancing prosecution of the application.

By canceling or amending any claims herein, Applicants make no admission as to the validity of any rejection made by the Examiner against any of these claims. Applicants reserve the right to reassert any of the claims canceled herein or the original claim scope of any claim amended herein, in a continuing application.

Applicants submit that the above amendments introduce no new matter within the meaning of 32 U.S.C. §132, and respectfully request entry of the above amendments and favorable consideration of the application in view of the following.

II. Summary of the Office Action

Claims 7-9 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Wan (US 6,580,754 B1) in view of Ong (JP 2007-316161 A), and further in view of Holcomb (US 7,379,496 B2).

III. Response to Rejection under 35 U.S.C. §103

Claims 7-9 stand rejected under 35 U.S.C. §103(a) as allegedly unpatentable over Wan in view of Ong and further in view of Holcomb. Applicants respectfully traverse this rejection.

Applicants traverse the rejections as all of the features of the previously presented claimed subject matter are not disclosed, taught or suggested by the cited prior art of record. To establish a *prima facie* case of obviousness, the Examiner must establish that the prior art references teach or suggest all of the claim features. *Amgen, Inc. v. Chugai Pharm. Co.*, 18, USPQ2d 1016, 1023 (Fed. Cir. 1991); *In re Fine*, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988); *In re Wilson*, 165 USPQ2d 494, 496 (CCPA 1970).

A *prima facie* case of obviousness must also include a showing of the reasons why it would be obvious to modify the references to produce the present invention. *See Dystar Textilfarben GMBH v. C. H. Patrick*, 464 F.3d 1356 (Fed. Cir. 2006). The Examiner bears the initial burden to provide some convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teachings. *Id.* at 1366.

Applicants respectfully traverse this rejection since the cited prior art does not support a *prima facie* case of obviousness. Obviousness under 35 U.S.C. §103 is a question of law, with underlying factual considerations regarding (1) the scope and content of the prior art, (2) the differences between the prior art and the claimed invention, (3) the level of ordinary skill in the art, and (4) any relevant secondary considerations. *Ball Aerosol & Specialty Container, Inc. v. Ltd. Brands, Inc.*, 555 F.3d 984, 991 (Fed. Cir. 2009) *citing Graham v. John Deere Co.*, 383 U.S. 1, 17-18, 86 S. Ct. 684, 15 L. Ed. 2d 545 (1966). Title 35 U.S.C. §103 bars patentability unless "the improvement is more than the predictable use of prior art elements according to their

established functions." *In re Kubin*, 561 F.3d 1351, 1360 *citing KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007).

The Examiner alleges that the use of a process for super-resolution between layers in a hierarchical encoding is well-known in the art. Ong implements super-resolution processing on a predictive picture created by inter-layer intra prediction processor to use the processed picture as a reference picture in an enhancement layer, and there is a general explanation of a super-resolution process, *see* Ong Figure 4a section "Inter-layer prediction encoding …" and section "Super Resolution processor". Based on these descriptions, the Examiner alleges that the super-resolution process is employed for an additional extension of a reference picture for the encoding of an enhancement layer picture and that the super-resolution enlargement of the pictures decoded in a lower layer is a modification of Wan's technique with Ong's technique and is well known in the art.

The Examiner admits that the combination of Wan and Ong does not include the use of a set of super-resolution enlarged pictures with a standard resolution. However, the Examiner alleges that the use of resolution converters for encoding and decoding in multiple resolutions in order to extend the current and reference pictures is obvious from Holcomb. Holcomb has a current frame and a reference frame with different spatial resolutions to implement thereon different resolution conversions into spatial resolutions which another encoder can encode, to implement an encoding process to obtain an encoding output, see Figure 2. The Examiner alleges that like the current frame in the Holcomb configuration, a picture after the super-resolution enlargement may be used, and thus it is well known in the art.

Applicants respectfully submit the amendments to claims 7-9 in response to the

Examiner's arguments. Amendments to claims 7-9 refer to:

> (A) a spatial resolution of the set of super-resolution enlarged pictures, that of the set of super-resolution enlarged decoded pictures, and that of the set of resolution converted enlarged decoded pictures are made equal; and
>
> (B) the third encoder controls a selection of a set of reference pictures and creates a set of data on the selection of the set of reference pictures to identify a selected set of reference pictures during the process for prediction of the third combination.

Regarding (A), the combination of cited documents cannot control such that an enlargement ratio of the set of super-resolution enlarged pictures, that of the set of super-resolution enlarged decoded pictures, and that of the set of resolution converted enlarged decoded pictures are made equal.

During an encoding process in an enhancement layer, when resolutions are different between target pictures and reference pictures, it causes a problem where edges and shapes included in the pictures are not located at the same spatial location or at a near spatial location to each other, so that the amount of information of data on differences made from the target pictures and the reference pictures actually becomes large.

The presently claimed subject matter enables the setting of a prescribed enlargement ratio, thereby creating a sequence of target moving pictures and a sequence of reference moving pictures with a desired high resolution, and making use of these moving pictures with the high resolution to implement a third combination of processes for a prediction and an encoding to create a third sequence of encoded bits. Moreover, by controlling the prescribed enlargement

ratio equal among the first super-resolution enlarger, the second super-resolution enlarger, and the third resolution converter, an encoding for a sequence of moving pictures with a high resolution is made easy, *see* written description paragraph [0172].

Regarding (B), the presently claimed subject matter has the set of super-resolution enlarged pictures from the first super-resolution enlarger as a set of encoding target pictures, has the set of super-resolution enlarged decoded pictures from the second super-resolution enlarger as a second set of reference pictures, and has the set of resolution converted enlarged decoded pictures from the third resolution converter as a first set of reference pictures. During a process for the prescribed prediction at the third encoder of the presently claimed subject matter, there is a configuration to employ either the first reference picture or the second reference picture to create a predictive picture and subtract the predictive picture from the target picture to create a data on a difference in between, *see* written description paragraph [0165].

Moreover, for control to make a selection of reference picture, the presently claimed subject matter has a configuration to create a set of data on the selection of reference picture to identify the first reference picture or the second reference picture, whichever is used, *see* written description paragraph [0167].

The combination of cited documents cannot create a set of data on the selection of reference picture for control to make a selection of reference picture. For example, in the configuration of Holcomb, even though the super-resolution enlarged pictures is supplied to the current frame and the second reference picture is supplied to the reference frame, since the first reference picture is not supplied, it is not possible to select a reference picture during the prediction process. Thus, Holcomb cannot create data on the selection of reference picture to

identify the first reference picture or the second reference picture, whichever is used.

Thus, no combination of Wan, Ong, and Holcomb teach each and every feature of the presently amended claims 7-9. Therefore, the Examiner has not proven a *prima facie* case of obviousness. Applicants respectfully request reconsideration and withdrawal of the rejections.

CONCLUSION

Applicant believes that a full and complete response has been made to the pending Office Action and respectfully submits that all of the stated grounds for rejection have been overcome or rendered moot. Accordingly, Applicant respectfully submits that all pending claims are allowable and that the application is in condition for allowance.

Should the Examiner feel that there are any issues outstanding after consideration of this response, the Examiner is invited to contact Applicant's undersigned representative at the number below to expedite prosecution.

Prompt and favorable consideration of this Reply is respectfully requested.

Respectfully submitted,
NATH, GOLDBERG & MEYER

Date: September 15, 2014

/ Jerald L. Meyer/

Jerald L. Meyer, Reg. No. 41,194
Customer No. 20529

NATH, GOLDBERG & MEYER
112 South West Street
Alexandria, VA 22314
Tel: 703-548-6284
Fax: 703-683-8396

Electronic Patent Application Fee Transmittal	
Application Number:	12995039
Filing Date:	29-Nov-2010
Title of Invention:	MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYTEM, MOVING PICTURE REENCODING METHOD, AND MOVING PICTURE REENCODING PROGRAM
First Named Inventor/Applicant Name:	Satoru Sakazume
Filer:	Stanley Protigal/Annie Kock
Attorney Docket Number:	31181U
Filed as Large Entity	

U.S. National Stage under 35 USC 371 Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Extension - 1 month with $0 paid	1251	1	200	200

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**200**

Electronic Acknowledgement Receipt	
EFS ID:	20132623
Application Number:	12995039
International Application Number:	
Confirmation Number:	7504
Title of Invention:	MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYTEM, MOVING PICTURE REENCODING METHOD, AND MOVING PICTURE REENCODING PROGRAM
First Named Inventor/Applicant Name:	Satoru Sakazume
Customer Number:	20529
Filer:	Stanley Protigal/Annie Kock
Filer Authorized By:	Stanley Protigal
Attorney Docket Number:	31181U
Receipt Date:	15-SEP-2014
Filing Date:	29-NOV-2010
Time Stamp:	16:39:27
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$200
RAM confirmation Number	3308
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1	Extension of Time	sb0022.pdf	186386 62fe391d89c6445be88a4de8cc6c8da449044ada	no	2
Warnings:					
Information:					
2	Amendment/Req. Reconsideration-After Non-Final Reject	ROA_31181U_09152014.pdf	178076 cc6486386d6ef5255ca5d03246d175c238e32f66	no	28
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	30671 18903fbf14dfe690ee89264fd3431034d67b9f94	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	395133		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/22 (03-13)
Approved for use through 3/31/2013. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)	Docket Number (Optional) 31181U
Application Number 12/995,039	Filed November 29, 2010
For MOVING PICTURE ENCODING SYSTEM...	
Art Unit 2482	Examiner PICON-FELICIANO, ANA J

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above-identified application.

The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):

	Fee	Small Entity Fee	Micro Entity Fee	
☑ One month (37 CFR 1.17(a)(1))	$200	$100	$50	$ 200
☐ Two months (37 CFR 1.17(a)(2))	$600	$300	$150	$
☐ Three months (37 CFR 1.17(a)(3))	$1,400	$700	$350	$
☐ Four months (37 CFR 1.17(a)(4))	$2,200	$1,100	$550	$
☐ Five months (37 CFR 1.17(a)(5))	$3,000	$1,500	$750	$

☐ Applicant asserts small entity status. See 37 CFR 1.27.

☐ Applicant certifies micro entity status. See 37 CFR 1.29.
Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.

☐ A check in the amount of the fee is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☐ The Director has already been authorized to charge fees in this application to a Deposit Account.

☐ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number _____.

☑ Payment made via EFS-Web.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

I am the

☐ applicant/inventor.

☐ assignee of record of the entire interest. See 37 CFR 3.71. 37 CFR 3.73(b) statement is enclosed (Form PTO/SB/96).

☑ attorney or agent of record. Registration number 41,194.

☐ attorney or agent acting under 37 CFR 1.34. Registration number _____.

/Jerald L. Meyer/ — Signature

September 15, 2014 — Date

Jerald L. Meyer — Typed or printed name

703-548-6284 — Telephone Number

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.

☐ * Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.136(a). The information is required to obtain or retain a benefit by the public, which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/SB/06 (09-11)
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 12/995,039	Filing Date 11/29/2010	☐ To be Mailed

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	09/15/2014	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 25	Minus	** 25	= 0	X $80 =	0
	Independent (37 CFR 1.16(h))	* 16	Minus	***16	= 0	X $420 =	0
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
/ANNIE SINGLETON/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/995,039	11/29/2010	Satoru Sakazume	31181U	7504

20529 7590 05/15/2014

NATH, GOLDBERG & MEYER
Joshua Goldberg
112 South West Street
Alexandria, VA 22314

EXAMINER	
PICON-FELICIANO, ANA J	
ART UNIT	PAPER NUMBER
2482	

NOTIFICATION DATE	DELIVERY MODE
05/15/2014	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

USPTO@nathlaw.com

Office Action Summary	Application No. 12/995,039	Applicant(s) SAKAZUME, SATORU	
	Examiner ANA PICON-FELICIANO	Art Unit 2482	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 November 2010*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) *2-26* is/are pending in the application.

5a) Of the above claim(s) *2-6 and 10-26* is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *7-9* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☒ The specification is objected to by the Examiner.

11)☒ The drawing(s) filed on *11/29/2010* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☒ All b)☐ Some** c)☐ None of the:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date *See Continuation Sheet*.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

Continuation of Attachment(s) 2). Information Disclosure Statement(s) (PTO/SB/08), Paper No(s)/Mail Date :11/29/2010,12/19/2012,7/15/2013.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application is being examined under the pre-AIA first to invent provisions.

Election/Restrictions

2. Applicant's election *without traverse* of **Species D: Figure 13** in the reply filed on **17 October 2013** is acknowledged. Applicant indicated that claims 2-26 read on the elected Species. However, claims 2-6 and 10-26 does not read on the elected species. During a telephone interview on **27 January 2014**, the applicant was informed that the claims 2-26 were not generic. The reasons for these claims not being generic are the following:

Regarding claim 2, the claim recites elements such as a first resolution converter and a second encoder that are not included in Figure 13. Therefore, this claim is not generic.

Regarding claim 3, the claim recites elements such as a first resolution converter, a second encoder, and a second super-resolution converter that are not included in Figure 13. Therefore, this claim is not generic.

Regarding claims 4-6, they are dependent on claim 2, therefore, these claims are not generic for the same reasons as explained above.

Regarding claims 7-9, the claims recite elements included in Figure 13. Therefore, these claims read on Figure 13.

Regarding claim 10, the claim recites elements such as a first resolution converter, a second resolution converter and a second encoder that are not included in Figure 13. Therefore, this claim is not generic.

Regarding claim 11, the claim recites a method that includes elements such as a first resolution conversion and a second encoding that are not included in Figure 13. Therefore, this claim is not generic.

Regarding claim 12, the claim recites a recording medium that includes elements such as a first resolution conversion and a second encoding that are not included in Figure 13. Therefore, this claim is not generic.

Regarding claim 13, the claim recites elements such as a first resolution converter and a second decoder that are not included in Figure 13. Therefore, this claim is not generic.

Regarding claim 14, the claim is dependent on claim 13, therefore, this claim is not generic for the same reasons as explained above.

Regarding claim 15, the claim recites elements such as a first resolution converter, a second decoder and a reencoder that are not included in Figure 13. Therefore, this claim is not generic.

Regarding claim 16, the claim is dependent on claim 15, therefore, this claim is not generic for the same reasons as explained above.

Regarding claim 17, the claim recites a method that includes elements such as a first resolution conversion and a second decoding that are not included in Figure 13. Therefore, this claim is not generic.

Regarding claim 18, the claim is dependent on claim 17, therefore, this claim is not generic for the same reasons as explained above.

Regarding claim 19, the claim recites a method that includes elements such as first resolution conversion, second decoding and reencoding that are not included in Figure 13. Therefore, this claim is not generic.

Regarding claim 20, the claim recites a recording medium that includes elements such as a first resolution conversion and a second decoding that are not included in Figure 13. Therefore, this claim is not generic.

Regarding claim 21, the claim recites a recording medium that includes elements such as a first resolution conversion, a second decoding and reencoding that are not included in Figure 13. Therefore, this claim is not generic.

Regarding claims 22-24, they are dependent on claim 3, therefore, these claims are not generic for the same reasons as explained above.

Regarding claim 25, the claim recites a method that includes elements such as a first resolution conversion and a second resolution conversion that are not included in Figure 13. Therefore, this claim is not generic.

Regarding claim 26, the claim recites a recording medium that includes elements such as a first resolution conversion and a second resolution conversion that are not included in Figure 13. Therefore, this claim is not generic.

4. Accordingly, **claims 2-6 and 10-26** do not read on the elected **Species D: Figure 13**. Therefore, claims 2-6 and 10-26 have been withdrawn from consideration.

5. **Claims 7-9** have been examined.

Priority

6. Applicant's claim for the benefit of a prior-filed application **PCT/JP2009/059801** field on **28 May 2009** under 35 U.S.C. 119(e) or under 35 U.S.C. 120, 121, or 365(c) is acknowledged.

7. Acknowledgment is made of applicant's claim for foreign priority under 35 U.S.C. 119 (a)-(d). The certified copy has been filed in parent Application No. **JP P2009-123960**, filed on **22 May 2009** and Application No. **JP P2008-142433**, filed on **30 May 2008**.

Information Disclosure Statement

8. The information disclosure statement (IDS) submitted on 29 November 2010, 19 December 2012 and 15 July 2013 are in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Specification

9. The abstract of the disclosure is objected to because "***exceeds 150 words***". Correction is required. See MPEP § 608.01(b).

Claim Rejections - 35 USC § 103

The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained through the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under pre-AIA 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.

2. Ascertaining the differences between the prior art and the claims at issue.

3. Resolving the level of ordinary skill in the pertinent art.

4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

10. Claims 7-9 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over **Wan et al. (US 6,580,754 B1)** (hereinafter Wan) in view of **ONG CHIN PHEK et al.(JP 2007-316161 A)** (hereinafter Ong), and further in view of **Holcomb et al.(US 7,379,496 B2)**(hereinafter Holcomb).

Regarding claim 7, Wan teaches a moving picture encoding system **[See Fig. 1 and abstract regarding scalable codec with two layers for video]** comprising:

a first encoder configured to work on a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution **[See Fig. 1 and col. 4 lines 45-65 regarding base layer encoder 110 and base layer decoder 170 for encoding and decoding of an input sequence that is a base video stream]**; and

a third resolution converter configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a third resolution conversion

to create a set of resolution converted enlarged decoded pictures with a resolution higher than the standard resolution **[See Fig. 1 and col. 4 lines 45-65 regarding midprocessor 120 configured to provide an upsampled reference image for predictive coding of the input enhanced video stream or layer at an enhancement layer encoder 130].**

Wan does not explicitly teach a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution; and a second super-resolution enlarger configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a second super-resolution enlargement to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution.

However, the use of super-resolution processors in scalable video coding systems was well known in the art at the time of the invention was made as evident from the teaching of Ong **[See Figs. 4a-4b and pages 16-17, sections: "Inter-layer prediction encoding apparatus and decoding apparatus" and "Super Resolution processor", regarding super resolution processor 410/430 used to enhance additional reference images for coding of the enhancement layer images]**. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to modify Wan with Ong teachings by including "a second super-resolution enlarger configured to acquire the set of decoded pictures from the first encoder to

implement thereon a process for a second super-resolution enlargement to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution" for providing super resolution processing in image and video processing for getting good super-resolved images**[See Ong: page 14 sections: "Problems to be solved" and "Means of Solving the Problems"]**.

Neither Wan nor Ong explicitly teach a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution.

However, the use of resolution converters for multi-resolution encoding and decoding to enhance current and reference frames was well known in the art at the time of the invention was made as evident from the teaching of Holcomb **[See Figs. 2-3, col. 6 lines 8-27 and col. 7 lines 23-48 regarding resolution converter 210 that receives a current frame (205), converts the frame into another resolution and communicates with other encoder module for prediction and other encoding processes. Further on, the resolution converter 230 receives reference frame 225 and executes similarly]**. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to modify Wan with Ong super-resolution and Holcomb teachings by including "a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution" for providing a video

encoder that adaptively changes video frame sizes to reduced blocking artifacts at low bitrates**[See Holcomb: col. 1 lines 13-16]**.

Further on, when combined with Ong and Holcomb as explained above, Wan also teaches a third encoder configured to have the set of super-resolution enlarged pictures from the first super-resolution enlarger as a set of encoding target pictures, employing the set of super-resolution enlarged decoded pictures from the second super-resolution enlarger and the set of resolution converted enlarged decoded pictures from the third resolution converter as sets of reference pictures, to implement thereon a third combination of processes for a prediction and an encoding to create a third sequence of encoded bits**[See Fig. 1 and col. 4 lines 45-65 regarding enhancement layer encoder 130 that receives a target or enhanced current frame or input enhanced video and enhanced reference frames for efficiently code the enhancement layer].**

Regarding claim 8, Wan teaches a moving picture encoding system **[See Fig. 1 and abstract regarding scalable codec with two layers for video]** comprising:

a first encoder configured to work on a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution **[See Fig. 1 and col. 4 lines 45-65 regarding base layer encoder 110 and base layer decoder 170 for encoding and decoding of an input sequence that is a base video stream]**; and

a third resolution converter configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a third resolution conversion to create a set of resolution converted enlarged decoded pictures with a resolution higher than the standard resolution**[See Fig. 1 and col. 4 lines 45-65 regarding midprocessor 120 configured to provide an upsampled reference image for predictive coding of the input enhanced video stream or layer at an enhancement layer encoder 130]**.

Wan does not explicitly teach a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

However, the use of super-resolution processors in scalable video coding systems was well known in the art at the time of the invention was made as evident from the teaching of Ong **[See Figs. 4a-4b and pages 16-17, sections: "Inter-layer prediction encoding apparatus and decoding apparatus" and "Super Resolution processor", regarding super resolution processor 410/430 used to enhance additional reference images for coding of the enhancement layer images]**. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to modify Wan with Ong teachings by including "a super-resolution enlarger" for providing super resolution processing in image and video processing for getting good super-resolved images **[See Ong: page 14 sections: "Problems to be solved" and "Means of Solving the Problems"]**.

Neither Wan nor Ong explicitly teach whether the first super-resolution enlarger is configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution.

However, the use of resolution converters for multi-resolution encoding and decoding to enhance current and reference frames was well known in the art at the time of the invention was made as evident from the teaching of Holcomb **[See Figs. 2-3, col. 6 lines 8-27 and col. 7 lines 23-48 regarding resolution converter 210 that receives a current frame (205), converts the frame into another resolution and communicates with other encoder module for prediction and other encoding processes. Further on, the resolution converter 230 receives reference frame 225 and executes similarly]**. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to modify Wan with Ong super-resolution and Holcomb teachings by including “a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution” for providing a video encoder that adaptively changes video frame sizes to reduced blocking artifacts at low bitrates**[See Holcomb: col. 1 lines 13-16]**.

Further on, when combined with Ong and Holcomb as explained above, Wan also teaches a third encoder configured to have the set of super-resolution enlarged pictures from the first super-resolution enlarger as a set of encoding target pictures,

employing the set of resolution converted enlarged decoded pictures from the third resolution converter as a set of reference pictures, to implement thereon a third combination of processes for a prediction and an encoding to create a third sequence of encoded bits**[See Fig. 1 and col. 4 lines 45-65 regarding enhancement layer encoder 130 that receives a target or enhanced current frame or input enhanced video and enhanced reference frames for efficiently code the enhancement layer]**.

Regarding claim 9, Wan teaches a moving picture encoding system **[See Fig. 1 and abstract regarding scalable codec with two layers for video]** comprising:

a first encoder configured to work on a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution **[See Fig. 1 and col. 4 lines 45-65 regarding base layer encoder 110 and base layer decoder 170 for encoding and decoding of an input sequence that is a base video stream]**.

Wan does not explicitly teach a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution; and a second super-resolution enlarger configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a second super-resolution enlargement to

create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution.

However, the use of super-resolution processors in scalable video coding systems was well known in the art at the time of the invention was made as evident from the teaching of Ong **[See Figs. 4a-4b and pages 16-17, sections: "Inter-layer prediction encoding apparatus and decoding apparatus" and "Super Resolution processor", regarding super resolution processor 410/430 used to enhance additional reference images for coding of the enhancement layer images]**. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to modify Wan with Ong teachings by including "a second super-resolution enlarger configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a second super-resolution enlargement to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution" for providing super resolution processing in image and video processing for getting good super-resolved images**[See Ong: page 14 sections: "Problems to be solved" and "Means of Solving the Problems"]**.

Neither Wan nor Ong explicitly teach a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution.

However, the use of resolution converters for multi-resolution encoding and decoding to enhance current and reference frames was well known in the art at the time

of the invention was made as evident from the teaching of Holcomb **[See Figs. 2-3, col. 6 lines 8-27 and col. 7 lines 23-48 regarding resolution converter 210 that receives a current frame (205), converts the frame into another resolution and communicates with other encoder module for prediction and other encoding processes. Further on, the resolution converter 230 receives reference frame 225 and executes similarly]**. Thus, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to modify Wan with Ong super-resolution and Holcomb teachings by including "a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution" for providing a video encoder that adaptively changes video frame sizes to reduced blocking artifacts at low bitrates**[See Holcomb: col. 1 lines 13-16]**.

Further on, when combined with Ong and Holcomb as explained above, Wan also teaches a third encoder configured to have the set of super-resolution enlarged pictures from the first super-resolution enlarger as a set of encoding target pictures, employing the set of super-resolution enlarged decoded pictures from the second super-resolution enlarger as a set of reference pictures, to implement thereon a third combination of processes for a prediction and an encoding to create a third sequence of encoded bits**[See Fig. 1 and col. 4 lines 45-65 regarding enhancement layer encoder 130 that receives a target or enhanced current frame or input enhanced**

video and enhanced reference frames for efficiently code the enhancement layer].

Conclusion

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

- Hosaka et al.(US 6,091,855)
- Tipping et al.(US 7,106,914 B2)
- Demos (US 7,428,639, B2)
- Han(US 2005/0195899 A1)
- Kobayashi et al.(US 2005/0128307 A1)
- Bruls et al.(US 2005/0105814 A1)
- Fogg et al.(US 2007/0091997 A1)
- Gong et al.(US 2007/0103595 A1)
- Kimoto(US 2007/0133680 A1)
- Park et al.(US 2007/0189385 A1)
- Toma et al.(US 2007/0247529 A1)
- Sullivan(US 2007/0160153 A1)
- KAGEYAMA et al.(US 2009/0034941 A1)

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to ANA PICON-FELICIANO whose telephone number is (571)272-5252. The examiner can normally be reached on Monday-Friday 9am to 5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Christopher Kelley can be reached on 571-272-7331. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/ANA PICON-FELICIANO/
Examiner, Art Unit 2482

/CHRISTOPHER S KELLEY/
Supervisory Patent Examiner, Art Unit 2482

Notice of References Cited	Application/Control No. 12/995,039	Applicant(s)/Patent Under Reexamination SAKAZUME, SATORU	
	Examiner ANA PICON-FELICIANO	Art Unit 2482	Page 1 of 2

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-6,580,754	06-2003	Wan et al.	375/240.01
*	B	US-7,379,496	05-2008	Holcomb et al.	375/240.03
*	C	US-6,091,855	07-2000	Hosaka et al.	382/240
*	D	US-7,106,914	09-2006	Tipping et al.	382/299
*	E	US-7,428,639	09-2008	Demos, Gary A.	713/176
*	F	US-2005/0195899	09-2005	Han, Woo-jin	375/240.21
*	G	US-2005/0128307	06-2005	Kobayashi et al.	348/208.1
*	H	US-2005/0105814	05-2005	Bruls et al.	382/240
*	I	US-2007/0091997	04-2007	Fogg et al.	375/240.1
*	J	US-2007/0103595	05-2007	Gong et al.	348/620
*	K	US-2007/0133680	06-2007	Kimoto, Takahiro	375/240.12
*	L	US-2007/0189385	08-2007	Park et al.	375/240.12
*	M	US-2007/0247529	10-2007	Toma et al.	348/222.1

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N	JP 2007316161 A	12-2007	Japan	ONG et al.	
	O					
	P					
	Q					
	R					
	S					
	T					

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*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	Machine Translation of JP 2007316161 A.
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	Examiner ANA PICON-FELICIANO	Art Unit 2482	Page 2 of 2

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2007/0160153	07-2007	Sullivan, Gary J.	375/240.29
*	B	US-2009/0034941	02-2009	KAGEYAMA et al.	386/126
	C	US-			
	D	US-			
	E	US-			
	F	US-			
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	J	US-			
	K	US-			
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CONFIRMATION NO. 7504

SERIAL NUMBER	FILING or 371(c) DATE RULE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/995,039	11/29/2010	375	2482	31181U

APPLICANTS

INVENTORS

Satoru Sakazume, Kanagawa-ken, JAPAN;

**** CONTINUING DATA ***************************

This application is a 371 of PCT/JP2009/059801 05/28/2009

**** FOREIGN APPLICATIONS ***************************

JAPAN P2009-123960 05/22/2009
JAPAN P2008-142433 05/30/2008

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12/21/2010

Foreign Priority claimed ☑ Yes ☐ No 35 USC 119(a-d) conditions met ☑ Yes ☐ No Verified and Acknowledged /ANA J PICON-FELICIANO/ Examiner's Signature	☐ Met after Allowance Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
		JAPAN	3	25	16

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UNITED STATES

TITLE

MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYTEM, MOVING PICTURE REENCODING METHOD, AND MOVING PICTURE REENCODING PROGRAM

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EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1	12/995039.app.	US-PGPUB; USPAT; USOCR	OR	ON	2014/05/01 14:19
L2	18844	(H04N19/00436 OR H04N19/00472 OR H04N19/00521 OR H04N19/00757 OR H04N19/00781 OR H04N19/00884 OR H04N19/0089).CPC.	US-PGPUB; USPAT; USOCR	OR	ON	2014/05/01 14:19
L3	36	l2 and (super near2 resolution) and (resolution near2 conver$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/05/01 14:20
L4	9246	375/240.12,240.18,E7.243,E7.226.ccls.	US-PGPUB; USPAT	OR	ON	2014/05/01 15:49
L5	13	L4 and (super$1resolution or "super resolution") and (cod$4 or encod$4 or decod$4) and (image$1 or video) and ((point near2 spread near2 function) or "PSF")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/05/01 15:49
L6	76	L4 and (super$1resolution or "super resolution") and (cod$4 or encod$4 or decod$4) and (image$1 or video)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/05/01 15:49
L7	1	L4 and ((super$1resolution or "super resolution" or high$1resolution or "high resolution") near2 (convert$4 and enlarg$4)) and (cod$4 or encod$4 or decod$4) and (image$1 or video)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/05/01 15:49
L8	10	L4 and ((super$1resolution or "super resolution" or high$1resolution or "high resolution") near5 ((convert$4 or transform$4) and (enlarg$4 or increas$4))) and (cod$4 or encod$4 or decod$4) and (image$1 or video)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/05/01 15:49

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	12995039
Filing Date	2010-11-29
First Named Inventor	Satoru SAKAZUME
Art Unit	2482
Examiner Name	PICON-FELICIANO, ANA J
Attorney Docket Number	31181U

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Receipt date: 07/15/2013	Application Number	12995039 12995039 - GAU: 2482
INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Filing Date	2010-11-29
	First Named Inventor	Satoru SAKAZUME
(Not for submission under 37 CFR 1.99)	Art Unit	2482
	Examiner Name	PICON-FELICIANO, ANA J
	Attorney Docket Number	31181U

	1	Sung Cheol Park, et al."Super-Resolution Image Reconstruction: A Technical Overview", Signal Processing Magazine,Vol. 20, Issue 3, IEEE, pages 21-37. May, 2003.	☐
	2	Office Action issued on May 21, 2013, in the Counterpart Japanese Application No. 2009-123960, two pages.	☐

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EXAMINER SIGNATURE

Examiner Signature	/Ana Picon-feliciano/	Date Considered	05/01/2014

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Receipt date: 07/15/2013	Application Number	12995039 12995039 - GAU: 2482
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99**)	Filing Date	2010-11-29
	First Named Inventor	Satoru SAKAZUME
	Art Unit	2482
	Examiner Name	PICON-FELICIANO, ANA J
	Attorney Docket Number	31181U

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☒ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

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☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☐ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Jerald L. Meyer/	Date (YYYY-MM-DD)	2013-07-15
Name/Print	Jerald L. Meyer	Registration Number	41194

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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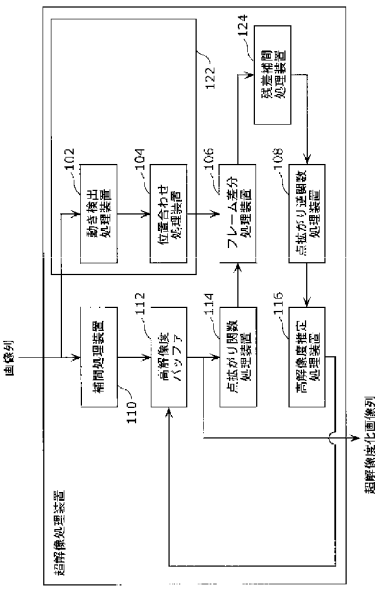
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(54)【発明の名称】残差補間を用いた超解像処理方法及び装置

(57)【要約】　（修正有）
【課題】画像列の解像度及び質を向上し、グリッドアーチファクトを低減した超解像処理の方法及び装置を提供する。
【解決手段】補間を行って最初の高解像度推定画像を生成し、位置合わせを行って位置合わせ画像を生成し、高解像度推定画像を不鮮明化し、不鮮明化画像と位置合わせ画像とを減算して残差画像を生成し、欠損していない周辺画素の残差値を用いて欠損残差を補間し、点拡がり逆関数を用いて残差画像から逆投影画像を生成し、平滑化画像と逆投影画像とを組み合わせて強調係数を生成し、強調係数を高解像度推定画像に更新して新たな高解像度推定画像を生成することにより、欠損画素の残差値を欠損していない周辺画素の残差値から補間する。
【選択図】図１ａ



【特許請求の範囲】
【請求項１】
画像列に対して残差補間を用いた超解像処理を行うための方法であって、
補間を行って最初の高解像度推定画像を生成するステップ（１１０）と、
位置合わせを行って位置合わせ画像を生成するステップ（１２２）と、
以下のステップを繰り返すステップとを備えることを特徴とする方法。
点拡がり関数を用いて前記高解像度推定画像を不鮮明化し、不鮮明化画像を生成するステップ（１１４）
前記不鮮明化画像と前記位置合わせ画像とを減算し、残差画像を生成するステップ（１０６）
欠損していない周辺画素の残差値を用いて、前記残差画像から欠損残差を補間するステップ（１２４）
点拡がり逆関数を用いて前記残差画像を逆投影し、逆投影画像を生成するステップ（１０８）
平滑化画像と前記逆投影画像とを組み合わせ、強調係数を生成するステップ（１１６）
前記強調係数を高解像度推定画像に更新し、新たな高解像度推定画像を生成するステップ（１１２）
【請求項２】
位置合わせを行って位置合わせ画像を生成する請求項１記載の方法であって、
動き補償を行ってワーピングベクトルを生成するステップ（１０２）と、
前記ワーピングベクトルに基づいて位置合わせを行い、位置合わせ画像を生成するステップ（１０４）と
を備えることを特徴とする方法。
【請求項３】
欠損していない周辺画素の残差値を用いて、前記残差画像から欠損残差を補間する請求項１に記載の方法であって、
対象画素が残差値を持つか否かを確認するステップ（Ｓ５０２）と、
前記対象画素が残差値を持たない場合に、補間を行うのに十分な残差を周辺画素が持つか否かを確認するステップ（Ｓ５０４）と、
前記対象画素が残差値を持たない場合、かつ補間を行うのに十分な残差を周辺画素が持たない場合に、前記対象画素の残差値を前記周辺画素の残差値から補間するステップ（Ｓ５０６）と、
他の画素が存在するか否かを確認するステップ（Ｓ５１０）と、
他の画素が存在しない場合に、前記対象画素を走査順における次の画素として設定するステップ（Ｓ５０８）と、
他の画素が存在しない場合に、前記対象画素が残差値を持つか否かを確認するステップから処理を繰り返すステップと、
他の画素が存在しないと確認された場合に、処理を終了するステップと
を備えることを特徴とする方法。
【請求項４】
欠損していない周辺画素の残差値を用いて、前記残差画像から欠損残差を補間する請求項３記載の方法であって、
前記走査順は、ラスタ走査、逆ラスタ走査、及び任意の走査順序のいずれかである
ことを特徴とする方法。
【請求項５】
欠損していない周辺画素の残差値を用いて、前記残差画像から欠損残差を補間する請求項１記載の方法であって、さらに、
補間された残差値を用いてさらに新たな補間残差値を生成できるように請求項３記載の方法を繰り返すステップ
を備えることを特徴とする方法。

【請求項６】
欠損していない周辺画素の残差値を用いて、前記残差画像から欠損残差を補間する請求項１記載の方法であって、さらに、
残差補間のパス毎に異なる走査順を用いるステップ
を備えることを特徴とする方法。
【請求項７】
欠損していない周辺画素の残差値を用いて、前記残差画像から欠損残差を補間する請求項１に記載の方法であって、
対象画素が残差値を持つか否かを確認するステップ（Ｓ６０６）と、
前記対象画素が残差値を持たない場合に、前の画素と次の画素とが残差を持つか否かを確認するステップ（Ｓ６０８）と、
前記対象画素が残差値を持たない場合、かつ前記前の画素と次の画素とが残差値を持つ場合に、前記対象画素の残差値を前記前の画素と次の画素との残差値から補間するステップ（Ｓ６１０）と、
他の画素が存在するか否かを確認するステップ（Ｓ６１４）と、
他の画素が存在しない場合に、前記対象画素を走査順における次の画素として設定するステップ（Ｓ６１２）と、
他の画素が存在しない場合に、前記対象画素が残差値を持つか否かを確認するステップから処理を繰り返すステップと、
他の画素が存在しないと確認された場合に、処理を終了するステップと
を備えることを特徴とする方法。
【請求項８】
画像列に対して残差補間を用いた超解像処理を行うための装置であって、
補間を行って最初の高解像度推定画像を生成する手段（１１０）と、
位置合わせを行って位置合わせ画像を生成する手段（１２２）と、
以下のステップを繰り返す手段とを備えることを特徴とする装置。
点拡がり関数を用いて前記高解像度推定画像を不鮮明化し、不鮮明化画像を生成する手段（１１４）
前記不鮮明化画像と前記位置合わせ画像とを減算し、残差画像を生成する手段（１０６）
欠損していない周辺画素の残差値を用いて、前記残差画像から欠損残差を補間する手段（１２４）
点拡がり逆関数を用いて前記残差画像を逆投影し、逆投影画像を生成する手段（１０８）
平滑化画像と前記逆投影画像とを組み合わせ、強調係数を生成する手段（１１６）
前記強調係数を高解像度推定画像に更新し、新たな高解像度推定画像を生成する手段（１１２）
【請求項９】
画像列に対して残差補間を用いた超解像処理を行うためのＬＳＩ（Ｌａｒｇｅ　Ｓｃａｌｅ　Ｉｎｔｅｇｒａｔｅｄ）回路であって、
補間を行って最初の高解像度推定画像を生成するユニット（１１０）と、
位置合わせを行って位置合わせ画像を生成するユニット（１２２）と、
以下のステップを繰り返すユニットとを備えることを特徴とするＬＩＳ回路。
点拡がり関数を用いて前記高解像度推定画像を不鮮明化し、不鮮明化画像を生成するユニット（１１４）
前記不鮮明化画像と前記位置合わせ画像とを減算し、残差画像を生成するユニット（１０６）
欠損していない周辺画素の残差値を用いて、前記残差画像から欠損残差を補間するユニット（１２４）
点拡がり逆関数を用いて前記残差画像を逆投影し、逆投影画像を生成するユニット（1

０８）
平滑化画像と前記逆投影画像とを組み合わせ、強調係数を生成するユニット（１１６）
前記強調係数を高解像度推定画像に更新し、新たな高解像度推定画像を生成するユニット（１１２）
【請求項１０】
前処理装置又は後処理装置において、残差補間を用いて超解像処理を行う装置であって、
入力源を必要に応じて逆多重化し、非圧縮画像列又は符号化映像ビットストリームと他のビットストリームとを生成する手段（２０２）と、
前記符号化映像ビットストリームを必要に応じて復号し、復号化画像列と、オプションで補助データとを生成する手段（２０４）と、
オプションで、前記復号化画像列又は前記非圧縮画像列に対して前処理を行い、処理画像列を生成する手段（２０６）と、
前記処理画像列に対して、請求項１～９記載の残差補間を用いた超解像処理を行い、超解像度化画像列を生成する手段（２０８）と、
オプションで、前記超解像度化画像列に対して後処理を行い、処理済み超解像度化画像列を生成する手段（２１０）と、
オプションで圧縮を行って、オプションで前記処理済み超解像度化画像列を格納する手段（２１２）と、
オプションで前記処理済み超解像度化画像列を表示する手段（２１４）と
を備えることを特徴とする装置。
【請求項１１】
エンコーダにおいて、残差補間を用いて超解像処理を行う装置であって、
イントラ予測を行う手段（３０６）と、
動き検出を行う手段（３０２）と、
変換を行う手段（３０４）と、
量子化を行う手段（３０８）と、
エントロピ符号化を行う手段（３１０）と、
逆量子化を行う手段（３１２）と、
逆変換を行う手段（３１４）と、
逆イントラ予測を行う手段（３１６）と、
動き補償を行う手段（３１８）と、
前記動き検出及び動き補償に用いる参照画像に対して、請求項１～９記載の残差補間を用いた超解像処理を行う手段（３２０）と
を備えることを特徴とする装置。
【請求項１２】
デコーダにおいて、残差補間を用いて超解像処理を行う装置であって、
エントロピ復号を行う手段（３４０）と、
逆量子化を行う手段（３４２）と、
逆変換を行う手段（３４４）と、
逆イントラ予測を行う手段（３４６）と、
動き補償を行う手段（３５０）と、
前記動き補償に用いる参照画像に対して、請求項１～９記載の残差補間を用いた超解像処理を行う手段（３４８）と
を備えることを特徴とする装置。
【請求項１３】
レイヤ間予測を用いるエンコーダにおいて、残差補間を用いて超解像処理を行う装置であって、
基本レイヤを符号化する手段（４０２）と、
レイヤ間予測を用いて拡張レイヤを符号化する手段（４１２）と、

前記拡張レイヤと基本レイヤとの間でレイヤ間残差予測を行う手段（４０４）と、
前記拡張レイヤと基本レイヤとの間でレイヤ間動きデータ予測を行う手段（４０６）と、
前記拡張レイヤと基本レイヤとの間でレイヤ間イントラ予測を行う手段（４０８）と、
前記拡張レイヤを符号化するための追加的な参照として用いられる前記基本レイヤのイントラ画像又は復号化画像に対して、請求項１～９記載の残差補間を用いた超解像処理を行う手段（４１０）と
を備えることを特徴とする装置。
【請求項１４】
レイヤ間予測を用いるデコーダにおいて、残差補間を用いて超解像処理を行う装置であって、
基本レイヤを復号する手段（４２２）と、
レイヤ間予測を用いて拡張レイヤを復号する手段（４３２）と、
前記拡張レイヤと基本レイヤとの間でレイヤ間残差予測を行う手段（４２４）と、
前記拡張レイヤと基本レイヤとの間でレイヤ間動きデータ予測を行う手段（４２６）と、
前記拡張レイヤと基本レイヤとの間でレイヤ間イントラ予測を行う手段（４２８）と、
前記拡張レイヤを復号するための追加的な参照として用いられる前記基本レイヤのイントラ画像又は復号化画像に対して、請求項１～９記載の残差補間を用いた超解像処理を行う手段（４３０）と
を備えることを特徴とする装置。
【発明の詳細な説明】
【技術分野】
【０００１】
本発明は、あらゆる画像・映像処理、特に画像・映像超解像処理に利用可能である。
【背景技術】
【０００２】
超解像処理は、複数の低解像度画像から高解像画像を生成する技術である。この技術をプラズマディスプレイパネル（ＰＤＰ）、液晶ディスプレイ（ＬＣＤ）、ブラウン管（ＣＲＴ）などの表示装置に用いて、表示対象の入力画像列の解像度及び質を向上させることができる。超解像処理をハードディスクレコーダやＤＶＤ（Ｄｉｇｉｔａｌ　Ｖｅｒｓａｔｉｌｅ　Ｄｉｓｃ）レコーダなどの記録装置において用いた場合、トランスコーディングや格納の対象となる画像の解像度及び質を向上することができる。また、超解像度は印刷目的でも利用可能である。この場合、カメラレコーダやデジタルカメラからの画像列を処理して一枚の高解像度・高画質画像を生成できる。同様に、監視に応用した場合、顔や車両のナンバープレートの解像度及び画質を向上できる。
【０００３】
超解像処理方法には画像の位置合わせを伴う方法がある。同方法では、観測された低解像度画像を動き補償し、位置合わせ画像と呼ばれる共通の高解像度グリッドに変換する。高解像度フレームの最初の推定フレームは、バイキュービック補間などの空間補間方法を用いて得られる。この推定フレームは、不鮮明化、フレーム差分、点広がり逆関数、正則化、及び細密化の処理を繰り返すことで改善される。残差画像はフレーム差分を求める動作中に生成される。これによって、位置合わせ画像は、不鮮明化された高解像度推定フレームから減算される。超解像処理の詳細に関しては、例えば米国特許出願番号２００４／０１５６５６１　Ａ１及び米国特許出願番号２００５／００１９０００　Ａ１などを参照されたい。
【発明の開示】
【発明が解決しようとする課題】
【０００４】
良質な超解像画像を得るためには、位置合わせ画像が良質であることが重要である。正

確な位置合わせを行うためには、正確な動き補償、及び対象画像と周辺画像との間のサブピクセルシフトを行う必要がある。サブピクセルシフトを行わなければ、位置合わせ画像に欠損画素が生じる。結果として、残差画像にも同様の欠損画素が生じる。高解像度推定画像における対応の欠損画素は、欠損画素のないものに比べて細密化される度合いが低くなる。問題となるのは、これらの欠損画素は周期的に発生し、結果としてグリッドアーチファクトが発生してしまうことである。このため、エッジがぎざぎざ又は鋸歯状に見えてしまう。例えば、２倍解像度アップサンプリングの場合、画素毎に輝度が高かったり、低かったり、また高かったりと、交互のパターンなる。

【課題を解決するための手段】

【０００５】

本発明では、上記グリッドアーチファクトの問題を解決するために残差補間を用いる。残差補間において、欠損画素の残差値を、欠損していない周辺画素の残差値から補間する。

【発明の効果】

【０００６】

本発明は、グリッドアーチファクトを防ぐために残差補間を用いている点で新しい。高解像度推定画像に対し平滑化の拘束条件を加えることで、正則化によってもグリッドアーチファクトを防ぐことができる。しかしながら、平滑化の拘束条件は画像全体に適用されるため、平滑化の強度を制御する必要がある。平滑化を必要としない領域では不鮮明化が発生し、強度が適切に設定されなかった場合は、不鮮明化が過度になったり不十分になったりする。

【０００７】

残差補間は欠損画素に対して行われるため、画素が欠損していない領域は不鮮明化されない。また、残差補間の強度は、必然的に残差そのものの値に応じて設定される。残差値が大きければ補間された値も大きくなり、逆もまた同様である。

【０００８】

結果として、正則化を用いた場合と比較して、より鮮明な画像を生成できるより優れた超解像のアルゴリズムが得られる。

【０００９】

残差補間は正則化と併用可能である。この併用により、正則化の強度を抑えて不鮮明化が過度に行われることを防ぐことができる。

【発明を実施するための最良の形態】

【００１０】

後処理又は前処理装置

図２は後処理又は前処理装置における超解像処理装置の使用を示すブロック図である。入力Ｄ２５２は、映像及び／又は音声ソースなどで構成される。必要であれば、逆多重化器２０２を用いて映像ソースを他のソースから分離する。また必要であれば、他のソース又は他のビットストリームＤ２５６を他の処理装置で処理する。また、映像ソースを圧縮してもよい。この場合、符号化された映像ビットストリームＤ２５８を映像デコーダ２０４で復号し、復号化画像列Ｄ２６２を生成する。また映像ソースは圧縮されなくてもよい。この場合、非圧縮画像列Ｄ２５４を用いる。オプションで前処理装置２０６を用いて画像列Ｄ２６２及びＤ２５４を処理し、処理画像列Ｄ２６４を生成してもよい。超解像処理装置２０８は画像列を処理して超解像度化画像列Ｄ２６６を生成する。超解像処理装置２０８は残差補間も行う。映像ソースを圧縮した場合、超解像処理装置は、符号化映像ビットストリームからの補助データＤ２６０をオプションで用いることができる。補助データの例として、動きベクトル、量子化パラメータ、デブロッキングフィルタ強度などがある。超解像度化画像列は、さらに後処理装置２１０で処理されてもよい。処理済み超解像度化画像列Ｄ２６８は、表示装置２１４を用いて表示できる。オプションとして、記憶装置２１２を用いて格納されてもよい。また記憶装置２１２において、格納のために圧縮を用いてもよい。

【００１１】
符号化装置及び復号装置
図３ａ及び図３ｂは、符号化装置（エンコーダ）及び復号装置（デコーダ）における超解像処理装置の使用をそれぞれ示す２枚のブロック図である。エンコーダにおいて、画像列はイントラ符号化又はインター符号化される。イントラ予測処理装置３０６は、対象フレームの情報を用いて予測を行う。動き検出処理装置３０２は、他のフレームを参照して動き補償予測を行う。その結果として処理装置３０２及び３０６から得られる画像は、次に変換処理装置３０４、量子化処理装置３０８、次いでエントロピ処理装置３１０で処理され、符号化映像ビットストリームが生成される。対象フレームは、逆量子化処理装置３１２、逆変換処理装置３１４、動き補償処理装置３１８、及び逆イントラ予測処理装置３１６を備えるローカルデコーダを用いて再構成され、動き検出処理装置３０２が用いる参照フレームとして格納される。本発明では、動き検出処理装置３０２及び動き補償装置３１８が用いる参照フレームの質及び解像度を向上させるために、超解像処理装置３２０を用いる。超解像処理装置３２０は残差補間も行う。オプションとして、動きベクトル、量子化パラメータ、デブロッキングフィルタ強度などの補助データを超解像処理装置３２０において用いることができる。

【００１２】
デコーダにおいて、エントロピ復号処理装置３４０、逆量子化処理装置３４２、逆変換処理装置３４４、逆イントラ予測処理装置３４６、及び動き検出処理装置３５０を用いて、符号化映像ビットストリームから画像列を再構成する。エンコーダと同様に、超解像処理装置３４８を用いて参照フレームの質と解像度を向上させる。超解像処理装置３４８は残差補間も行う。オプションとして、動きベクトル、量子化パラメータ、デブロッキングフィルタ強度などの補助データを超解像処理装置３４８において用いることができる。超解像処理装置３４８は、さらに、表示された画像も改善させる。

【００１３】
説明したエンコーダ及びデコーダは簡略化されたものである。現在、デブロッキングフィルタなど、画質をさらに向上させるための高度なツールを使用するエンコーダやデコーダがある。本発明では、図３ａ及び図３ｂに示されるとおりに符号化と復号が行われる必要はない。ここでは、動き検出、動き補償予測、及び表示に用いる参照フレームを改善することで符号化効率又はピクチャの質を向上させるためにエンコーダ及びデコーダにおいて超解像処理を用いることができることの一例を示しているに過ぎない。

【００１４】
レイヤ間予測符号化装置及び復号装置
図４ａ及び図４ｂは、符号化装置（エンコーダ）及び復号装置（デコーダ）におけるレイヤ間イントラ予測のための超解像処理装置の使用をそれぞれ示す２枚のブロック図である。符号化効率を向上させるために、階層符号化にレイヤ間予測を用いる。レイヤ間予測を用いる階層符号化の一例として、ＩＳＯ／ＩＥＣ１４９６－１０にスケーラブル拡張を適用するというワーキングドラフトがあり、スケーラブル映像符号化としても知られている。基本レイヤ符号化処理装置４０２を用いて基本レイヤ画像列を符号化する。拡張レイヤ符号化処理装置４１２を用いて拡張レイヤ画像列を符号化する。拡張レイヤ符号化処理装置４１２は、レイヤ間予測を用いて拡張レイヤと基本レイヤとの間の冗長性を削減することで、拡張レイヤだけを符号化する場合と比較して符号化効率を向上させる。レイヤ間残差予測処理装置４０４を用いて拡張レイヤ残差と基本レイヤ残差との間の冗長性を削減する。レイヤ間動きデータ予測処理装置４０６を用いて拡張レイヤと基本レイヤとにおける動きデータ間の冗長性を削減する。動きデータの例として、マクロブロック毎に用いられるパーティションサイズ及びタイプ、並びに予測方向、動きベクトルなどがある。レイヤ間イントラ予測処理装置４０８は、拡張レイヤの画像を符号化するための追加の参照画像として、基本レイヤのイントラ画像又は基本レイヤの再構成画像を利用する。これらの追加の参照画像を改善するために、超解像処理装置４１０を用いる。超解像処理装置４１０は残差補間も行う。オプションとして、動きベクトル、量子化パラメータ、デブロッキ

ングフィルタ強度などの補助データを超解像処理装置４１０において用いることができる。

【００１５】

デコーダにおいて、基本レイヤ復号処理装置４２２を用いて基本レイヤビットストリームを復号する。拡張レイヤ復号処理装置４３２は、レイヤ間残差予測処理装置４２４、レイヤ間動きデータ予測処理装置４２６、及びレイヤ間イントラ予測処理装置４２８を用いて拡張レイヤビットストリームを復号する。エンコーダと同様に、レイヤ間イントラ予測処理装置４２８からの参照ピクチャを改善するために超解像処理装置４３０を用いる。超解像処理装置４３０は残差補間も行う。オプションとして、動きベクトル、量子化パラメータ、デブロッキングフィルタ強度などの補助データを超解像処理装置４３０において用いることができる。

【００１６】

超解像処理装置

図１ａは超解像処理装置内の処理装置（機能ブロック）を示すブロック図である。補間処理装置１１０は、超解像度化の対象となるフレームを補間する。補間方法には、公知であるバイリニア補間、バイキュービック補間、Ｌａｎｃｚｏｓ補間などがある。補間された画像は高解像度バッファ１１２に格納される。これが最初の高解像度推定画像となる。１２２における処理装置によって、両像列の位置合わせが行われる。１２２は、参照フレームと対象フレームとの間のワーピングベクトルを算出する動き検出処理装置１０２を備える。位置合わせ処理装置１０４はワーピングベクトルに基づいて位置合わせを行う。点拡がり関数処理装置１１４は、高解像度バッファ１１２における高解像度推定画像を不鮮明化する。フレーム差分処理装置１０６は位置合わせ画像と不鮮明化された高解像度推定画像との間の差分（残差）を算出する。残差補間処理装置１２４は、欠損画素の残差値を、欠損していない周辺画素の残差値から補間する。点拡がり逆関数処理装置１０８は差分（残差）を高解像度グリッドに逆投影する。高解像度推定処理装置１１６は逆投影された差分と平滑化の拘束条件とを組み合わせて強調係数を生成する。次にこの強調係数を用いて高解像度推定画像を更新する。これにより、向上処理の繰り返しが１サイクル完了する。この処理を、処理装置１１４、１０６、１２４、１０８、１１６、及び１１８を用いて繰り返す。この処理は所定のサイクル数になるまで繰り返してもよいし、強調係数の値が一定のしきい値以下になるまで繰り返してもよい。また、適応向上処理を画素単位で行って、特定の画素のみを選択し、さらなる向上処理を行ってもよい。

【００１７】

図１ｂは、図１ａと同様の超解像処理装置内の処理装置（機能ブロック）を示すブロック図である。図１ｂは、照度マスキング及び／又は照度補償処理装置１２０と正則化処理装置１１８とが追加されている点で異なる。これら２つの処理装置はオプションである。処理装置１２０は、位置合わせ処理装置１０４が用いる照度補償値と照度マスクとを算出する。処理装置１１８は、処理装置１１６が用いる平滑化の拘束条件を算出するために用いられる。

【００１８】

残差補間（一般的ケース）

図５は一般的なケースを対象とした残差補間を示すフロー図である。残差画像における全ての画素が走査される。走査順序はラスタ走査順又は逆ラスタ走査順である。ラスタ走査では、最初の行を左から右へ走査し、次に２番目の行を左から右へ走査するといった具合に最後の行まで走査する。逆ラスタ走査では、最初の列を上から下に走査し、次に２番目の列を上から下へ走査するといった具合に最後の列まで走査する。他の走査順序を用いてもよい。ステップＳ５０２では、対象画素が残差を持つか否かを確認する。すなわち、対象画素が欠損画素であるか否かを確認する。残差を持たない場合、ステップＳ５０４において、補間に十分な残差が周辺画素にあるか否かを確認する。例えば、２タップフィルタを用いる場合、該当する場所に２つの残差値があるはずである。又は、残差画像の局所特性に合うように補間フィルタを変化させてもよい。例えば、通常、６つの値が存在する

場合は６タップＡＶＣフィルタを用い、エッジにおいて２つの値しか存在しない場合は２タップバイリニアフィルタを用いることができる。十分な残差がある場合、ステップＳ５０６において、対象画素の残差値を周辺画素から補間する。ステップＳ５１０は、ステップＳ５０２において対象画素が残差を持つと確認された場合、又はステップＳ５０４において補間に十分な周辺残差がない場合、又はステップＳ５０６の後に実行される。ステップＳ５１０において、他にも画素が存在するか否かを確認する。存在しない場合、処理を終了する。存在する場合、ステップＳ５０８において、走査順で次の画素を対象画素として設定し、ステップＳ５０２の処理を繰り返す。

【００１９】

処理を繰り返し、次の処理において他の欠損画素を補間するために、現在の処理における補間残差が用いられている。また、最初の残差補間処理をラスタ走査及び水平補間フィルタを用いて行い、２番目の残差補間処理を逆ラスタ走査及び垂直補間フィルタを用いて行うことも可能である。これは２次元分離型補間フィルタを用いる場合に有用である。

【００２０】

残差補間（具体例）

図６ｂは２倍スケール比及び２タップバイリニアフィルタという具体的なケースを対象とする残差補間を示すフロー図である。図６ａは、本具体例における残差６０２及び補間残差６０４の位置の一例を示す。スケール比が２倍であるため、欠損画素は交互に位置する。２パス処理を行い、１番目のパスではラスタ走査を用いた水平補間を行い、２番目のパスでは逆ラスタ走査を用いた垂直補間を行う。それぞれのパスにおいて次に挙げるステップが実行される。すなわち、ステップＳ６０６において、対象画素が残差を持つか否かを確認する。持たない場合、ステップＳ６０８において、走査順において直前の画素と次の画素とが残差を持つか否かを確認する。これは２タップバイリニア補間フィルタを用いているためである。もし可能であれば、ステップＳ６１０において、対象画素の残差値は、直前の画素の残差値と次の画素の残差値との平均値となる。ステップＳ６１４において、他にも画素が存在するか否かを確認する。存在しない場合、処理を終了する。存在する場合、ステップＳ６１２において、走査順で次の画素を対象画素として設定し、ステップＳ６０６の処理を繰り返す。

【００２１】

システムＬＳＩ

残差補間を用いた超解像処理装置の各機能ブロックは典型的には集積回路であるＬＳＩ（Ｌａｒｇｅ　Ｓｃａｌｅ　Ｉｎｔｅｇｒａｔｅｄ）回路として実現される。このＬＳＩは１チップ化されても良いし、複数チップ化されても良い。ここでは、ＬＳＩとしたが、集積度の違いにより、ＩＣ、システムＬＳＩ、スーパーＬＳＩ、ウルトラＬＳＩと呼称されることもある。

【００２２】

また、集積回路化の手法はＬＳＩに限るものではなく、専用回路又は汎用プロセッサで実現してもよい。ＬＳＩ製造後に、プログラムすることが可能なＦＰＧＡ（Field Programmable Gate Array）や、ＬＳＩ内部の回路セルの接続や設定を再構成可能なリコンフィギュラブル・プロセッサを利用しても良い。

【００２３】

さらには、製造技術の進歩によりＬＳＩに置き換わる集積回路化の技術が登場すれば、当然、その技術を用いて集積化を行ってもよい。バイオ技術の適応等が可能性としてありえる。

【図面の簡単な説明】

【００２４】

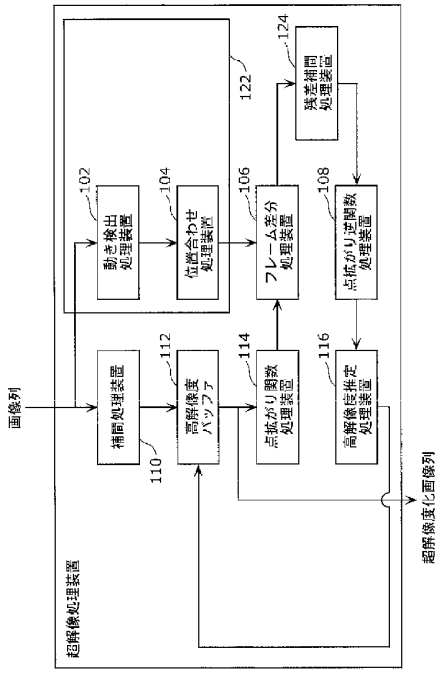
【図１ａ】超解像処理装置内の処理装置を示すブロック図である。

【図１ｂ】正則化処理装置と照度マスキング及び／又は照度補償処理装置とが追加されている点を除いて図１ａと同様の超解像処理装置内の処理装置を示すブロック図である。

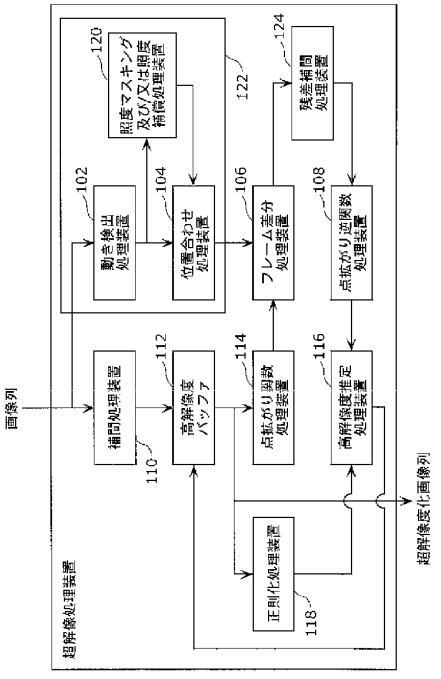
【図２】後処理又は前処理を目的とする超解像処理装置の使用を示すブロック図である。

【図３ａ】エンコーダにおける超解像処理装置の使用を示すブロック図である。
【図３ｂ】デコーダにおける超解像処理装置の使用を示すブロック図である。
【図４ａ】レイヤ間予測を用いるエンコーダにおける超解像処理装置の使用を示すブロック図である。
【図４ｂ】レイヤ間予測を用いるデコーダにおける超解像処理装置の使用を示すブロック図である。
【図５】一般的なケースを対象とした残差補間を示すフロー図である。
【図６ａ】２倍スケール比及び２タップバイリニア補間フィルタという具体的なケースを対象とする残差及び補間残差の位置を示す図である。
【図６ｂ】２倍スケール比及び２タップバイリニア補間フィルタという具体的なケースを対象とする残差補間を示すフロー図である。

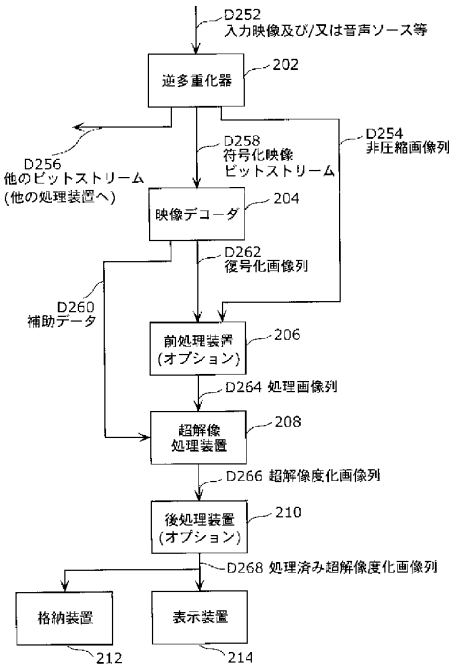
【図１ａ】



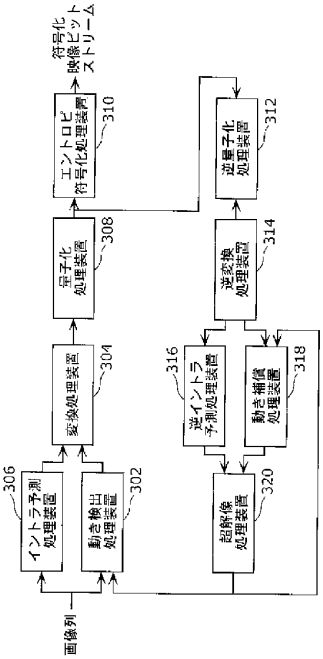
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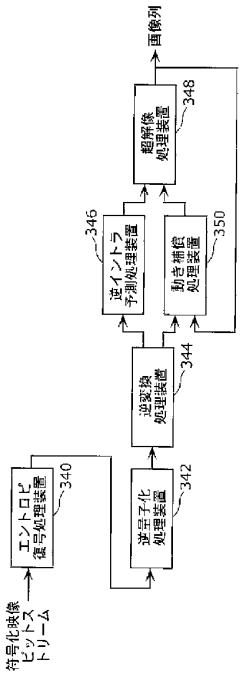
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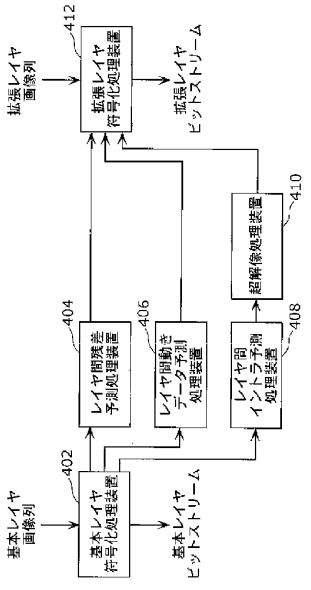
【図３ａ】



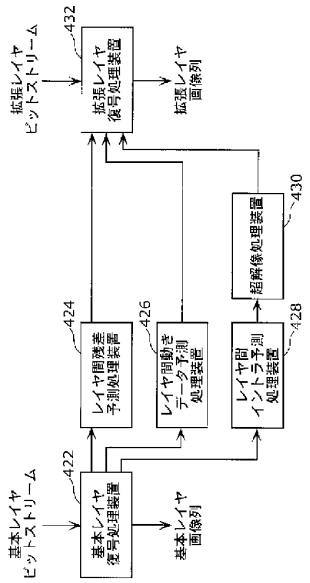
【図３ｂ】



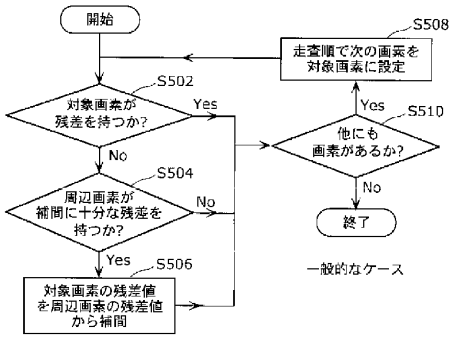
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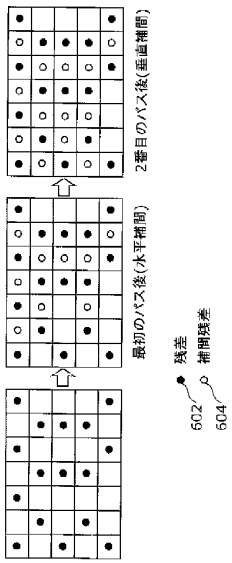
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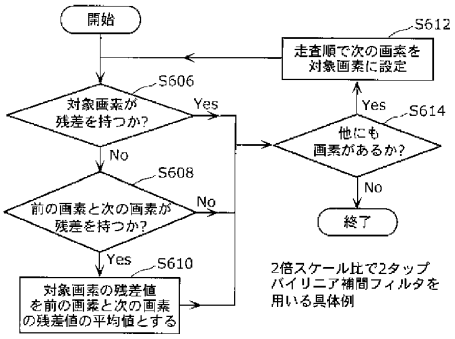
【図５】



【図６ａ】



【図６ｂ】



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GG17 JJ02 JJ07 KK14 KK20
5C082 AA12 AA21 AA32 AA37 BA20 BA41 BB02 BB15 BB22 BD01
BD02 CA21 CA32 CA84 DA55 DA65 DA86 MM01

【外国語明細書】

TITLE OF THE INVENTION

Method and apparatus for super resolution processing with residual interpolation

DETAILED DESCRIPTION OF THE INVENTION

Industrial Field of Utilization

This invention can be used in any image and video processing, more particularly, in image and video super resolution processing.

Background and Prior Art

Super-resolution processing is a technique to produce high resolution images from a plurality of low resolution images. It can be used in display devices such as PDP (Plasma Display Panel), LCD (Liquid Crystal Display), and also CRT (Cathode Ray Tube) monitor, to enhance the resolution and quality of the input sequence of images for display purposes. When used in a recording device, such as a harddisk recorder or a DVD (Digital Versatile Disc) recorder, it can enhance the resolution and quality for transcoding or storage purpose. Super-resolution can also be used for printing purposes, whereby a series of images from a camcorder or digital camera can be processed to form a single high resolution, high quality image. Similarly, in surveillance application, it can enhance the resolution and quality of faces and vehicle number plate.

One method for super resolution processing involves image registration, whereby the observed low resolution images are motion compensated and warped into a common high resolution grid, referred to as the registered image. The initial estimate for the high resolution frame is obtained by spatial interpolation method such as bicubic interpolation. This estimate is iteratively refined by a process of blurring; frame difference; inversed point spread function; regularization; and refinement. A residual image is produced during the frame difference operation, whereby the registered image is subtracted from the blurred high resolution estimate. Details of super resolution processing can be found in various prior art including patent US 2004/0156561 A1, and patent US 2005/0019000 A1 for example.

Problems to be solved

A good registered image is importance for getting a good super-resolved image. Good registration includes accurate motion estimation, and also sub-pixel shifts between the current image and the neighbouring images. When there is a lack of sub-pixel shifts, the registered image will contain missing pixels. Consequently, it results in the residual image having similar missing pixels. The corresponding missing pixels in the high resolution estimate will undergo less refinement compared with those non-missing pixels. The problem is that these missing pixels occurs in a periodic manner, and results in the appearance of grid artifacts. Visually, it makes edges look jaggy or saw-tooth shape. For example, in a 2x resolution upsampling case, it can result in an alternating pattern, with one pixel brighter, the next pixel darker, and then brighter, and so on.

Means of Solving the Problems

In the current invention, residual interpolation is used to solve the mentioned problem of grid artifact. Residual interpolation involves interpolating the residual value of the missing pixels from the neighboring non-missing pixels residual value.

Effects of Invention

What is novel about this invention is that residual interpolation is used to prevent grid artifact. Regularization can also prevent grid artifact by applying smoothness constrain to the high resolution estimate. However, it is applied on the entire image and the strength of the smoothing needs to be controlled. Blurring will occur for regions which do not require smoothing, and also when the strength is not appropriately set, over blurring or under blurring will occur.

Residual interpolation is applied for missing pixels and hence will not blur the regions with non-missing pixels. Also, the strength of residual interpolation is naturally taken care of by the value of the residual itself. When residual value is high, so will the interpolated value, and vice versa.

The result is a better super resolution algorithm producing sharper images compared with using regularization.

Residual interpolation can be used together with regularization, whereby the strength of regularization can be reduced to prevent over blurring.

Best Mode for Carrying out the Invention

Post-processing or pre-processing apparatus

Referring to figure 2, a block diagram depicting the use of super resolution processor in a post-processing or pre-processing apparatus is shown. The input **D252** consists of video and/or audio source, etc. If required, a demuxer **202**, is used to separate the video source from the other source. If required, the other source or the other bitsreams **D256**, are processed by other processor. The video source may be compressed, and in this case, the encoded video bitstream **D258** is decoded by a video decoder **204**, producing decoded sequence of images **D262**. The video source may also be uncompressed, and in this case, the uncompressed sequence of images **D254** is used. An optional pre-processor **206** may be used to process the sequence of images **D262** and **D254**, producing processed sequences of images **D264**. A super-resolution processor **208** processes the sequence of images, producing super resolution enhanced sequence of images **D266**. The super resolution processor **208** includes residual interpolation. Optionally, if the video source is compressed, auxiliary data **D260** from the encoded video bitstream can be used by the super resolution processor. Examples of auxiliary data include motion vectors, quantization parameters, and deblocking filter strength. The super resolution enhanced sequence of images may undergo further processing by post-processor **210**. The processed super resolution enhanced sequence of images **D268**, can be displayed using display devices **214**. Optionally, it can be stored using storage devices **212**. Additionally, the storage devices **212** may employ compression for storage.

Encoding apparatus and decoding apparatus

Referring to figure 3a and figure 3b, two block diagrams depicting the use of super resolution processor in an encoding apparatus (encoder) and decoding apparatus (decoder) are shown respectively. In the encoder, a sequence of images can undergo intra coding or inter coding. An intra prediction processor **306** performs prediction using current frame information. A motion estimation processor **302** performs motion compensated prediction by referencing other frames. The resulting images from processor **302**, and **306**, are then processed by transformation processor **304**, quantization processor **308**, and then entropy processor **310** producing an encoded video bitstream. A local decoder comprising of inverse quantization processor **312**, inverse transformation processor **314**,

motion compensation processor **318**, and inverse intra prediction processor **316** are used to reconstruct the current frame, which will be stored as reference frame used by motion estimation processor **302**. In the present invention, a super resolution processor **320** is used to enhance the quality and resolution of the reference frame used by the motion estimation processor **302** and motion compensation processor **318**. The super resolution processor **320** includes residual interpolation. Optionally, auxiliary data such as motion vectors, quantization parameters, and deblocking filter strength can be used by the super resolution processor **320**.

In the decoder, the sequence of images are reconstructed from the encoded video bitstream using entropy decoding processor **340**, inverse quantization processor **342**, inverse transformation processor **344**, inverse intra prediction processor **346**, and motion estimation processor **350**. A super resolution processor **348** is used to enhance the quality and resolution of the reference frame similar to the encoder. The super resolution processor **348** includes residual interpolation. Optionally, auxiliary data such as motion vectors, quantization parameters, and deblocking filter strength can be used by the super resolution processor **348**. Additionally, the displayed images are also enhanced by the super resolution processor **348**.

The encoder and decoder described is a simplified version. There are currently encoders and decoders which uses advanced tools such as deblocking-filter to further enhance the quality of the images. The current invention does not specified that encoding and decoding must be performed exactly as shown in figure 3a, and 3b. It is used only as an example to explain that super resolution can be utilized in an encoder and decoder to improve the coding efficiency or picture quality, by enhancing the reference frames used for motion estimation, motion compensated prediction and for display.

Inter-layer prediction encoding apparatus and decoding apparatus

Referring to figure 4a and 4b, two block diagrams depicting the use of super resolution processor for inter-layer intra prediction in an encoding apparatus (encoder) and decoding apparatus (decoder) are shown respectively. Inter-layer prediction is used for layered coding to improve the coding efficiency. One example of layered coding using inter-layer prediction is the working draft of the scalable extension to ISO/IEC 14496-part 10, also known as scalable video coding. A base-layer encoding processor **402** is used to encode the base-layer sequence of images. An enhancement-layer encoding processor **412** is used to encode the enhancement-layer sequence of images. Inter-layer prediction is used by the enhancement-layer encoding processor **412** to remove redundancy between the enhancement-layer and base-layer, improving the coding efficiency compared with coding the enhancement-layer alone. Inter-layer residual prediction processor **404** is used to remove the redundancy between the enhancement-layer residual and the base-layer residual. An inter-layer motion data prediction processor **406** is used to remove redundancy between motion data in the enhancement-layer and base-layer. Examples of motion data include the partition size and types used by each macroblock, the prediction direction, and the motion vectors. An inter-layer intra prediction processor **408** make use of the intra images of the base layer or the reconstructed images of the base layer as additional reference images for coding of the enhancement layer images. A super resolution processor **410** is used to enhance these additional reference images. The super resolution processor **410** includes residual interpolation. Optionally, auxiliary data such as motion vectors, quantization parameters, and deblocking filter strength can be used by the super resolution processor **410**.

In the decoder, a base-layer decoding processor **422** is used to decode the base-layer bitstream. The enhancement-layer decoding processor **432** makes use of the inter-layer residual prediction processor **424**, inter-layer motion data prediction processor **426**, and inter-layer intra prediction processor **428** to decode the enhancement-layer bitstream. Similar to the encoder a super resolution processor **430** is used to enhance the reference pictures from the inter-layer intra prediction processor **428**. The super resolution processor **430** includes residual interpolation. Optionally, auxiliary data such as motion

vectors, quantization parameters, and deblocking filter strength can be used by the super resolution processor **430**.

Super Resolution processor

Referring to figure 1a, a block diagram depicting the processors (functional blocks) within the super resolution processor is shown. An interpolation processor **110** interpolates the frame that will be super resolution enhanced. Methods for interpolation include the well-known bi-linear interpolation, bi-cubic interpolation, and Lanczos interpolation. The interpolated image is stored in the high resolution buffer **112**. This is the initial high resolution estimate. Registration is performed for the sequence of images by the processors in **122**. This includes the motion estimation processor **102**, which computes the warping vectors between the reference frames and the current frame. The registration processor **104**, performs registration based on the warping vectors, The point spread function processor **114** blurs the high resolution estimate in the high resolution buffer **112**. The frame difference processor **106** computes the difference (residual) between the registered image and the blurred high resolution estimate. The residual interpolation processor **124** interpolates the residual value of the missing pixels from the residual values of the neighboring non-missing pixels. The inverse point spread function processor **108** back-projects the differences (residual) onto the high resolution grid. The high resolution estimate processor **116** combines the back projected difference and the smoothing constraints, producing the enhancement coefficients. The enhancement coefficients are then used to update the high resolution estimate. This completes one cycle of iteration for the enhancement process. The process repeats using processor **114**, **106**, **124**, **108**, **116**, and **118**. The iteration may continue until a predetermined number of cycles or until the value of the enhancement coefficients falls below certain threshold. Adaptive enhancement process can also be performed on a pixel by pixel level, whereby only certain pixels may be selected to undergo further enhancement process.

Referring to figure 1b, a block diagram depicting the processor (functional blocks) within the super resolution processor similar to that in figure 1a is shown. The difference is the additional illumination masking and/or illumination compensation processor **120**, and regularization processor **118**. These 2 processors are optional. For processor **120**, it computes the illumination compensation value and the illumination mask, which will be used by registration processor **104**. Processor **118** is used to compute the smoothing constrains, which will be used by processor **116**.

Residual interpolation (generic case)

Referring to figure 5, a flow diagram of residual interpolation for a generic case is shown. All the pixels in the residual image will be scanned. The scanning order can be raster scan or transposed raster scan. In raster scan, the first row is scanned from the left to right, and then the second row is scanned from the left to right, and so on until the last row. For transposed raster scan, the first column is scanned from the top down, and then the second is scanned from the top down, and so on until the last column. Other scanning order may be used. At step **S502**, the current pixel is checked whether it has a residual. In other words it checks whether the current pixel is a missing pixel. If it does not have a residual, at step **S504**, the neighboring pixels are checked whether there are sufficient residual for interpolation. For example, if a 2-tap filter is used, then there should be 2 residual values in the appropriate positions. Alternatively, the interpolation filter may be adaptively changed to suit the local characteristics of the residual image. For example, normally when 6 values are present, a 6-tap AVC filter can be used, and at the edges, when only 2 values are present, a 2-tap bilinear filter can be used. If there are sufficient residual, at step **S506**, The residual value of the current pixel is interpolated from the neighboring pixels. Step **S510** is executed when, at step **S502**, it is checked that the current pixel has a residual, or at step **S504** there is insufficient neighboring residual for interpolation, or after step **S506**. At Step **510**, it is check if there are more pixels. If not, the process ends. Otherwise, at step **S508** the next pixel in the scanning order is set as the current pixel, and the process repeats at step **S502**.

The process can be repeated and the interpolated residual for the current process are being used to interpolate more missing pixels in the next process. Also, the first residual interpolation process can be performed with raster scan and a horizontal interpolation filter, while the second residual interpolation process can be performed with transposed raster scan and a vertical interpolation filter. Such case is useful when 2D separable interpolation filters are used.

Residual interpolation (specific example)

Referring to figure 6b, a flow diagram of residual interpolation for a specific case of 2x scale ratio and a 2-tap bilinear filter is shown. Figure 6a shows an example of the position of residual **602**, and interpolated residual **604** for this specific case. Since the scale ratio is 2x, the position of missing pixels forms an alternating pattern. A two pass process is used, whereby in the first pass, horizontal interpolation is performed with raster scan and in the second pass, vertical interpolation is performed with transposed raster scan. For each pass, the following steps are performed. At step **S606**, it checks whether the current pixel has a residual. If not, at step **S608**, it checks whether the previous pixel and the next pixel in the scanning order have residual. This is because a 2-tap bilinear interpolation filter is used. If available, at step **S610**, the residual value of the current pixel is the averaged value of the previous pixel's residual value and next pixel's residual value. At step **S614**, it checks whether there are more pixels. If not, the process ends. Otherwise, at step **S612**, the next pixel in the scanning order is set as the current pixel, and the process repeats at step **S606**.

System LSI

The functional blocks of the super resolution processor with residual interpolation are typically achieved in the form of integrated circuit or LSI (Large Scale Integrated) circuit. Each of these parts can be in many single-function LSIs, or also can be in one integrated LSI. The name used here is LSI, but it may also be called IC, system LSI, super LSI, or ultra LSI in accordance with the degree of integration.

Moreover, ways to achieve integration is not only LSI, but also special circuit or general purpose processor and so forth can achieve the integration. FPGA (Field Programmable Gate Array) that can be programmed after manufacturing LSI or reconfigurable processor that can re-configure the connection or configuration of LSI can be used for the same purpose.

In the future, with advancement in manufacturing technology, a brand-new technology may replace LSI. The integration can be done by that technology. Application of biotechnology is one such possibility.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig 1a is a block diagram depicting the processors within the super resolution processor.

Fig 1b is a block diagram depicting the processors within the super resolution processor, similar to figure 1a except with the additional regularization processor and illumination masking and/or illumination compensation processor.

Fig. 2 is a block diagram depicting the use of a super resolution processor for post-processing or pre-processing.

Fig. 3a is a block diagram depicting the use of a super resolution processor in an encoder.

Fig. 3b is a block diagram depicting the use of a super resolution processor in a decoder.

Fig 4a is a block diagram depicting the use of a super resolution processor in an encoder where by interlayer prediction is used.

Fig 4b is a block diagram depicting the use of a super resolution processor in a decoder where by interlayer prediction is used.

Fig 5 is a flow diagram of residual interpolation for a generic case.

Fig 6a is a diagram depicting the position of residual and interpolated residual for a specific case of 2x scale ratio and a 2-tap bilinear interpolation filter.

Fig 6b is a flow diagram of residual interpolation for a specific case of 2x scale ratio and a 2-tap bilinear interpolation filter.

WHAT IS CLAIMED IS

1. A method for super resolution processing with residual interpolation of a sequence of images, comprising:

a step for interpolation, producing an initial high resolution estimate; (110)

a step for registration, producing a registered image; (122)

a step for repeating the following steps;

a step for blurring the high resolution estimate by using a point spread function, producing a blurred image; (114)

a step for subtracting the blurred image and registered image, producing a residual image; (106)

a step for interpolating the missing residual from the residual image by using the residual value of the neighbouring non-missing pixels; (124)

a step for back projecting the residual image by using an inverse point spread function, producing a back-projected image; (108)

a step for combing the smoothing image and the back-projected image, producing the enhancement coefficients; and (116)

a step for updating the enhancement coefficients to the high resolution estimate, producing a new high resolution estimate. (112)

2. A method for registration, producing a registered image, as claimed in claim 1, comprising:

a step for motion estimation, producing warping vectors; and (102)

a step for registration based on the warping vectors, producing a registered image. (104)

3. A method for interpolating the missing residual from the residual image by using the residual value of the neighbouring non-missing pixels, as claimed in claim 1, comprising:

a step for checking whether the current pixel has a residual value; (S502)

a step for checking whether the neighbouring pixels have sufficient residual for interpolation, if the current pixel does not have a residual value; (S504)

a step for interpolating the residual value of the current pixel from the residual values of the neighbouring pixels, if the current pixel does not have a residual value and the neighbouring pixels have sufficient residual for interpolation ; (S506)

a step for checking whether there are more pixels; (S510)

a step for setting the current pixel as the next pixel in the scanning order, if there are no more pixels; (S508)

a step for repeating the process from the step for checking whether the current pixel has a residual value, if there are no more pixels; and

a step for ending the process when it is checked that there are no more pixels.

4. The method for interpolating the missing residual from the residual image by using the residual value of the neighbouring non-missing pixels, as claimed in claim 3, wherein said scanning order, can be raster scan or inverse raster scan, or any arbitrary scanning sequence.

5. A method for interpolating the missing residual from the residual image by using the residual value of the neighbouring non-missing pixels, as claimed in claim 1, further comprising:

a step for repeating the method as claimed in claim 3, so that the interpolated residual values can be used to further produce new interpolated residual values.

6. A method for interpolating the missing residual from the residual image by using the residual value of the neighbouring non-missing pixels, as claimed in claim 1, further comprising:

a step for using different scanning order for each pass of residual interpolation.

7. Another method for interpolating the missing residual from the residual image by using the residual value of the neighbouring non-missing pixels, as claimed in claim 1, comprising:

a step for checking whether the current pixel has a residual value; (S606)

a step for checking whether the previous pixel and the next pixel have residual, if the current pixel does not have a residual; (S608)

a step for interpolating the residual value of the current pixel from the residual values of the previous pixel and next pixel, if the current pixel does not have a residual value and the previous pixel and next pixel have residual value; (S610)

a step for checking whether there are more pixels; (S614)

a step for setting the current pixel as the next pixel in the scanning order, if there are no more pixels; (S612)

a step for repeating the process from the step for checking whether the current pixel has a residual value, if there are no more pixels; and

a step for ending the process when it is checked that there are no more pixels.

8. An apparatus for super resolution processing with residual interpolation of a sequence of images, comprising:

a means for interpolation, producing an initial high resolution estimate; (110)

a means for registration, producing a registered image; (122)

a means for repeating the following steps;

a means for blurring the high resolution estimate by using a point spread function, producing a blurred image; (114)

a means for subtracting the blurred image and registered image, producing a residual image; (106)

a means for interpolating the missing residual from the residual image by using the residual value of the neighbouring non-missing pixels; (124)

a means for back projecting the residual image by using an inverse point spread function, producing a back-projected image; (108)

a means for combing the smoothing image and the back-projected image, producing the enhancement coefficients; and (116)

a means for updating the enhancement coefficients to the high resolution estimate, producing a new high resolution estimate. (112)

9. A LSI (Large Scale Integrated) circuit for super resolution processing with residual interpolation of a sequence of images, comprising:

a unit for interpolation, producing an initial high resolution estimate; (110)

a unit for registration, producing a registered image; (122)

a unit for repeating the following steps;

a unit for blurring the high resolution estimate by using a point spread function, producing a blurred image; (114)

a unit for subtracting the blurred image and registered image, producing a residual image; (106)

a unit for interpolating the missing residual from the residual image by using the residual value of the neighbouring non-missing pixels; (124)

a unit for back projecting the residual image by using an inverse point spread function, producing a back-projected image; (108)

a unit for combing the smoothing image and the back-projected image, producing the enhancement coefficients; and (116)

a unit for updating the enhancement coefficients to the high resolution estimate, producing a new high resolution estimate. (112)

10. An apparatus for super resolution processing with residual interpolation in a pre-processor or post-processor, comprising:

a means for demuxing the input source if required, producing uncompressed sequence of images or encoded video bitstream and other bitstreams; (202)

a means for decoding the encoded video bitstream if required, producing a decoded sequence of images and optionally, auxiliary data; (204)

a means for optionally pre-processing the decoded sequence of images or the uncompressed sequence of images, producing a processed sequence of images; (206)

a means for super resolution processing with residual interpolation, as claimed in claim 1 to 9, of the processed sequence of images, producing super resolution enhanced sequence of images; (208)

a means for optionally post processing the super resolution enhanced sequence of images, producing processed super resolution enhanced sequence of images; (210)

a means for optionally storing the processed super resolution enhanced sequence of images, with optional compression; and (212)

a means for optionally displaying the processed super resolution enhanced sequence of images. (214)

11. An apparatus for super resolution processing with residual interpolation in an encoder, comprising:

a means for intra prediction; (306)

a means for motion estimation; (302)

a means for transformation; (304)

a means for quantization; (308)

a means for entropy coding; (310)

a means for inverse quantization; (312)

a means for inverse transformation; (314)

a means for inverse intra prediction; (316)

a means for motion compensation; and (318)

a means for super resolution processing with residual interpolation, as claimed in claim 1 to 9, of reference images used by the motion estimation and motion compensation. (320)

12. An apparatus for super resolution processing with residual interpolation, in a decoder, comprising:

a means for entropy decoding; (340)

a means for inverse quantization; (342)

a means for inverse transformation; (344)

a means for inverse intra prediction; (346)

a means for motion compensation; and (350)

a means for super resolution processing with residual interpolation, as claimed in claim 1 to 9, of reference images used by the motion compensation. (348)

13. An apparatus for super resolution processing with residual interpolation in an encoder where inter-layer prediction is used, comprising:

a means for encoding the base layer; (402)

a means for encoding the enhancement layer with inter-layer prediction; (412)

a means for inter-layer residual prediction between the enhancement layer and base layer; (404)

a means for inter-layer motion data prediction between the enhancement layer and base layer; (406)

a means for inter-layer intra prediction between he enhancement layer and base layer; and (408)

a means for super resolution processing with residual interpolation, as claimed in claim 1 to 9, of the intra images or decoded images of the base layer that is used as additional reference for coding the enhancement layer. (410)

14. An apparatus for super resolution processing with residual interpolation in a decoder where inter-layer prediction is used, comprising:

a means for decoding the base layer; (422)

a means for decoding the enhancement layer with inter-layer prediction; (432)

a means for inter-layer residual prediction between the enhancement layer and base layer; (424)

a means for inter-layer motion data prediction between the enhancement layer and base layer; (426)

a means for inter-layer intra prediction between he enhancement layer and base layer; and (428)

a means for super resolution processing with residual interpolation, as claimed in claim 1 to 9, of the intra images or decoded images of the base layer that is used as additional reference for decoding the enhancement layer. (430)

ABSTRACT

Super-resolution is an image and video processing technique for improving the resolution and quality of a sequence of images. Provided is a method and apparatus for performing super resolution with residual interpolation. Residual interpolation involves interpolating the residual value of the missing pixels from the residual values of the neighbouring non-missing pixels. This reduces the grid artifacts in the super resolved image.

Representative Drawing

Figure 1a

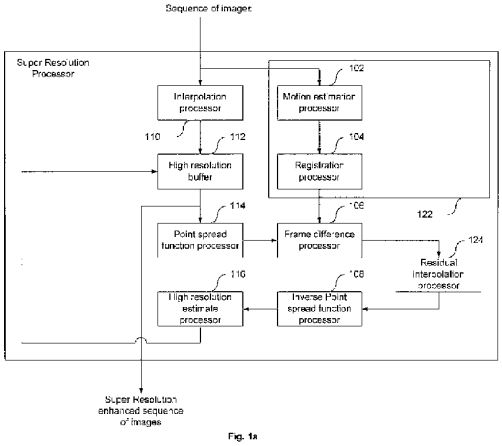


Fig. 1a

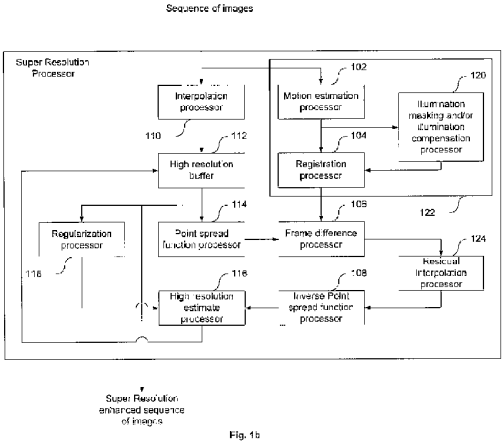


Fig. 1b

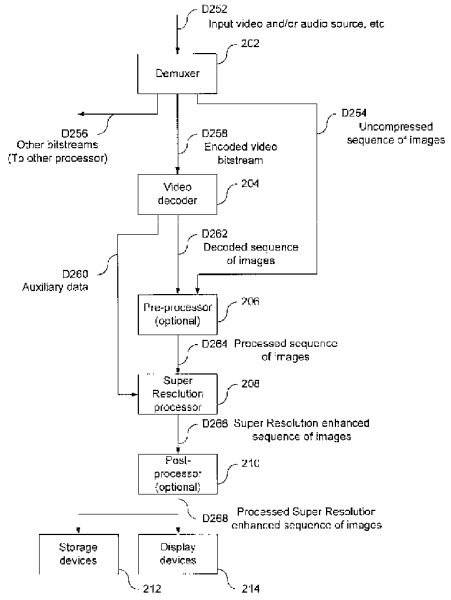


Fig. 2

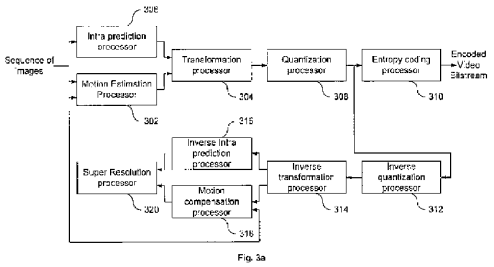


Fig. 3a

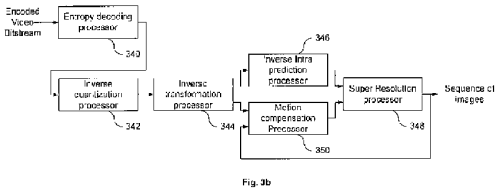


Fig. 3b

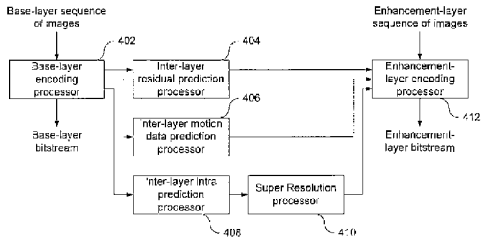


Fig. 4a

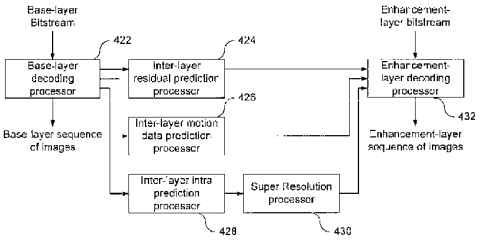


Fig. 4b

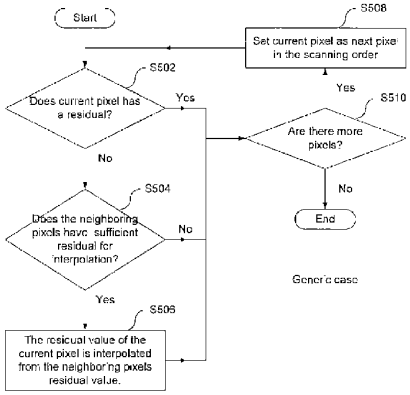


Fig. 5

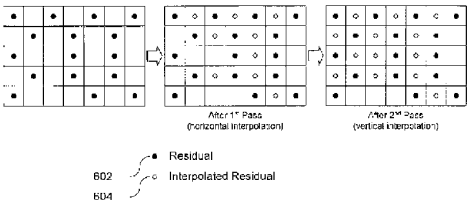


Fig. 6a

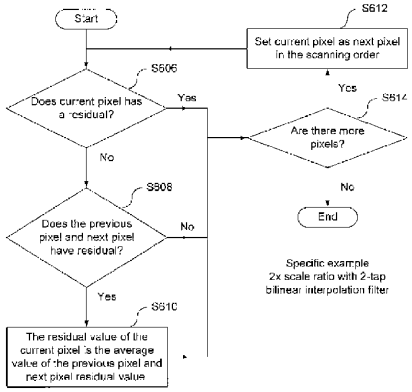

Start
S612
Set current pixel as next pixel in the scanning order
S606
Does current pixel has a residual?
Yes
No
S614
Are there more pixels?
Yes
No
End
S608
Does the previous pixel and next pixel have residual?
No
Yes
S610
The residual value of the current pixel is the average value of the previous pixel and next pixel residual value
Specific example
2x scale ratio with 2-tap
bilinear interpolation filter

Fig. 6b

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
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		or ("20070189385") or ("20060050974") or ("20110228857") or ("6122433") or ("20090296809") or ("20100020870") or ("20080304562") or ("20090147857") or ("7957465") or ("20080130740") or ("20120230393") or ("20080123737") or ("20020191851") or ("20010016010") or ("6301428") or ("20060045491") or ("20090296811") or ("20080137731") or ("20110170001") or ("20070280350") or ("20080130756") or ("20080137732") or ("20080123972") or ("20060268982") or ("20080123736") or ("20080111897") or ("20040120404") or ("20130135433") or ("20040234145") or ("20050147174") or ("20050025250") or ("20110051811") or ("6047100") or ("7181131") or ("20060133480") or ("20030007559") or ("20020039384") or ("20120163449") or ("20020041632") or ("20080124050") or ("20130136169") or ("20090190666") or ("20090028239") or ("20110038412") or ("20070223575") or ("20070003149") or ("20050281334") or ("20090180537") or ("20120099644") or ("20110032999") or ("20100086059") or ("20060114995") or ("20010046263") or ("20110019973") or ("20090010332") or ("20110249749") or ("20110235714") or ("20050094728") or ("20110142123") or ("20030138052") or ("20080304561") or ("20070160152") or ("20120002720") or ("20090080534") or ("20090220008") or ("20090147848") or ("20040156438") or ("20020031184") or ("20110255594") or ("20030138050") or ("20130170548") or ("20080170627") or ("6081295") or ("20120027087") or ("20060048193") or ("20090225866") or ("20060098215") or ("6480630") or ("20100215100") or ("20100158116") or ("20130170561") or ("20040091159") or ("20100135385") or ("20090122877") or ("20070121722") or ("20120230394") or ("20050147172") or ("20070195737") or ("20020122495") or ("20010019585") or ("20090129471") or ("20110096713") or ("20060149763") or ("20070189395") or ("20120027082") or ("20110299600") or ("20090116820") or ("20060280372")).PN. or (("20100316124") or ("20080317136") or ("20060029132") or ("20110194621") or ("20100195714") or ("20100303369") or ("6707778") or ("20090220000") or ("20020159526") or ("20090323803") or ("20110293017") or ("20070126853") or ("20070296826") or ("20070053425") or ("20110293008") or ("20060239359") or ("20110293016") or ("20060034371") or ("20090028427") or ("20050147160") or ("20090232221") or ("20110188572") or ("20040228403") or ("20100034269") or ("20060126728") or ("20100135394") or ("20040208481") or ("20110286530") or					

		("6990244") or ("20020090030") or ("20020145702") or ("7072491") or ("20080212683") or ("7212576") or ("20040013399") or ("20050281329") or ("20020181597")).PN.				
S48	82	S44 and (super$1resolution or "super resolution") and (svc or (scalab$6 near2 (cod$4 or encod$4 or decod$4))) and (image$1 or video)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/08/28 16:11
S49	15	S47 and (super$1resolution or "super resolution") and (svc or (scalab$6 near2 (cod$4 or encod$4 or decod$4))) and (image$1 or video)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/08/28 16:11
S50	63	S47 and (super$1resolution or "super resolution") and (cod$4 or encod$4 or decod$4) and (image$1 or video)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/08/28 16:13
S51	35	(super$1resolution or "super resolution") and (enhancement near2 layer) and (base near2 layer) and (image$1 or video)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/08/28 17:21
S52	4698	victor near2 company near2 japan.as.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/08/28 18:09
S53	1	S52 and (super$1resolution or "super resolution") and (svc or (scalab$6 near2 (cod$4 or encod$4 or decod$4))) and (image$1 or video)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/08/28 18:09
S54	104	S52 and (super$1resolution or "super resolution")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/08/28 18:09
S55	29	S52 and (super$1resolution or "super resolution") and video	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/08/28 18:09

S59	4920	sung near2 park.in.	US-PGPUB; USPAT	OR	ON	2013/08/29 14:39
S60	1462	S59 and imag$4	US-PGPUB; USPAT	OR	ON	2013/08/29 14:39
S61	264	S60 and resolution	US-PGPUB; USPAT	OR	ON	2013/08/29 14:39
S62	3	S60 and (super near2 resolution)	US-PGPUB; USPAT	OR	ON	2013/08/29 14:40
S63	7	S59 and (super near2 resolution)	US-PGPUB; USPAT	OR	ON	2013/08/29 14:40
S64	7	S59 and (super near2 resolution)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/08/29 14:41
S66	11	satoru near2 sakazume.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/08/29 14:47
S67	55	shimauchi near2 kazuhiro.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/08/29 14:48
S68	80	kumakura near2 toru.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/08/29 14:54
S69	171	ueda near2 motoharu.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/08/29 14:58
S70	94	S69 and cod$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/08/29 14:58
S71	1	(pixel near2 insert$4) and filter$4 and (pixel near2 thin$4) and resolution and position$$ and interpolat$4 and enlarg$6 and repetition	US-PGPUB; USPAT	OR	ON	2013/08/29 15:57
S72	19	(pixel near2 insert$4) and filter$4 and (pixel near2 thin$4) and resolution and position$$ and interpolat$4 and enlarg$6	US-PGPUB; USPAT	OR	ON	2013/08/29 15:58

S73	455	(resolution near2 enlarg$6) and (resolution near2 conver$4)	US-PGPUB; USPAT	OR	ON	2013/08/29 16:02
S74	18	(super near2 resolution near2 enlarg$6) and (resolution near2 conver$4)	US-PGPUB; USPAT	OR	ON	2013/08/29 16:03
S76	59339	(H04N19/00436 OR H04N19/00472 OR H04N19/00521 OR H04N19/00757 OR H04N19/00781 OR H04N19/00884 OR H04N19/0089).CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/16 14:00
S77	5	S76 and (super near2 resolution near2 enlarg$6) and (resolution near2 conver$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/16 14:01
S80	39	S76 and (super near2 resolution) and (resolution near2 conver$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/16 14:07
S81	7827	(h04n7/50 or h04n7/26244 or h04n7/26271 or h04n7/26015 or h04n7/26031).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/16 14:29
S82	4	S81 and (super near2 resolution) and (resolution near2 conver$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/16 14:29
S83	22	S81 and (super near2 resolution)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/16 14:30
S84	41	S81 and (resolution near2 conver$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/16 14:51
S85	2193	(parallel near3 (process$4 or encod$4 or cod$4 or decod$4)) and (resolution near2 conver$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/16 15:11

S86	82	(parallel near3 (process$4 or encod$4 or cod$4 or decod$4)) and (resolution near2 conver$4) and ("super-resolution" or "super resolution")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/16 15:13
S87	117	(S76 or S81) and (parallel near3 (process$4 or encod$4 or cod$4 or decod$4)) and (resolution near2 conver$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/16 15:40
S88	11	CN102084657B US20130163673 US20130182776 US20130163676 US20130170558 CN102084657A WO2012033962A2 JP2010220001A WO2012033966A1 EP0935395A2 US20110176604 US20130170544 US6483945 US20020181595 US20090010559 US20130163661 WO2012033967A1 US20010010707 US6792045 US7925108 US20130163679 WO2012033963A2 US20090110056 US20110229046 US6574274 US20130170564 US6271774 US20070263731	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/16 15:46
S89	37	US20110229028 US20130170746 US20110292995 WO2012033965A1 WO2012033970A1 EP1811784A1 WO2012033964A1 US6310915 EP1860886A1 US20110298974 WO2012033972A1 WO2006038679A1 US6785464 US6456661 US20040022318 WO2012033971A1 US8559526 US8145006 US7715477 US20070116130 WO1998010593A2 US8023561 US20040017852 US7386049 US20110096226 US7656950 US20040017853 US5987179 WO2009145271A1 CN102823242A US8036268 US20040264566 JP2003153271A US20110002382 US20070077023 US6915018 CN102986220A US20020061184 US20080095228 US20080031328 WO2008053557A1 JP2010011448A WO2008047257A2 US20060262861 WO2000030359A1 US6141059 US6414999 US7397858 US6795499 US20040264580 US7394851 WO2011090790A8 US8428116 AU2009299222A1 US7366240 US20070047662 US6339619 WO2001035411A4 US20070165715 US20070154185 US20010006562 US20090168866 WO2009005071A1 US6959042 US20070153913 US20070153893 WO2007095640A2 US20020001411 US20070153895 US20040080669 US6567471 US20070153911 US20070160141	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/16 15:48

		US20070153894 US6097842 US20100061445 US8223847 US20030067989 US5828421 US20070047661 EP1773065A2 US20070058729 US8023754 US7139316 US6459812 US20070153912				
S90	37	US6389173 US6427027 US20030142747 CN103210645A AU2001012471A US20110216836 EP1811787A2 EP1793616A2 US7711051 US20100054338 US20110249738 EP1793615A2 US20060126952 WO2007115133A2 US20080260026 AU1997041371A EP1469681A1 EP1659532A3 AU1997041371B2 US20050084162 WO2012105959A1 EP1058262A2 WO2006040896A1 US20040008774 EP0979010A2 US7212576 US20040141653 EP1793612A2 US6580755 EP1793614A2 EP1465430A2 WO2001035411A1 CN103141092A US8213516 EP2012546A2 US7643690 EP1445773A1 EP1793613A2 US6038256 US20020090135 US7116827 EP1806929A1 EP1811788A2 US6292585 US6950556 US7184600 US20090016437 WO2006008681A1 US20050084159 US20050089230 US6567561 US20030053704 US6307967 US20030038982 US20060204112 US20050084163 US20050084165 EP0923243B1 US7460719 WO2012033963A3 US6961471 WO2012033962A3 EP0923243A1 US6934416 US20050084160 US20050084164 US6879724 US6987887 US6154495 US7298911 US6754268 US5969768 WO2012033963A8 US6546138 US7031532 US6480630 WO2007081752A2 US5883678 US20070286283 US6330364 US6687296 CN102823243A US6975768 US6088486 EP1819170A1 EP1467563A1 US6353684 WO2006044370A1 US6330284 US20080075164 US6130913 US6125140 US6466624 US6343156 WO2004114672A1 US6393059 US6990244 US6094457 US7072491 US6724436 EP0926898A1 EP1209911A2 JP05115058A US20060045188 US20110007823 US20080253448 AU2001061874B2 EP1659532A2 EP0966161A2 US6192083 US20080253450 US20140003519 WO2014006267A1 WO2003107678A1 AU2007205175A1 US20010053182 US6141447 AU2010219337A1 US6339620 US20010021260 EP0731422B1 US20120195365 WO2013055806A1 US7899121 AU2012201234A1 US20100290537 US6256451	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/16 16:01
S91	32	AU2001061874A1 US6160844	US-PGPUB;	OR	ON	2014/01/16

		US20100080291 US20050002454 AU2007205175B2 US20120014434 WO2004114671A2 US6400768 US20080152020 WO2003036981A1 AU2007234543A1 US20070263087 US20080232464 US20080013625 US20110142129 US5699117 US20080013627 EP2088554A2 US20090285302 US20070263719 US20020037161 WO2013055808A1 JP2003102005A US20080013626 US20030016755 EP2667603A1 US8406292 US20080008237 US20030128766 US20080044157 US20080044156 US6587506 WO2011071754A1 WO2013156678A1 EP1085465A2 WO2011143599A1 EP2403248A1 WO2008133910A2 US6853378 WO2011090790A1 EP0948211B1 AU1996064209B2 WO2005055613A1 US6636640 US7469007 US20060190625 EP1793618B1 EP0731422A2 US6560282 US8254458 US20020159755 US5475435 US20030080980 AU2011228218A1 US20040086190 US20060034522 US20100086048 EP2337357A1 US7558465 US7272185 WO1997039584A1 US20020181793 US8019169 US20040086189 EP1085465B1 US8467459 US20060280244 US20110211122 WO2013160277A1 US20070160153 JP2009267573A US20120013717 AU2001018359A1 US20130271651 AU1996064209B AU2001018359B2 US20060146931 US8619865	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			16:14
S92	46	AU1996064209A AU1996043310A US20050254010 US6546189 US7148908 AU1997023590B AU1997023590A US6198851 US20030128292 US8135234 EP2265028A2 US6621933 US20080019444 WO2009073075A1 US20100150229 US20030012561 US20120002728 US20020059643 AU2000042645B2 WO2010021665A1 US7746931 US20140003508 US8295347 EP1976300A2 US7126993 WO2009131830A1 AU2007214423C1 US20060291570 JP2006115051A US20040228409 US7376341 EP1313326A2 US20100220939 AU2007214423B2 US20120294355 WO1999033024A1 US20130089135 US5253056 US20120128072 US20080095450 US5270813 US8170118 US20060193384 US20080089428 US7889937 AU1996043310B US20130089154 US20010028404 US6349154 US20090129759 AU2003273187B2 US20030185456 US20060045467 CN101040531A AU2003273187A1 US20010048719 EP2416580A2 WO2006068401A1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/16 16:28

		AU1997019395A EP1085465A9 EP1786212A1 US20090316787 AU2000042645A1 US20090168900 US20130051458 US20010021303 US20060133490 AU2001018353A1 EP0596423A2 AU2007214423A1 WO2010090629A1 US8385427 WO2004008776A1 EP1255249B1 WO2012052968A1 JP06303594A US8179420 US6310962 US8442120 EP0942605A2 EP0948211A2 US20100020883 US20050002458 US20070230568 WO2001058170A1 WO2007003340A2 US5907374 AU2001018353B2 EP1981280A2 AU2010219337B2 EP1991007A3 US20060034369 EP1309203A2 US20110280311 US20090028239 US7933494 JP2012060306A WO2012036467A2 US20020081094 WO2007076486A2 US20060072673 US8036266 EP1769633B1 EP1596609A2 EP2249567A1 US20060233252 US8131135 US6477202 EP2205003A2 EP0914007B9 US6763067 US7292782 EP2613534A2 US8243820 EP2568705A1 US20060256868 WO2010033151A1 US8306126 US8260122 US20080205508 US6748018 US20030002583 US20110280316 US20020030684 US8107528 EP0914007B1 US20060013297 US20100124278 US20110194604 WO1996035998A1 EP2360843A2 AU2007311526A1 US20100142614 EP1703734A1 AU2004229732A1			
S93	53	WO2002032207A2 US5227878 US6535558 US20070053444 US20100189418 US20120294369 WO2007129840A1 AU1996055477B US20110157470 US8139150 AU1995020529A EP0944264B1 US6301428 US20060093032 US6782132 WO2007089696A2 US8358701 WO1998041011A1 US7209635 US20050018770 EP0596423B1 EP1628485A3 WO2001033861A1 EP1988720A2 US6674796 US20090202162 WO2004034330A1 AU1999028124A US20110064321 US20040170330 US20140003504 US6621865 EP1976301A2 US20050053133 US20130107941 US6493389 US20060072672 US20060280250 EP1215911A2 US7957610 US20070036218 EP1230642A1 AU1999048798A1 US20020110192 AU1999048798B2 US20070247529 US8335256 US20120262630 US20050254577 WO2007005750A2 US20130083847 US20060171463 WO2011091301A1 US5376971 US20050249289 US20010033619 US6408099	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/16 16:33

		US20030012552 CA2798354A1 US20080152013 US20080144714 US20100220785 US20080144720 US7675971 US20120328019 EP1255249B2 WO2013022540A1 WO1997003443A1 WO1999051033A2 US20070009024 US6795498 US8243813 US6724977 US20060120466 AU1996055477A US20010001016 US7496236 EP0944264A2 US6526178 WO2003026300A1 JP2002016921A US20020067768 US20110243252 US20010001621 US7609900 US8149913 WO2010067529A1 US6408096 US7518630 WO2005022921A1 AU1994070409A EP0590800A2 EP1098526A2 US6563954 US8320450 US6064748 US7956930 US20060233259 US20020136461 US6441754 US6556627 US6181743 AU1996054538A EP0577337A2 US6421465 EP1725043A2 AU1996055520B US20120069905 EP0579395A1 US6956600 AU2010231805A1 US20120269275 US6480628 EP1193983A2 US7697609 JP2009027535A AU1995020529B US6549720 US20120063692 US7539347 US20120275512 AU2003261923A1 EP0771119A2 US20120294367 US20050063466 US6597858 US5815209 US20130300923 US7606124 WO2011037772A1 US20020009141 US6490321 US20120275515 WO2004093461A1 US6801574 WO2004049728A1 WO2012108200A1 EP2372922A1 US20080008245 EP1056296A2 US20010048768 AU1996055520A US20080170627 US8340191 US20090028427 AU1996055520B2 US20110075738 US20090268805 EP1793618A2 US20070002946 US20130077674 EP1821545A2 EP2429193A3 US20050226325 US20070058948 US20080130758 US20080019438 US20110038417 US20100046636 US20020090136 WO2003005728A1 US7903732 AU1994070853A WO2003056833A2 WO2013160559A1 US20010055336 EP2224745A1 US20030161404 US20060262216 EP2571268A1 EP1152622B1 EP1152622B9 US20050084167 US20130051456 USRE40079 US20030063668 JP2012004660A US8488671 US20080170793				
S106	166	(video with resolution)and((enhancement and base) with layer)and(scalable or scalability)and(standard with resolution)and(high with resolution)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/24 14:02
S107	30	(video with	US-PGPUB;	OR	ON	2014/01/24

		resolution)and((enhancement and base) with layer)and(scalable or scalability) and (standard with resolution) and (high with resolution) and ((target and reference) with (frame or image))	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			14:03
S108	74	(video with resolution)and((enhancement and base) with layer)and(scalable or scalability) and (standard with resolution) and (high with resolution) and (target and reference)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/24 14:04
S109	314	(video with resolution)and((enhancement and base) with layer)and(scalable or scalability) and ((standard or low or lower or reduced or original) with resolution) and ((higher or high or enhanced or greater) with resolution) and (target and reference)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/24 14:07
S110	240	S109 not S108	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/24 14:47
S111	1000	(("20130163673") or ("20130182776") or ("20130163676") or ("20130170558") or ("20110176604") or ("20130170544") or ("6483945") or ("20020181595") or ("20090010559") or ("20130163661") or ("20010010707") or ("6792045") or ("7925108") or ("20130163679") or ("20090110056") or ("20110229046") or ("6574274") or ("20130170564") or ("6271774") or ("20070263731") or ("20110229028") or ("20130170746") or ("20110292995") or ("6310915") or ("20110298974") or ("6785464") or ("6456661") or ("20040022318") or ("8559526") or ("8145006") or ("7715477") or ("20070116130") or ("8023561") or ("20040017852") or ("7386049") or ("20110096226") or ("7656950") or ("20040017853") or ("5987179") or ("8036268") or ("20040264566") or ("20110002382") or ("20070077023") or ("6915018") or ("20020061184") or ("20080095228") or ("20080031328") or ("20060262861") or ("6141059") or ("6414999") or ("7397858") or ("6795499") or ("7394851") or ("20040264580") or ("8428116") or ("7366240") or ("6339619") or ("20070047662") or ("20070165715") or ("20070154185") or ("20010006562") or ("20090168866") or ("6959042") or ("20070153893") or ("20070153913") or ("20020001411") or ("20070153895") or ("20040080669") or ("6567471") or ("20070153911") or	US-PGPUB; USPAT	OR	OFF	2014/01/24 16:43

		("20070160141") or ("20070153894") or ("6097842") or ("8223847") or ("5828421") or ("20100061445") or ("20030067989") or ("20070047661") or ("20070058729") or ("8023754") or ("7139316") or ("6459812") or ("6389173") or ("6427027") or ("20070153912") or ("20030142747") or ("20110216836") or ("7711051") or ("20100054338") or ("20110249738") or ("20060126952") or ("20080260026") or ("20050084162") or ("20040008774") or ("7212576") or ("20040141653") or ("6580755") or ("8213516") or ("7643690") or ("6038256") or ("7116827") or ("20020090135") or ("6292585") or ("6950556") or ("7184600") or ("20090016437") or ("20050084159") or ("20050089230") or ("6567561") or ("6307967") or ("20030053704") or ("20030038982") or ("20060204112") or ("7460719") or ("20050084163") or ("20050084165") or ("6961471") or ("6934416") or ("20050084160") or ("20050084164") or ("6879724") or ("6987887") or ("6154495") or ("7298911") or ("6754268") or ("5969768") or ("6546138") or ("7031532") or ("6480630") or ("6330364") or ("5883678")).PN. or (("20070286283") or ("6687296") or ("6975768") or ("6088486") or ("6353684") or ("6330284") or ("6130913") or ("20080075164") or ("6125140") or ("6466624") or ("6343156") or ("6393059") or ("6990244") or ("7072491") or ("6724436") or ("6094457") or ("20110007823") or ("20060045188") or ("20080253448") or ("6192083") or ("20080253450") or ("20140003519") or ("6141447") or ("20010053182") or ("6339620") or ("20010021260") or ("20120195365") or ("7899121") or ("6256451") or ("20100290537") or ("6160844") or ("20100080291") or ("20050002454") or ("20120014434") or ("6400768") or ("20080152020") or ("20110142129") or ("20070263087") or ("20080232464") or ("5699117") or ("20080013625") or ("20080013627") or ("20090285302") or ("20070263719") or ("20020037161") or ("20080013626") or ("20030016755") or ("8406292") or ("20080008237") or ("20030128766") or ("20080044157") or ("20080044156") or ("6587506") or ("6853378") or ("6636640") or ("7469007") or ("20060190625") or ("8254458") or ("6560282") or ("5475435") or ("20020159755") or ("20030080980") or ("20040086190") or ("20060034522") or ("7272185") or ("7558465") or ("20100086048") or						

		("20020181793") or ("8019169") or ("20040086189") or ("8467459") or ("20060280244") or ("20110211122") or ("20070160153") or ("20130271651") or ("20120013717") or ("20060146931") or ("8619865") or ("6546189") or ("20050254010") or ("7148908") or ("6198851") or ("6621933") or ("20030128292") or ("8135234") or ("20100150229") or ("20080019444") or ("20030012561") or ("20120002728") or ("20020059643") or ("7746931") or ("20140003508") or ("8295347") or ("7126993") or ("20060291570") or ("20040228409") or ("7376341") or ("20100220939") or ("20120294355") or ("5253056") or ("20130089135") or ("20080095450") or ("5270813") or ("20120128072") or ("8170118") or ("7889937") or ("20060193384") or ("20080089428") or ("20130089154") or ("6349154") or ("20010028404") or ("20090129759") or ("20030185456") or ("20060045467") or ("20010048719") or ("20090316787") or ("20090168900") or ("20130051458") or ("20010021303") or ("20060133490") or ("8385427") or ("8179420") or ("6310962") or ("8442120") or ("20100020883") or ("5907374") or ("20050002458") or ("20070230568") or ("20110280311") or ("20060034369")).PN. or (("20090028239") or ("7933494") or ("20020081094") or ("8036266") or ("20060072673") or ("20060233252") or ("8131135") or ("6477202") or ("6763067") or ("8243820") or ("7292782") or ("8306126") or ("20060256868") or ("8260122") or ("6748018") or ("20080205508") or ("8107528") or ("20030002583") or ("20110280316") or ("20060013297") or ("20020030684") or ("20100142614") or ("20100124278") or ("20110194604") or ("6535558") or ("5227878") or ("20100189418") or ("20070053444") or ("20120294369") or ("8139150") or ("6301428") or ("20110157470") or ("20060093032") or ("6782132") or ("7209635") or ("8358701") or ("20050018770") or ("6674796") or ("20090202162") or ("20140003504") or ("6621865") or ("20110064321") or ("20040170330") or ("20050053133") or ("20130107941") or ("6493389") or ("20060072672") or ("20060280250") or ("7957610") or ("20070036218") or ("20070247529") or ("8335256") or ("20020110192") or ("20050254577") or ("20120262630") or ("5376971") or ("20130083847") or ("20060171463") or ("6408099") or ("20050249289") or ("20010033619") or ("7675971") or ("20080152013") or ("20080144714") or						

		("20030012552") or ("20100220785") or ("20080144720") or ("20120328019") or ("20070009024") or ("8243813") or ("6724977") or ("6795498") or ("20060120466") or ("20010001016") or ("6526178") or ("7496236") or ("20020067768") or ("20110243252") or ("20010001621") or ("7609900") or ("7518630") or ("8149913") or ("6408096") or ("6563954") or ("8320450") or ("7956930") or ("20060233259") or ("6556627") or ("6064748") or ("6181743") or ("6441754") or ("20020136461") or ("6421465") or ("6956600") or ("20120069905") or ("20120269275") or ("6480628") or ("7697609") or ("6549720") or ("7539347") or ("20120063692") or ("20120275512") or ("20120294367") or ("20050063466") or ("6597858") or ("5815209") or ("20130300923") or ("7606124") or ("6490321") or ("20020009141") or ("6801574") or ("20120275515") or ("20080008245") or ("20010048768") or ("8340191") or ("20080170627") or ("20090028427") or ("20110075738") or ("20090268805") or ("20070002946") or ("20130077674") or ("20050226325") or ("20070058948") or ("20080130758") or ("20080019438") or ("7903732") or ("20110038417") or ("20100046636") or ("20020090136") or ("20030161404")).PN. or ((("20060262216") or ("20010055336") or ("RE40079") or ("20050084167") or ("20130051456") or ("8488671") or ("20030063668") or ("20030156647") or ("20080170793") or ("6522693") or ("7978762") or ("20080170624") or ("7859956") or ("8494294") or ("6028634") or ("20040190624") or ("8275036") or ("20060088098") or ("8391364") or ("8588308") or ("20090207844") or ("6567470") or ("20120014432") or ("5818531") or ("6256346") or ("8249142") or ("7020382") or ("7003036") or ("20070286289") or ("5959672") or ("6041160") or ("20090010333") or ("20050232497") or ("6519285") or ("5802240") or ("8634473") or ("5796438") or ("8422806") or ("5414469") or ("20040131118") or ("20010021273") or ("20090103603") or ("7289564") or ("6535559") or ("20080063081") or ("20060274075") or ("20030108099") or ("6643328") or ("8243803") or ("20130294502") or ("6611624") or ("20020122486") or ("7974345") or ("20080089404") or ("6842539") or ("20030133502") or ("20020114391") or ("20100067580") or ("20060109900") or ("20120314771") or					

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S112	28	S111 and (video with resolution)and((enhancement and base) with layer)and(scalable or scalability) and ((standard or low or lower or reduced or original) with resolution) and ((higher or high or enhanced or greater) with resolution) and (target and reference)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/24 16:43
S113	66	(("20130163673") or ("20130182776") or ("20130163676") or ("20130170558") or ("20110176604") or ("20130170544") or ("6483945") or ("20020181595") or ("20090010559") or ("20130163661") or ("20010010707") or ("6792045") or ("7925108") or ("20130163679") or ("20090110056") or ("20110229046") or ("6574274") or ("20130170564") or ("6271774") or ("20070263731") or ("20110229028") or ("20130170746") or ("20110292995") or ("6310915") or ("20110298974") or ("6785464") or ("6456661") or ("20040022318") or ("8559526") or ("8145006") or ("7715477") or ("20070116130") or ("8023561") or ("20040017852") or ("7386049") or ("20110096226") or ("7656950") or ("20040017853") or ("5987179") or ("8036268") or ("20040264566") or ("20110002382") or ("20070077023") or ("6915018") or ("20020061184") or ("20080095228") or ("20080031328") or ("20060262861") or ("6141059") or ("6414999") or ("7397858") or ("6795499") or ("7394851") or ("20040264580") or ("8428116") or ("7366240") or ("6339619") or ("20070047662") or ("20070165715") or ("20070154185") or ("20010006562") or ("20090168866") or ("6959042") or ("20070153893") or ("20070153913") or ("20020001411")).PN.	US-PGPUB; USPAT	OR	OFF	2014/01/24 16:45
S114	0	S111 and (video with resolution) and	US-PGPUB;	OR	ON	2014/01/24

		(super$1resolution near2 (enlarger and converter))	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			16:56
S115	0	S111 and (video with resolution) and (super$1resolution with (enlarger or converter))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/24 16:56
S116	2	S111 and video and (super$1resolution with (enlarger or converter))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/24 16:56
S117	52	S111 and video and super$1resolution	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/24 16:57
S118	77	video and (superresolution or super-resolution) and (scalable or scalability) and enhancement and base	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/01/24 17:37

5/1/2014 4:35:32 PM
C:\Users\afeliciano\Documents\EAST\Workspaces\case_12995039.wsp

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12995039	SAKAZUME, SATORU
	Examiner	**Art Unit**
	ANA PICON-FELICIANO	2482

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	09/10/2013	05/07/2014							
	1	-	N							
	2	÷	N							
	3	÷	N							
	4	÷	N							
	5	÷	N							
	6	÷	N							
	7	÷	✓							
	8	÷	✓							
	9	÷	✓							
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	23	÷	N							
	24	÷	N							
	25	÷	N							
	26	÷	N							

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12995039	SAKAZUME, SATORU
	Examiner	Art Unit
	ANA PICON-FELICIANO	2482

CPC- SEARCHED		
Symbol	Date	Examiner
H04N	1/16/2014	AP
H04N(Update)	5/1/2014	AP

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner
H04N 7/50,7/26244,7/26271,7/26015,7/26031,19/00436,19/00472,19/00521,19/00757,19/00781,19/00884,19/0089	1/16/2014	AP
H04N 19/00436,19/00472,19/00521,19/00757,19/00781,19/00884,19/0089(Update)	5/1/2014	AP

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
375	240.12,240.18,E7.243,E7.226	7/23/2013	AP
375	240.12,240.18,E7.243,E7.226(Update)	5/1/2014	AP

SEARCH NOTES		
Search Notes	Date	Examiner
EAST Search on USPC class/subclass	7/23/2013	AP
EAST Search on Assignee	8/28/2013	AP
EAST Search on Inventor	8/29/2013	AP
EAST Search on CPC class/subclass	1/16/2014	AP
EAST Search on keywords	1/24/2014	AP
Consulted Christopher Kelley (SPE Art Unit 2482)	9/10/2013	AP
Consulted Christopher Kelley (SPE Art Unit 2482)	4/29/2014	AP
EAST Search Update on classifications	5/1/2014	AP
Consulted Christopher Kelley(SPE Art Unit 2482)	5/7/2014	AP

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S22	45	super$1resolution and encoder and ((point near2 spread near2 function) or "PSF")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/07/23 14:44
S23	425	(super$1resolution or "super resolution") and (cod$4 or encod$4 or decod$4) and ((point near2 spread near2 function) or "PSF")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/07/23 14:56
S24	15351	(super$1resolution or "super resolution") and (cod$4 or encod$4 or decod$4) and (image$1 or video) ((point near2 spread near2 function) or "PSF")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/07/23 14:56
S25	420	(super$1resolution or "super resolution") and (cod$4 or encod$4 or decod$4) and (image$1 or video) and ((point near2 spread near2 function) or "PSF")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/07/23 14:57
S26	8574	375/240.12,240.18,E7.243,E7.226.ccls.	US-PGPUB; USPAT	OR	ON	2013/07/23 16:44
S27	13	S26 and (super$1resolution or "super resolution") and (cod$4 or encod$4 or decod$4) and (image$1 or video) and ((point near2 spread near2 function) or "PSF")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/07/23 16:44
S28	69	S26 and (super$1resolution or "super resolution") and (cod$4 or encod$4 or decod$4) and (image$1 or video)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/07/23 16:46
S29	1	S26 and ((super$1resolution or "super resolution" or high$1resolution or "high resolution") near2 (convert$4 and enlarg$4)) and (cod$4 or encod$4 or decod$4) and (image$1 or video)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	ON	2013/07/23 16:49

			IBM_TDB			
S30	2	S26 and ((super$1resolution or "super resolution" or high$1resolution or "high resolution") near5 (convert$4 and enlarg$4)) and (cod$4 or encod$4 or decod$4) and (image$1 or video)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/07/23 16:50
S31	10	S26 and ((super$1resolution or "super resolution" or high$1resolution or "high resolution") near5 ((convert$4 or transform$4) and (enlarg$4 or increas$4))) and (cod$4 or encod$4 or decod$4) and (image$1 or video)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/07/23 16:53
S32	1000	(("20010010707") or ("20130163676") or ("20130163673") or ("20130170558") or ("20130182776") or ("20130170544") or ("20130163679") or ("20130170564") or ("20130163661") or ("20020181595") or ("20110157470") or ("20040264566") or ("20110176604") or ("20110298974") or ("20040017853") or ("20040022318") or ("20110229046") or ("20130170746") or ("20040017852") or ("20110229028") or ("20100189418") or ("20070263731") or ("20090010559") or ("20070230914") or ("20110096226") or ("20070077023") or ("20110007823") or ("20080095228") or ("20060262861") or ("20020061184") or ("20090168866") or ("6792045") or ("20070116130") or ("20040264580") or ("20090016437") or ("20100061445") or ("20090110056") or ("20110164676") or ("20080260026") or ("20110002382") or ("20110216836") or ("6785464") or ("20090168900") or ("8145006") or ("20070165715") or ("20070047661") or ("20070047662") or ("20070058729") or ("20020159755") or ("20030067989") or ("20070154185") or ("7957628") or ("20090129759") or ("20050084162") or ("20010006562") or ("20050084159") or ("20050089230") or ("20050084165") or ("20050084163") or ("20060204112") or ("20020090135") or ("20030038982") or ("20050084160") or ("20050084164") or ("20100054338") or ("20030053704") or ("20060126952") or ("20070153912") or ("20070153894") or ("20080019444") or ("20070153895") or ("20040080669") or ("20030142747") or ("20070153913") or ("20070153893") or ("20020081094") or ("20070160141") or ("20030128292") or ("20070153911") or ("20060291570") or ("20020059643") or ("20110142129") or ("20080075164") or ("20030002583") or ("20030080980") or ("20060045467") or ("20120195365") or ("20060045188") or ("20110194604") or ("20100086048") or ("20060120466") or ("20120294355") or ("20050226325") or ("20090285307") or ("20060215765") or ("20050002454") or	US-PGPUB; USPAT	OR	OFF	2013/07/23 17:02

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S33	11	S32 and ((super$1resolution or "super resolution" or high$1resolution or "high resolution") near5 ((convert$4 or transform$4) and (enlarg$4 or increas$4))) and (cod$4 or encod$4 or decod$4) and (image$1 or video)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/07/23 17:49
S34	217	S32 and (super$1resolution or "super resolution" or high$1resolution or "high resolution") and (cod$4 or encod$4 or decod$4) and (image$1 or video)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/07/23 17:56
S35	4	S32 and ((first and second and third) near3 (super$1resolution or "super resolution" or high$1resolution or "high resolution")) and (cod$4 or encod$4 or decod$4) and (image$1 or video)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/07/23 17:58
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		0785686 b1" "ep 0779744 a2" "ep 0577337 a2" "ep 1634457 b1" "ep 0767587 b1" "ep 2528334 a1" "ep 0542474 b1" "ep 2352296 a1" "ep 0920214 a2" "ep 2161924 a1" "ep 2605514 a1" "ep 1119204 a2" "ep 0971542 a2" "ep 2055108 b1" "ep 1463333 a1" "ep 0589504 a1" "ep 0665513 b1" "ep 1239679 a2" "ep 0665513 a2" "ep 2205003 a2" "ep 1596609 a2" "ep 2477410 a1" "ep 0579395 a1" "ep 1069777 a1" "ep 0961991 b1" "ep 1944729 a2" "ep 1926314 a1" "ep 1437733 b1" "ep 0707426 b1" "ep 0588411 b1" "ep 0589504 b1" "ep 0944264 b1" "ep 1947860 a2" "ep 0967805 a2" "ep 2271098 a1" "ep 2357826 a2" "ep 1628485 a2" "ep 1040666 b1" "ep 0944264 a2" "ep 0707426 a2" "ep 2224745 a1" "ep 1010330 b1" "ep 1634458 b1"				
S39	0	S38 and S37 and ((first and second and third) near3 (super$1resolution or "super resolution" or high$1resolution or "high resolution")) and (cod$4 or encod$4 or decod$4) and (image$1 or video)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/07/23 18:57
S40	0	S38 and S37 and (super$1resolution or "super resolution" or high$1resolution or "high resolution") and (cod$4 or encod$4 or decod$4) and (image$1 or video)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/07/23 18:58
S41	1	S38 and (super$1resolution or "super resolution" or high$1resolution or "high resolution") and (cod$4 or encod$4 or decod$4) and (image$1 or video)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/07/23 18:59
S42	5	S37 and (super$1resolution or "super resolution" or high$1resolution or "high resolution") and (cod$4 or encod$4 or decod$4) and (image$1 or video)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2013/07/23 18:59
S43	1	12/995039.app.	US-PGPUB; USPAT	OR	ON	2013/07/23 20:21

5/1/2014 4:32:33 PM
C:\Users\afeliciano\Documents\EAST\Workspaces\case_12995039.wsp

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	
Filing Date	2010-11-29
First Named Inventor	Satoru SAKAZUME
Art Unit	TBD
Examiner Name	TBD
Attorney Docket Number	31181U

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	1	2008-042407	JP	A	2008-02-21	NIPPON HOSO KYOKAI <NHK>		☒
	2	2008-053848	JP	A	2008-03-06	OKI ELECTRIC IND CO LTD		☒
	3	07-162870	JP	A	1995-06-23	AT & T CORP BELL COMMUN RES INC		☒

EFS Web 2.1.17

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Receipt date: 11/29/2010	Application Number	12995039 - GAU: 2482
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Filing Date	2010-11-29
	First Named Inventor	Satoru SAKAZUME
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	31181U

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
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EXAMINER SIGNATURE

Examiner Signature	/Ana Picon-feliciano/	Date Considered	05/01/2014

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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	12995039
Filing Date	2010-11-29
First Named Inventor	Satoru SAKAZUME
Art Unit	2482
Examiner Name	PICON-FELICIANO, ANA J
Attorney Docket Number	31181U

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	1	20070064795	A1	2007-03-22	Cho et al.	

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/Ana Picon-feliciano/

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2007-110348	JP	A	2007-04-26	NTT DOCOMO INC	English Abstract cover page attached separately.	☒

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Receipt date: 12/19/2012	Application Number	12995039 12995039 - GAU: 2482
INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Filing Date	2010-11-29
	First Named Inventor	Satoru SAKAZUME
(Not for submission under 37 CFR 1.99)	Art Unit	2482
	Examiner Name	PICON-FELICIANO, ANA J
	Attorney Docket Number	31181U

	1	Office action issued on September 28, 2012 in the counterpart Chinese Application, ten (10) pages	☐

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Examiner Signature	/Ana Picon-feliciano/	Date Considered	05/01/2014

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.F./

Receipt date: 12/19/2012	Application Number	12995039 12995039 - GAU: 2482
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99**)	Filing Date	2010-11-29
	First Named Inventor	Satoru SAKAZUME
	Art Unit	2482
	Examiner Name	PICON-FELICIANO, ANA J
	Attorney Docket Number	31181U

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Jerald L. Meyer/	Date (YYYY-MM-DD)	2012-12-19
Name/Print	Jerald L. Meyer	Registration Number	41194

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/995,039	11/29/2010	Satoru Sakazume	31181U	7504

20529 7590 02/20/2014

NATH, GOLDBERG & MEYER
Joshua Goldberg
112 South West Street
Alexandria, VA 22314

EXAMINER	
PICON-FELICIANO, ANA J	
ART UNIT	**PAPER NUMBER**
2482	

NOTIFICATION DATE	DELIVERY MODE
02/20/2014	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

USPTO@nathlaw.com

Examiner-Initiated Interview Summary	**Application No.** 12/995,039	**Applicant(s)** SAKAZUME, SATORU	
	Examiner ANA PICON-FELICIANO	**Art Unit** 2482	

All participants (applicant, applicant's representative, PTO personnel):

(1) *ANA PICON-FELICIANO-Patent Examiner*. (3)_____.

(2) *Scott C. Langford-Attorney*. (4)_____.

Date of Interview: *27 January 2014*.

Type: ☒ Telephonic ☐ Video Conference
☐ Personal [copy given to: ☐ applicant ☐ applicant's representative]

Exhibit shown or demonstration conducted: ☐ Yes ☒ No.
If Yes, brief description: _____.

Issues Discussed ☐101 ☐112 ☐102 ☐103 ☒Others
(For each of the checked box(es) above, please describe below the issue and detailed description of the discussion)

Claim(s) discussed: *2-26*.

Identification of prior art discussed: *None*.

Substance of Interview
(For each issue discussed, provide a detailed description and indicate if agreement was reached. Some topics may include: identification or clarification of a reference or a portion thereof, claim interpretation, proposed amendments, arguments of any applied references etc...)

Applicant was informed that there was a typographical error in the Requirement for Restriction/Election mailed on 17 September 2013 regarding claims 2-26 pending in the application. Examiner clarified that claims 2-26 are not generic.

Applicant recordation instructions: It is not necessary for applicant to provide a separate record of the substance of interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

☐ Attachment

/ANA PICON-FELICIANO/ Examiner, Art Unit 2482	/CHRISTOPHER S KELLEY/ Supervisory Patent Examiner, Art Unit 2482

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of:

SAKAZUME — Conf. No.: 7504

Serial No. **12/995,039** — Art Unit: 2482

Filed: November 29, 2010 — Examiner: PICON-FELICIANO

For: MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYTEM, MOVING PICTURE REENCODING METHOD, AND MOVING PICTURE REENCODING PROGRAM

RESPONSE TO RESTRICTION REQUIREMENT

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

This paper is prepared and filed in response to the outstanding Restriction Requirement bearing a mailing date of September 17, 2013 ("Office Action"). Applicants do not believe that any extension of time is necessary under 37 C.F.R. §1.136(a). Applicants believe that no fees are required at this time. However, if any fees are required for further extension of time, or any other additional fees are required, such fees are hereby authorized to be charged to Deposit Account No. 14-0112. In view of the following election and remarks, the Applicant respectfully requests the Examiner to conduct a first substantive examination of the application.

REMARKS

I. Elections/Restriction Summary

This Office Action alleges that this application contains claims directed to more than one species of the generic invention. These species are alleged to lack unity of invention because they are not so linked as to form a single general inventive concept under PCT Rule 13.1. The species are as follows:

a. Species A: Figures 1 and 8;

b. Species B: Figures 7 and 9;

c. Species C: Figure 10;

d. Species D: Figure 13;

e. Species E: Figure 16;

f. Species F: Figure 17;

g. Species G: Figure 18;

h. Species H: Figure 19; and

i. Species I: Figure 22.

Applicant is required to elect a single species to which the claims shall be restricted if no generic claim is finally held to be allowable. The reply must also identify the claims readable on the elected species, including any claims subsequently added.

Upon the allowance of a generic claim, Applicant will be entitled to consideration of claims to additional species which are written in dependent form or otherwise require all the limitations of an allowed generic claim. Currently, the following claims are generic: 2-26.

II. Applicant's Response - Election and Identification of Claims

Applicant hereby elects Species D: Figure 13, without traverse, and identifies claims 2-26 as encompassing the elected species. Applicant submits that this election without traverse is not meant to concede any of the remarks made by the Examiner in the Office Action.

CONCLUSION

In light of the foregoing, Applicant respectfully requests that the Examiner conduct a first substantive examination of the application. In the event the Examiner finds any issues outstanding after considering this Response, the Examiner is invited to contact Applicants' undersigned representative at the number below. Prompt and favorable consideration of this Reply is respectfully requested.

Respectfully submitted,

October 17, 2013

/Jerald L. Meyer/

NATH, GOLDBERG & MEYER
112 South West Street
Alexandria, VA 22314-2891
Tel: 703-548-6284
Fax: 703-683-8396

Jerald L. Meyer
Reg. No. 41,194
Scott C. Langford
Reg. No. 70,675
Customer No. 20529

Electronic Acknowledgement Receipt

EFS ID:	17145612
Application Number:	12995039
International Application Number:	
Confirmation Number:	7504
Title of Invention:	MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYTEM, MOVING PICTURE REENCODING METHOD, AND MOVING PICTURE REENCODING PROGRAM
First Named Inventor/Applicant Name:	Satoru Sakazume
Customer Number:	20529
Filer:	Stanley Protigal/Lauren Lee
Filer Authorized By:	Stanley Protigal
Attorney Docket Number:	31181U
Receipt Date:	17-OCT-2013
Filing Date:	29-NOV-2010
Time Stamp:	10:16:43
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Response to Election / Restriction Filed	31181U_RRR_mailed_09172013.pdf	84106 ad7f33f701ab250ac7829f921c020a0f871a1651	no	3
Warnings:					
Information:					

Total Files Size (in bytes):	84106

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New Applications Under 35 U.S.C. 111
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National Stage of an International Application under 35 U.S.C. 371
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New International Application Filed with the USPTO as a Receiving Office
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United States Patent and Trademark Office
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/995,039	11/29/2010	Satoru Sakazume	31181U	7504

20529 7590 09/17/2013

NATH, GOLDBERG & MEYER
112 South West Street
Alexandria, VA 22314

EXAMINER	
PICON-FELICIANO, ANA J	
ART UNIT	**PAPER NUMBER**
2482	
MAIL DATE	**DELIVERY MODE**
09/17/2013	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 12/995,039	Applicant(s) SAKAZUME, SATORU	
	Examiner ANA PICON-FELICIANO	Art Unit 2482	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 1 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 November 2010*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

5)☒ Claim(s) *2-26* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☐ Claim(s) _____ is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☒ Claim(s) *2-26* are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some * c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

REQUIREMENT FOR UNITY OF INVENTION

As provided in 37 CFR 1.475(a), a national stage application shall relate to one invention only or to a group of inventions so linked as to form a single general inventive concept ("requirement of unity of invention"). Where a group of inventions is claimed in a national stage application, the requirement of unity of invention shall be fulfilled only when there is a technical relationship among those inventions involving one or more of the same or corresponding special technical features. The expression "special technical features" shall mean those technical features that define a contribution which each of the claimed inventions, considered as a whole, makes over the prior art.

The determination whether a group of inventions is so linked as to form a single general inventive concept shall be made without regard to whether the inventions are claimed in separate claims or as alternatives within a single claim. See 37 CFR 1.475(e).

1. This application contains claims directed to more than one species of the generic invention. These species are deemed to lack unity of invention because they are not so linked as to form a single general inventive concept under PCT Rule 13.1.

The species are as follows:

a. Species A: Figures 1 and 8

b. Species B: Figures 7 and 9

c. Species C: Figure 10

d. Species D: Figure 13

e. Species E: Figure 16

f. Species F: Figure 17

g. Species G: Figure 18

h. Species H: Figure 19

j. Species I: Figure 22

Applicant is required, in reply to this action, to elect a single species to which the claims shall be restricted if no generic claim is finally held to be allowable. The reply must also identify the claims readable on the elected species, including any claims subsequently added. An argument that a claim is allowable or that all claims are generic is considered non-responsive unless accompanied by an election.

Upon the allowance of a generic claim, applicant will be entitled to consideration of claims to additional species which are written in dependent form or otherwise require all the limitations of an allowed generic claim. Currently, the following claim(s) are generic: **2-26**.

2. The groups of inventions listed above do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

- Each species relate to an encoder and a respective decoder under class 375/240.12.
- Species would require a different search among them.

Applicant is advised that the reply to this requirement to be complete must include (i) an election of a species or a grouping of patentably indistinct species to be examined even though the requirement may be traversed (37 CFR 1.143) **and (ii) identification of the claims encompassing the elected species** or grouping of patentably indistinct species, including any claims subsequently added. An argument that a claim is allowable or that all claims are generic is considered nonresponsive unless accompanied by an election.

The election may be made with or without traverse. To preserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point out supposed errors in the election of species requirement, the election shall be treated as an election without traverse. Traversal must be presented at the time of election in order to be considered timely. Failure to timely traverse the requirement will result in the loss of right to petition under 37 CFR 1.144. If claims are added after the election, applicant must indicate which of these claims are readable on the elected species or grouping of patentably indistinct species.

Should applicant traverse on the ground that the species, or groupings of patentably indistinct species from which election is required, are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing the species to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the species unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103 or pre-AIA 35 U.S.C. 103(a) of the other species.

Upon the allowance of a generic claim, applicant will be entitled to consideration of claims to additional species which depend from or otherwise require all the limitations of an allowable generic claim as provided by 37 CFR 1.141.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ANA PICON-FELICIANO whose telephone number is (571)272-5252. The examiner can normally be reached on Monday-Friday 9am to 5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Christopher Kelley can be reached on 571-272-7331. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/ANA PICON-FELICIANO/
Examiner, Art Unit 2482

/CHRISTOPHER S KELLEY/
Supervisory Patent Examiner, Art Unit 2482

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12995039	SAKAZUME, SATORU
	Examiner	Art Unit
	ANA PICON-FELICIANO	2482

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	09/10/2013								
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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	12995039
	Filing Date	2010-11-29
	First Named Inventor	Satoru SAKAZUME
	Art Unit	2482
	Examiner Name	PICON-FELICIANO, ANA J
	Attorney Docket Number	31181U

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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	1							☐
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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

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	Art Unit	2482
	Examiner Name	PICON-FELICIANO, ANA J
	Attorney Docket Number	31181U

	1	Sung Cheol Park, et al."Super-Resolution Image Reconstruction: A Technical Overview", Signal Processing Magazine,Vol. 20, Issue 3, IEEE, pages 21-37. May, 2003.	☐
	2	Office Action issued on May 21, 2013, in the Counterpart Japanese Application No. 2009-123960, two pages.	☐

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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	Filing Date	2010-11-29
	First Named Inventor	Satoru SAKAZUME
	Art Unit	2482
	Examiner Name	PICON-FELICIANO, ANA J
	Attorney Docket Number	31181U

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☒ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☐ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Jerald L. Meyer/	Date (YYYY-MM-DD)	2013-07-15
Name/Print	Jerald L. Meyer	Registration Number	41194

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	16311201
Application Number:	12995039
International Application Number:	
Confirmation Number:	7504
Title of Invention:	MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYTEM, MOVING PICTURE REENCODING METHOD, AND MOVING PICTURE REENCODING PROGRAM
First Named Inventor/Applicant Name:	Satoru Sakazume
Customer Number:	20529
Filer:	Stanley Protigal/samuel woldeyesus
Filer Authorized By:	Stanley Protigal
Attorney Docket Number:	31181U
Receipt Date:	15-JUL-2013
Filing Date:	29-NOV-2010
Time Stamp:	15:47:32
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Non Patent Literature	OfficeAction_31181UII.pdf	79618 76f85e5a44bbf58f460f28e90a1c999f1c3b4100	no	2
Warnings:					
Information:					

2	Non Patent Literature	NPL_31181U.pdf	1116993 0ed346e8b222e04fc9f8e0dc2a859b04a2dedbe9	no	18
Warnings:					
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New Applications Under 35 U.S.C. 111

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New International Application Filed with the USPTO as a Receiving Office

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	12995039
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First Named Inventor	Satoru SAKAZUME
Art Unit	2482
Examiner Name	PICON-FELICIANO, ANA J
Attorney Docket Number	31181U

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20070064795	A1	2007-03-22	Cho et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2007-110348	JP	A	2007-04-26	NTT DOCOMO INC	English Abstract cover page attached separately.	☒

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Filing Date	2010-11-29
	First Named Inventor	Satoru SAKAZUME
	Art Unit	2482
	Examiner Name	PICON-FELICIANO, ANA J
	Attorney Docket Number	31181U

	1	Office action issued on September 28, 2012 in the counterpart Chinese Application, ten (10) pages	☐

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	12995039
	Filing Date	2010-11-29
	First Named Inventor	Satoru SAKAZUME
	Art Unit	2482
	Examiner Name	PICON-FELICIANO, ANA J
	Attorney Docket Number	31181U

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Jerald L. Meyer/	Date (YYYY-MM-DD)	2012-12-19
Name/Print	Jerald L. Meyer	Registration Number	41194

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Electronic Acknowledgement Receipt	
EFS ID:	14508281
Application Number:	12995039
International Application Number:	
Confirmation Number:	7504
Title of Invention:	MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYTEM, MOVING PICTURE REENCODING METHOD, AND MOVING PICTURE REENCODING PROGRAM
First Named Inventor/Applicant Name:	Satoru Sakazume
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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Foreign Reference	2007110348_31181U.pdf	2424231 04814b537b0481b30c44a33aa7fc9ccf5942d20b	no	34
Warnings:					
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2	Non Patent Literature	OfficeAction_31181U.pdf	518456 9b2364b7ecb79fd7c18ff1e3728c4a8ea0656d4a	no	10
Warnings:					
Information:					
3	Information Disclosure Statement (IDS) Form (SB08)	updated_IDS_31181U.pdf	612435 e2eaa59cacf0a8a237202d71371db2d95b7d454a	no	4
Warnings:					
Information:					
		Total Files Size (in bytes):	3555122		

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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT ABSTRACTS OF JAPAN

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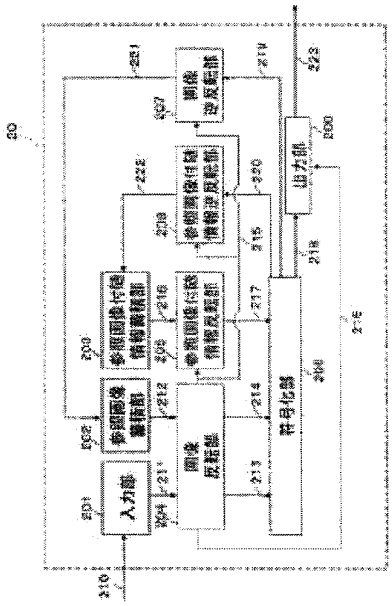
(51)Int.Cl. *H04N 7/32 (2006.01)*
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(71)Applicant : NTT DOCOMO INC
(72)Inventor : KATO SADAATSU
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(54) MOVING PICTURE CODING APPARATUS, MOVING PICTURE DECODING APPARATUS, MOVING PICTURE CODING METHOD, MOVING PICTURE DECODING METHOD, MOVING PICTURE CODING PROGRAM, AND MOVING PICTURE DECODING PROGRAM

(57)Abstract:
PROBLEM TO BE SOLVED: To code and decode image information more efficiently by generating a proper prediction signal.
SOLUTION: A moving picture coding apparatus disclosed herein includes: an input section 201 for receiving an input image being a coding object; a reference image storage section 202 for storing a reference image; a reference image associated information storage section 203 for storing reference image collateral information associated with the reference image; a coding section 206 for revising the reference image and the reference image associated information in matching with the input image and generating the prediction signal of the input image to code the input image; and an output section 209 that outputs compressed data coded by the coding means as coded data together with revision method information for denoting a revision method of the reference image.



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審査請求 未請求　請求項の数 14　OL　（全 31 頁）

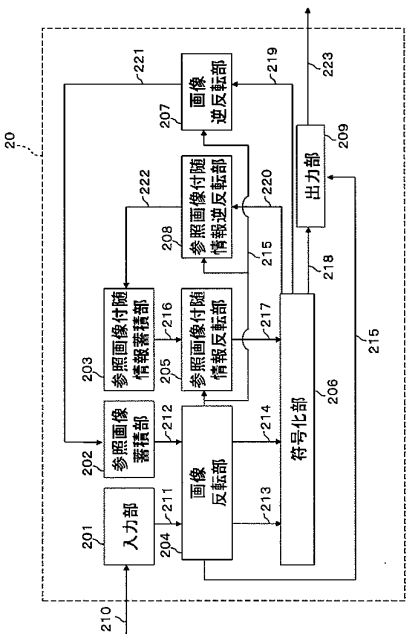
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最終頁に続く

(54)【発明の名称】動画像符号化装置、動画像復号化装置、動画像符号化方法、動画像復号化方法、動画像符号化プログラム、および動画像復号化プログラム

(57)【要約】
【課題】的確な予測信号を生成してより効率的に画像情報を符号化及び復号化すること。
【解決手段】本発明の動画像符号化装置は、符号化対象となる入力画像を入力する入力部２０１と、参照画像を蓄積する参照画像蓄積部２０２と、参照画像に付随する参照画像付随情報を蓄積する参照画像付随情報蓄積部２０３と、参照画像と参照画像付随情報とを入力画像に合わせて変更し、入力画像の予測信号を生成して入力画像の符号化を行う符号化部２０６と、符号化手段によって符号化された圧縮データを参照画像の変更方法を示す変更方法情報と合わせて符号化データとして出力する出力部２０９と、を備える。
【選択図】図２



【特許請求の範囲】
【請求項１】
符号化対象となる入力画像を入力する入力手段と、
参照画像を蓄積する参照画像蓄積手段と、
前記参照画像に付随する参照画像付随情報を蓄積する参照画像付随情報蓄積手段と、
前記参照画像と前記参照画像付随情報とを前記入力画像に合わせて変更し、前記入力画像の予測信号を生成して前記入力画像の符号化を行う符号化手段と、
前記符号化手段によって符号化された圧縮データを前記参照画像の変更方法を示す変更方法情報と合わせて符号化データとして出力する出力手段と、
を備える動画像符号化装置。
【請求項２】
符号化対象となる入力画像を入力する入力手段と、
参照画像を蓄積する参照画像蓄積手段と、
前記参照画像に付随する参照画像付随情報を蓄積する参照画像付随情報蓄積手段と、
前記入力画像と前記参照画像とを変更する画像変更手段と、
前記参照画像付随情報を前記入力画像と前記参照画像とに合わせて変更する参照画像付随情報変更手段と、
前記変更された参照画像と前記変更された参照画像付随情報とを用いて前記入力画像の予測信号を生成して前記入力画像の符号化を行う符号化手段と、
前記符号化手段によって符号化された圧縮データを前記参照画像の変更方法を示す変更方法情報と合わせて符号化データとして出力する出力手段と、
を備える動画像符号化装置。
【請求項３】
前記符号化手段により局所復号化された局所復号化画像を逆変更する画像逆変更手段と、
前記符号化手段から出力された局所復号化画像に付随する情報を逆変更する参照画像付随情報逆変更手段と、
をさらに備え、
前記参照画像蓄積手段は、前記画像逆変更手段が逆変更した情報を前記参照画像として蓄積し、
前記参照画像付随情報蓄積手段は、前記参照画像付随情報逆変更手段が逆変更した情報を前記参照画像付随情報として蓄積する
ことを特徴とする請求項１又は２に記載の動画像符号化装置。
【請求項４】
前記参照画像付随情報は前記参照画像の動きベクトルであることを特徴とする請求項１～３のいずれか１項に記載の動画像符号化装置
【請求項５】
入力された符号化データを圧縮データと変更方法情報とに分離する分離手段と、
参照画像を蓄積する参照画像蓄積手段と、
前記参照画像に付随する参照画像付随情報を蓄積する参照画像付随情報蓄積手段と、
前記変更方法情報を用いて前記参照画像と前記参照画像付随情報とを変更し、復号画像の予測信号を生成して、復号画像の復号化を行う復号化手段と、
を備える動画像復号化装置。
【請求項６】
入力された符号化データを圧縮データと変更方法情報とに分離する分離手段と、
参照画像を蓄積する参照画像蓄積手段と、
前記参照画像に付随する参照画像付随情報を蓄積する参照画像付随情報蓄積手段と、
前記参照画像を前記変更方法情報に従って変更する画像変更手段と、
前記参照画像付随情報を前記変更方法情報に従って変更する参照画像付随情報変更手段と、

前記変更された参照画像と、前記変更された参照画像付随情報を用いて、復号画像の予測信号を生成して、復号画像の復号化を行う復号化手段と、
を備える動画像復号化装置。
【請求項７】
前記復号化手段により復号化された復号化画像を逆変更する画像逆変更手段と、
前記復号化手段から出力された復号化画像に付随する情報を逆変更する参照画像付随情報逆変更手段と、
をさらに備え、
前記参照画像蓄積手段は、前記画像逆変更手段が逆変更した情報を前記参照画像として蓄積し、
前記参照画像付随情報蓄積手段は、前記参照画像付随情報逆変更手段が逆変更した情報を前記参照画像付随情報として蓄積する
ことを特徴とする請求項５又は６に記載の動画像復号化装置。
【請求項８】
前記参照画像付随情報は前記参照画像の動きベクトルであることを特徴とする請求項５～７のいずれか１項に記載の動画像復号化装置
【請求項９】
入力手段が、符号化対象となる入力画像を入力する入力ステップと、
参照画像蓄積手段が、参照画像を蓄積する参照画像蓄積ステップと、
参照画像付随情報蓄積手段が、前記参照画像に付随する参照画像付随情報を蓄積する参照画像付随情報蓄積ステップと、
符号化手段が、前記参照画像と前記参照画像付随情報とを前記入力画像に合わせて変更し、前記入力画像の予測信号を生成して前記入力画像の符号化を行う符号化ステップと、
出力手段が、前記符号化ステップにおいて符号化された圧縮データを前記参照画像の変更方法を示す変更方法情報と合わせて符号化データとして出力する出力ステップと、
を備える動画像符号化方法。
【請求項１０】
入力手段が、符号化対象となる入力画像を入力する入力ステップと、
参照画像蓄積手段が、参照画像を蓄積する参照画像蓄積ステップと、
参照画像付随情報蓄積手段が、前記参照画像に付随する参照画像付随情報を蓄積する参照画像付随情報蓄積ステップと、
画像変更手段が、前記入力画像と前記参照画像とを変更する画像変更ステップと、
参照画像付随情報変更手段が、前記参照画像付随情報を前記入力画像と前記参照画像とに合わせて変更する参照画像付随情報変更ステップと、
符号化手段が、前記変更された参照画像と前記変更された参照画像付随情報とを用いて前記入力画像の予測信号を生成して前記入力画像の符号化を行う符号化ステップと、
出力手段が、前記符号化ステップにおいて符号化された圧縮データを前記参照画像の変更方法を示す変更方法情報と合わせて符号化データとして出力する出力ステップと、
を備える動画像符号化方法。
【請求項１１】
分離手段が、入力された符号化データを圧縮データと変更方法情報とに分離する分離ステップと、
参照画像蓄積手段が、参照画像を蓄積する参照画像蓄積ステップと、
参照画像付随情報蓄積手段が、前記参照画像に付随する参照画像付随情報を蓄積する参照画像付随情報蓄積ステップと、
復号化手段が、前記変更方法情報を用いて前記参照画像と前記参照画像付随情報とを変更し、復号画像の予測信号を生成して、復号画像の復号化を行う復号化ステップと、
を備える動画像復号化方法。
【請求項１２】
分離手段が、入力された符号化データを圧縮データと変更方法情報とに分離する分離ス

テップと、
参照画像蓄積手段が、参照画像を蓄積する参照画像蓄積ステップと、
参照画像付随情報蓄積手段が、前記参照画像に付随する参照画像付随情報を蓄積する参照画像付随情報蓄積ステップと、
画像変更手段が、前記参照画像を前記変更方法情報に従って変更する画像変更ステップと、
参照画像付随情報変更手段が、前記参照画像付随情報を前記変更方法情報に従って変更する参照画像付随情報変更ステップと、
復号化手段が、前記変更された参照画像と前記変更された参照画像付随情報とを用いて、復号画像の予測信号を生成して、復号画像の復号化を行う復号化ステップと、
を備える動画像復号化方法。
【請求項１３】
コンピュータを
符号化対象となる入力画像を入力する入力手段と、
参照画像を蓄積する参照画像蓄積手段と、
前記参照画像に付随する参照画像付随情報を蓄積する参照画像付随情報蓄積手段と、
前記参照画像と前記参照画像付随情報とを前記入力画像に合わせて変更し、前記入力画像の予測信号を生成して前記入力画像の符号化を行う符号化手段と、
前記符号化手段によって符号化された圧縮データを前記参照画像の変更方法を示す変更方法情報と合わせて符号化データとして出力する出力手段と、
して機能させる動画像符号化プログラム。
【請求項１４】
コンピュータを
入力された符号化データを圧縮データと変更方法情報とに分離する分離手段と、
参照画像を蓄積する参照画像蓄積手段と、
前記参照画像に付随する参照画像付随情報を蓄積する参照画像付随情報蓄積手段と、
前記変更方法情報を用いて前記参照画像と前記参照画像付随情報とを変更し、復号画像の予測信号を生成して、復号画像の復号化を行う復号化手段と、
して機能させる動画像復号化プログラム。
【発明の詳細な説明】
【技術分野】
【０００１】
本発明は、動画像符号化装置、動画像復号化装置、動画像符号化方法、動画像復号化方法、動画像符号化プログラム、および動画像復号化プログラムに関するものである。
【背景技術】
【０００２】
動画像符号化装置の一つとして、下記非特許関連文献１に記載のように、入力画像をあらかじめフレームごとに上下方向、左右方向、または上下左右方向に対称に反転した後に符号化する、動画像反転符号化装置が存在する。これは、一般的に入力画像がフレーム内で不均一な特徴を持つため、ラスタスキャン順で左上から右下へ方向依存性のある予測符号化を行う場合、予測効率の高い方向に画像を反転することで符号化効率の向上が可能になるためである。
【０００３】
非特許関連文献１に記載の符号化装置は、入力画像を反転なし、上下方向反転、左右方向反転、上下左右方向反転の４種類の中から選んで反転する。図１（ａ）は入力画像を、図１（ｂ）は入力画像の反転なしの画像を、図１（ｃ）は入力画像を上下方向に反転した画像を、図１（ｄ）は入力画像を左右方向に反転した画像を、図１（ｅ）は入力画像を上下左右方向に反転した画像をそれぞれ示す。そして、符号化装置は、フレーム間での予測を行うインター予測での符号化においては、過去に符号化された画像の局所復号化済み画像である参照画像を入力画像と同じ方向に反転し、反転された参照画像を用いて符号化対

象である反転された入力画像の予測信号を生成して符号化を行う。符号化された圧縮データは入力画像の反転方向を示す識別子と合わせて出力される。また、符号化された圧縮データは局所復号化され、入力画像の反転方向と逆方向に反転されて入力画像と同じ方向に直され、次フレーム以降の参照画像として保存される。図１（ｆ）は入力画像の反転なしの画像（図１（ｂ））を逆方向に反転した画像を示す。すなわち、図１（ｆ）、図１（ｂ）は、図１（ａ）と同じ画像である。図１（ｇ）は入力画像を上下方向に反転した画像（図１（ｃ））を逆方向に反転した画像を示す。図１（ｈ）は入力画像を左右方向に反転した画像（図１（ｄ））を逆方向に反転した画像を示す。図１（ｉ）は入力画像を上下左右方向に反転した画像（図１（ｅ））を逆方向に反転した画像を示す。

【０００４】

また、非特許関連文献１に記載の復号化装置は、フレーム間での予測を行うインター予測での復号化においては、符号化装置から伝送された符号から入力画像の反転方向を示す識別子を取り出して反転方向を判別し、過去の復号化済み画像である参照画像を入力画像の反転方向と同じ方向に反転する。そして、復号化装置は符号化装置から伝送された符号から取り出した圧縮データと反転された参照画像を用いて、反転された画像を復号化したのち、反転された画像を入力画像の反転方向と逆方向に反転して入力画像と同じ方向に直して復号化画像とするとともに、復号化画像を次フレーム以降の参照画像として保存する。

【非特許文献１】村上他、「H.264/AVCBaseline Profileにおける方向依存性を利用した拡張符号化方式」、2005年 電子情報通信学会総合大会

【発明の開示】

【発明が解決しようとする課題】

【０００５】

前記従来技術における符号化装置および復号化装置は、予測信号を生成するために参照画像を入力画像の反転方向と同じ方向に反転させている。そのため、前記従来技術には以下のような問題がある。すなわち、予測信号の生成のために参照画像に付随する情報を必要とする場合、参照画像に付随する情報が反転した参照画面に対応しないため、正しい予測信号を生成することができない。また、前記従来技術における符号化装置および復号化装置はフレーム画像ごとに反転方向を変更するが、フレーム画像をさらに分割したスライスごとやブロックごとに反転方向を変更することができない。

【０００６】

本発明は、上記問題を解決するために成されたものであり、的確な予測信号を生成することにより、画像情報をより効率的に符号化する動画像符号化装置、動画像符号化方法、および動画像符号化プログラムと、符号化された画像情報をより効率的に復号化する動画像復号化装置、動画像復号化方法、および動画像復号化プログラムと、を提供することを目的とする。

【課題を解決するための手段】

【０００７】

本発明の動画像符号化装置は、符号化対象となる入力画像を入力する入力手段と、参照画像を蓄積する参照画像蓄積手段と、参照画像に付随する参照画像付随情報を蓄積する参照画像付随情報蓄積手段と、参照画像と参照画像付随情報とを入力画像に合わせて変更し、入力画像の予測信号を生成して入力画像の符号化を行う符号化手段と、符号化手段によって符号化された圧縮データを参照画像の変更方法を示す変更方法情報と合わせて符号化データとして出力する出力手段と、を備える。

【０００８】

本発明の動画像符号化方法は、入力手段が、符号化対象となる入力画像を入力する入力ステップと、参照画像蓄積手段が、参照画像を蓄積する参照画像蓄積ステップと、参照画像付随情報蓄積手段が、参照画像に付随する参照画像付随情報を蓄積する参照画像付随情報蓄積ステップと、符号化手段が、参照画像と参照画像付随情報とを入力画像に合わせて変更し、入力画像の予測信号を生成して入力画像の符号化を行う符号化ステップと、出力

手段が、符号化ステップにおいて符号化された圧縮データを参照画像の変更方法を示す変更方法情報と合わせて符号化データとして出力する出力ステップと、を備える。

【０００９】

本発明の動画像符号化プログラムは、コンピュータを、符号化対象となる入力画像を入力する入力手段と、参照画像を蓄積する参照画像蓄積手段と、参照画像に付随する参照画像付随情報を蓄積する参照画像付随情報蓄積手段と、参照画像と参照画像付随情報とを入力画像に合わせて変更し、入力画像の予測信号を生成して入力画像の符号化を行う符号化手段と、符号化手段によって符号化された圧縮データを参照画像の変更方法を示す変更方法情報と合わせて符号化データとして出力する出力手段として機能させる。

【００１０】

本発明によれば、参照画像蓄積手段が参照画像を蓄積し、参照画像付随情報蓄積手段が参照画像付随情報を蓄積するので、符号化対象となる入力画像に対応した情報を蓄積することができる。そして、符号化手段が参照画像と参照画像付随情報とを入力画像に合わせて変更し、符号化手段が予測信号を生成するので、入力画像を符号化しやすいように変更すると共に変更した入力画像に対応した予測信号を生成することができる。よって、符号化手段が参照画像と参照画像付随情報とを用いて予測信号をより正確に生成することができ、より効率的に入力画像の符号化を行うことができる。

【００１１】

本発明の動画像符号化装置は、符号化対象となる入力画像を入力する入力手段と、参照画像を蓄積する参照画像蓄積手段と、参照画像に付随する参照画像付随情報を蓄積する参照画像付随情報蓄積手段と、入力画像と参照画像とを変更する画像変更手段と、参照画像付随情報を入力画像と参照画像とに合わせて変更する参照画像付随情報変更手段と、変更された参照画像と変更された参照画像付随情報とを用いて入力画像の予測信号を生成して入力画像の符号化を行う符号化手段と、符号化手段によって符号化された圧縮データを参照画像の変更方法を示す変更方法情報と合わせて符号化データとして出力する出力手段と、を備える。

【００１２】

本発明の動画像符号化方法は、入力手段が、符号化対象となる入力画像を入力する入力ステップと、参照画像蓄積手段が、参照画像を蓄積する参照画像蓄積ステップと、参照画像付随情報蓄積手段が、参照画像に付随する参照画像付随情報を蓄積する参照画像付随情報蓄積ステップと、画像変更手段が、入力画像と参照画像とを変更する画像変更ステップと、参照画像付随情報変更手段が、参照画像付随情報を入力画像と参照画像とに合わせて変更する参照画像付随情報変更ステップと、符号化手段が、変更された参照画像と変更された参照画像付随情報とを用いて入力画像の予測信号を生成して入力画像の符号化を行う符号化ステップと、出力手段が、符号化ステップにおいて符号化された圧縮データを参照画像の変更方法を示す変更方法情報と合わせて符号化データとして出力する出力ステップと、を備える。

【００１３】

本発明によれば、参照画像蓄積手段が参照画像を蓄積し、参照画像付随情報蓄積手段が参照画像付随情報を蓄積するので、符号化対象となる入力画像に対応した情報を蓄積することができる。そして、画像変更手段が入力画像と参照画像とを変更し、参照画像付随情報変更手段が参照画像付随情報を入力画像と参照画像とに合わせて変更し、符号化手段が変更された参照画像と変更された参照画像付随情報とを用いて入力画像の予測信号を生成するので、入力画像を符号化しやすいように変更すると共に変更した入力画像に対応した予測信号を生成することができる。よって、符号化手段が参照画像と参照画像付随情報とを用いて予測信号をより正確に生成することができる。よって、より効率的に入力画像の符号化を行うことができる。

【００１４】

また、本発明の動画像符号化装置は、符号化手段により局所復号化された局所復号化画像を逆変更する画像逆変更手段と、符号化手段から出力された局所復号化画像に付随する

情報を逆変更する参照画像付随情報逆変更手段と、をさらに備え、参照画像蓄積手段は画像逆変更手段が逆変更した情報を参照画像として蓄積し、参照画像付随情報蓄積手段は、参照画像付随情報逆変更手段が逆変更した情報を参照画像付随情報として蓄積することも好ましい。

【００１５】

また、本発明の動画像符号化方法は、画像逆変換手段が、符号化手段により局所復号化された局所復号化画像を逆変更する画像逆変更ステップと、参照画像付随情報逆変更手段が、符号化手段から出力された局所復号化画像に付随する情報を逆変更する参照画像付随情報逆変更ステップと、をさらに備え、参照画像蓄積ステップにおいて、前記画像逆変更ステップにおいて逆変更した情報を参照画像として蓄積し、参照画像付随情報蓄積ステップにおいて、参照画像付随情報逆変更ステップにおいて逆変更した情報を参照画像付随情報として蓄積することも好ましい。

【００１６】

このようにすることにより、次に入力される入力画像に対応した参照画像と参照画像付随情報とを生成することができる。

【００１７】

また、本発明の動画像符号化装置の参照画像付随情報は参照画像の動きベクトルであることも好ましい。

【００１８】

また、本発明の動画像符号化方法における参照画像付随情報は参照画像の動きベクトルであることも好ましい。

【００１９】

本発明の動画像復号化装置は、入力された符号化データを圧縮データと変更方法情報に分離する分離手段と、参照画像を蓄積する参照画像蓄積手段と、参照画像に付随する参照画像付随情報を蓄積する参照画像付随情報蓄積手段と、変更方法情報を用いて参照画像と参照画像付随情報とを変更し、復号画像の予測信号を生成して、復号画像の復号化を行う復号化手段と、を備える。

【００２０】

本発明の動画像復号化方法は、分離手段が、入力された符号化データを圧縮データと変更方法情報に分離する分離ステップと、参照画像蓄積手段が、参照画像を蓄積する参照画像蓄積ステップと、参照画像付随情報蓄積手段が、参照画像に付随する参照画像付随情報を蓄積する参照画像付随情報蓄積ステップと、復号化手段が、変更方法情報を用いて参照画像と参照画像付随情報とを変更し、復号画像の予測信号を生成して、復号画像の復号化を行う復号化ステップと、を備える。

【００２１】

本発明の動画像復号化プログラムは、コンピュータを、入力された符号化データを圧縮データと変更方法情報に分離する分離手段と、参照画像を蓄積する参照画像蓄積手段と、参照画像に付随する参照画像付随情報を蓄積する参照画像付随情報蓄積手段と、変更方法情報を用いて参照画像と参照画像付随情報とを変更し、復号画像の予測信号を生成して、復号画像の復号化を行う復号化手段と、して機能させる。

【００２２】

本発明によれば、参照画像蓄積手段が参照画像を蓄積し、参照画像付随情報蓄積手段が参照画像に付随する参照画像付随情報を蓄積するので、符号化対象となる入力画像に対応した情報を蓄積することができる。そして、分離手段が入力された符号化データを圧縮データと変更方法情報に分離し、復号化手段が変更方法情報を用いて参照画像と参照画像付随情報とを変更して復号画像の予測信号を生成するので、参照画像と参照画像付随情報とを圧縮データに対応して変更し、圧縮データに対応した予測信号を生成することができる。よって、復号化手段が参照画像と参照画像付随情報とを用いて予測信号をより正確に生成することができ、より効率的に圧縮データの復号化を行うことができる。

【００２３】

本発明の動画像復号化装置は、入力された符号化データを圧縮データと変更方法情報に分離する分離手段と、参照画像を蓄積する参照画像蓄積手段と、参照画像に付随する参照画像付随情報を蓄積する参照画像付随情報蓄積手段と、参照画像を変更方法情報に従って変更する画像変更手段と、参照画像付随情報を変更方法情報に従って変更する参照画像付随情報変更手段と、変更された参照画像と、変更された参照画像付随情報を用いて、復号画像の予測信号を生成して、復号画像の復号化を行う復号化手段と、を備える。

【００２４】

本発明の動画像復号化方法は、分離手段が、入力された符号化データを圧縮データと変更方法情報に分離する分離ステップと、参照画像蓄積手段が、参照画像を蓄積する参照画像蓄積ステップと、参照画像付随情報蓄積手段が、参照画像に付随する参照画像付随情報を蓄積する参照画像付随情報蓄積ステップと、画像変更手段が、参照画像を変更方法情報に従って変更する画像変更ステップと、参照画像付随情報変更手段が、参照画像付随情報を変更方法情報に従って変更する参照画像付随情報変更ステップと、復号化手段が、変更された参照画像と変更された参照画像付随情報とを用いて、復号画像の予測信号を生成して、復号画像の復号化を行う復号化ステップと、を備える。

【００２５】

本発明によれば、参照画像蓄積手段が参照画像を蓄積し、参照画像付随情報蓄積手段が参照画像に付随する参照画像付随情報を蓄積するので、符号化対象となる入力画像に対応した情報を蓄積することができる。そして、分離手段が入力された符号化データを圧縮データと変更方法情報に分離し、画像変更手段が参照画像を変更方法情報に従って変更し、参照画像付随情報変更手段が参照画像付随情報を変更方法情報に従って変更し、復号化手段が変更された参照画像と変更された参照画像付随情報とを用いて復号画像の予測信号を生成するので、圧縮データに対応して参照画像および参照画像付随情報を変更し、圧縮データに対応した予測信号を生成することができる。よって、復号化手段が参照画像と参照画像付随情報とを用いて予測信号をより正確に生成することができる。よって、より効率的に圧縮データの復号化を行うことができる。

【００２６】

また、本発明の動画像符号化装置は、復号化手段により復号化された復号化画像を逆変更する画像逆変更手段と、復号化手段から出力された復号化画像に付随する情報を逆変更する参照画像付随情報逆変更手段と、をさらに備え、参照画像蓄積手段は画像逆変更手段が逆変更した情報を参照画像として蓄積し、参照画像付随情報蓄積手段は、参照画像付随情報逆変更手段が逆変更した情報を参照画像付随情報として蓄積することも好ましい。

【００２７】

また、動画像復号化方法は、画像逆変更手段が、復号化ステップにおいて復号化された復号化画像を逆変更する画像逆変更ステップと、参照画像付随情報逆変更手段が、復号化ステップにおいて復号化された復号化画像に付随する情報を逆変更する参照画像付随情報逆変更ステップと、をさらに備え、参照画像蓄積ステップにおいて、前記画像逆変更ステップにおいて逆変更した情報を参照画像として蓄積し、参照画像付随情報蓄積ステップにおいて、参照画像付随情報逆変更ステップにおいて逆変更した情報を参照画像付随情報として蓄積することも好ましい。

【００２８】

このようにすることにより、次に入力される復号化画像に対応した参照画像と参照画像付随情報とを生成することができる。

【００２９】

また、本発明の動画像復号化装置の参照画像付随情報は参照画像の動きベクトルであることも好ましい。

【００３０】

また、本発明の動画像復号化方法における参照画像付随情報は参照画像の動きベクトルであることも好ましい。

【発明の効果】

【００３１】
的確な予測信号を生成してより効率的に画像情報の符号化及び復号化をすることができる。
【発明を実施するための最良の形態】
【００３２】
本発明の実施形態に係わる動画像符号化装置および動画像復号化装置について図面を参照して説明する。なお、各図において、同一要素には同一符号を付して重複する説明を省略する。
【００３３】
（第1実施形態）
図２を用いて、本発明に係わる動画像符号化装置を説明する。
【００３４】
本発明に係る動画像符号化装置２０は、その機能的な構成要素として、入力部２０１（入力手段）と、参照画像蓄積部２０２（参照画像蓄積手段）と、参照画像付随情報蓄積部２０３（参照画像付随情報蓄積手段）と、画像反転部２０４（画像変更手段）と、参照画像付随情報反転部２０５（参照画像付随情報変更手段）と、符号化部２０６（符号化手段）と、画像逆反転部２０７（画像逆変更手段）と、参照画像付随情報逆反転部２０８（参照画像付随情報逆変更手段）と、出力部２０９（出力手段）とを備えて構成される。
【００３５】
入力部２０１は、入力された動画像信号２１０をフレーム画像に分離し、フレーム画像を入力画像２１１として画像反転部２０４に送る。
【００３６】
参照画像蓄積部２０２は、過去に符号化された画像の局所復号化済み画像である参照画像を蓄積する部分である。参照画像蓄積部２０２は参照画像２１２を画像反転部２０４に送る。
【００３７】
画像反転部２０４は、入力部２０１から送られた入力画像２１１を、反転なし、上下方向反転、左右方向反転、上下左右方向反転の４種類の中から選んで反転して、反転入力画像２１３を作成し、符号化部２０６に送る。また、画像反転部２０４は参照画像蓄積部２０２から送られた参照画像２１２を、入力画像２１１の反転方向と同じ方向に反転して、反転参照画像２１４を作成し、符号化部２０６に送る。また、画像反転部２０４は、入力画像２１１の反転方向を示す反転方向情報２１５を参照画像付随情報反転部２０５と、画像逆反転部２０７と、参照画像付随情報逆反転部２０８と、出力部２０９に送る。
【００３８】
参照画像付随情報蓄積部２０３は、過去に符号化された画像の局所復号化済み画像である参照画像に付随する情報である、参照画像付随情報を蓄積する部分である。参照画像付随情報蓄積部２０３は参照画像付随情報２１６を参照画像付随情報反転部２０５に送る。
【００３９】
参照画像付随情報反転部２０５は、画像反転部２０４から送られた反転方向情報２１５を用いて、参照画像付随情報蓄積部２０３から送られた参照画像付随情報２１６を入力画像の反転方向と同じ方向に合わせて反転し、反転参照画像付随情報２１７を作成し、符号化部２０６に送る。
【００４０】
符号化部２０６は、画像反転部２０４から送られた反転参照画像２１４と、参照画像付随情報反転部２０５から送られた反転参照画像付随情報２１７を用いて、画像反転部２０４から送られた反転入力画像２１３の予測信号を生成し、反転された入力画像の符号化を行う。符号化部２０６は反転された入力画像を符号化した圧縮データ２１８を出力部２０９に送る。また符号化部２０６は、反転されて局所復号化された反転局所復号化画像２１９を画像逆反転部２０７に送る。さらに符号化部２０６は、反転局所復号化画像付随情報２２０を参照画像付随情報逆反転部２０８に送る。

【００４１】
画像逆反転部２０７は、画像反転部２０４から送られた反転方向情報２１５を用いて、符号化部２０６から送られた反転局所復号化画像２１９を入力画像の反転方向と逆方向に反転して局所復号化画像２２１を生成し、次フレーム以降で参照画像として用いられるために参照画像蓄積部２０２に送る。
【００４２】
参照画像付随情報逆反転部２０８は、画像反転部２０４から送られた反転方向情報２１５を用いて、符号化部２０６から送られた反転局所復号化画像付随情報２２０を入力画像の反転方向と逆方向に反転して局所復号化画像付随情報２２２を生成し、次フレーム以降で参照画像付随情報として用いられるために参照画像付随情報蓄積部２０３に送る。
【００４３】
出力部２０９は、画像反転部２０４から送られた反転方向情報２１５と符号化部２０６から送られた圧縮データ２１８を合わせて、符号化データ２２３として外部へ伝送する。なお、反転方向情報２１５は、反転なしが「００」、上下方向反転が「０１」、左右方向反転が「１０」、上下左右方向反転が「１１」のようにフレームごとに２ビットの情報とする。また、反転方向情報２１５は上記以外に反転方向を示すあらゆる方法を用いることができる。
【００４４】
なお、参照画像付随情報２１６の一例としては、参照画像を生成する際に用いられた動きベクトルが挙げられる。この場合、参照画像付随情報蓄積部２０３は、参照画像を生成する際に用いられた動きベクトルを蓄積する。また、参照画像付随情報反転部２０５は、画像反転部２０４から送られた反転方向情報２１５を用いて、参照画像付随情報蓄積部２０３から送られた動きベクトルを入力画像の反転方向と同じ方向に合わせて反転し、反転参照画像付随情報２１７を生成する。
【００４５】
具体的には、参照画像付随情報反転部２０５は、参照画像付随情報蓄積部２０３から送られた動きベクトルが（ＭＶ１ｘ、ＭＶ１ｙ）であった場合、反転方向情報２１５が反転なしのときは反転参照画像付随情報として反転動きベクトルを（ＭＶ１ｘ、ＭＶ１ｙ）とし、反転方向情報２１５が上下方向反転のときは反転参照画像付随情報として反転動きベクトルを（ＭＶ１ｘ、-ＭＶ１ｙ）とし、反転方向情報２１５が左右方向反転ときは反転参照画像付随情報として反転動きベクトルを（-ＭＶ１ｘ、ＭＶ１ｙ）とし、反転方向情報２１５が上下左右方向反転ときは反転参照画像付随情報として反転動きベクトルを（-ＭＶ１ｘ、-ＭＶ１ｙ）として生成する。また、動きベクトルのフレーム内での位置も、入力画像や参照画像の画素の位置と同様に、反転方向に応じて反転される。
【００４６】
図５（ａ）は参照画像を生成する際に用いられた動きベクトルを示す。図５（ｂ）は反転なしの場合の反転動きベクトルを示す。すなわち、図５（ｂ）は図５（ａ）と同じ向きの動きベクトルである。図５（ｃ）は上下方向反転の場合の反転動きベクトルを示す。図５（ｄ）は左右方向反転の場合の反転動きベクトルを示す。図５（ｅ）は上下左右方向反転の場合の反転動きベクトルを示す。また、参照画像付随情報逆反転部２０８は、画像反転部２０４から送られた反転方向情報２１５を用いて、符号化部２０６から送られた反転動きベクトルを入力画像の反転方向と逆方向に反転して局所復号化画像付随情報２２２を生成する。具体的には、参照画像付随情報逆反転部２０８は、符号化部２０６から送られた反転動きベクトルが（ＭＶ２ｘ、ＭＶ２ｙ）であった場合、反転方向情報２１５が反転なしのときは局所復号化画像付随情報として動きベクトルを（ＭＶ２ｘ、ＭＶ２ｙ）とし、反転方向情報２１５が上下方向反転のときは局所復号化画像付随情報として動きベクトルを（ＭＶ２ｘ、-ＭＶ２ｙ）とし、反転方向情報２１５が左右方向反転ときは局所復号化画像付随情報として動きベクトルを（-ＭＶ２ｘ、ＭＶ２ｙ）とし、反転方向情報２１５が上下左右方向反転ときは局所復号化画像付随情報として動きベクトルを（-ＭＶ２ｘ、-ＭＶ２ｙ）として生成する。

【００４７】
また、反転動きベクトルのフレーム内での位置も、反転局所復号化画像の画素の位置と同様に、反転方向に応じて逆方向に反転される。図５（ｆ）は反転なしの場合の反転動きベクトル（図５（ｂ））を逆方向に反転した動きベクトルを示す。すなわち、図５（ｆ）は、図５（ａ）及び（ｂ）と同じ向きの動きベクトルである。図５（ｇ）は上下方向反転した反転動きベクトル（図５（ｃ））を逆方向に反転した動きベクトルを示す。図５（ｈ）は左右方向反転した反転動きベクトル（図５（ｄ））を逆方向に反転した動きベクトルを示す。図５（ｉ）は上下左右方向反転した反転動きベクトル（図５（ｅ））を逆方向に反転した動きベクトルを示す。但し、参照画像付随情報は上記の動きベクトルに限らず、参照画像を生成する際に用いられたあらゆる付随情報を用いることができる。

【００４８】
また、符号化部２０６で使用する符号化方式の一例としては、Ｈ．２６４／ＡＶＣ符号化方式（joint Video Team (JVT) of ISO/IEC MPEG and ITU-VCEG, “Editor’s Proposed Draft Text Modifications for Joint Video Specification(ITU-T Rec.H.264|ISO/IEC 14496-10 AVC”），Geneva modifications draft 37を参照)が挙げられる。但し、上記のＨ．２６４／ＡＶＣ符号化方式に限らず、参照画像と参照画像に付随する情報から入力画像の予測信号を生成して符号化を行うあらゆる方式の符号化法を適用することができる。

【００４９】
図３を用いて符号化部２０６をさらに詳細に説明する。

【００５０】
符号化部２０６は、その機能的な構成要素として、ブロック分割部３０１と、予測信号生成部３０２と、減算器３０３と、変換部３０４と、量子化部３０５と、エントロピー符号化部３０６と、逆量子化部３０７と、逆変換部３０８と、加算器３０９とを備えて構成される。

【００５１】
ブロック分割部３０１は、反転入力画像２１３を符号化処理する単位のブロックに分割して反転入力画像ブロック３１０を生成し、減算器３０３に送る。

【００５２】
予測信号生成部３０２は、反転参照画像２１４と反転参照画像付随情報２１７を用いて符号化対象のブロックの予測信号３１１を生成し、減算器３０３と加算器３０９に送る。また、予測信号生成部３０２は、予測信号の生成に用いた符号化情報３１２をエントロピー符号化部３０６に送る。さらに、予測信号生成部３０２は、予測信号の生成により決定された反転局所復号化画像付随情報２２０を出力する。

【００５３】
減算器３０３は、ブロック分割部３０１から送られた反転入力画像ブロック３１０から、予測信号生成部３０２から送られた予測信号３１１を減算して残差信号３１３を生成し、変換部３０４に送る。

【００５４】
変換部３０４は、減算器３０３から送られた残差信号３１３を直交変換して直交変換係数３１４を生成し、量子化部３０５に送る。

【００５５】
量子化部３０５は、変換部３０４から送られた直交変換係数３１４を量子化することにより、量子化直交変換係数３１５を生成し、エントロピー符号化部３０６と逆量子化部３０７に送る。

【００５６】
エントロピー符号化部３０６は、予測信号生成部３０２から送られた符号化情報３１２と、量子化部３０５から送られた量子化直交変換係数３１５を合わせてエントロピー符号化し、圧縮データ２１８を生成して出力する。

【００５７】

逆量子化部３０７は、量子化部３０５から送られた量子化直交変換係数３１５を逆量子化して局所復号化直交変換係数３１６を生成し、逆変換部３０８に送る。

【００５８】

逆変換部３０８は、逆量子化部３０７から送られた局所復号化直交変換係数３１６を逆直交変換して局所復号化残差信号３１７を生成し、加算器３０９に送る。

【００５９】

加算器３０９は、予測信号生成部３０２から送られた予測信号３１１と、逆変換部３０８から送られた局所復号化残差信号３１７を加算して反転局所復号化画像２１９を生成し、出力する。

【００６０】

なお、反転参照画像付随情報２１７の一例として、反転動きベクトルが挙げられる。この場合、予測信号生成部３０２は反転参照画像２１４と、反転参照画像付随情報２１７である反転動きベクトルを用いて、Ｈ．２６４／ＡＶＣ符号化方式におけるＢピクチャの時間ダイレクトモードの予測方式と同様に、符号化ブロックの予測信号を生成する。また、予測信号生成部３０２は参照画像と参照画像に付随する動きベクトルから入力画像の予測信号を生成するその他のあらゆる方式を用いても良い。

【００６１】

また、符号化部２０６は図４に示すような装置としても良い。

【００６２】

図３と図４の違いは、図３では予測信号生成部３０２が、反転参照画像２１４と、反転参照画像付随情報２１７を用いて予測信号を生成しているのに対し、図４では予測信号生成部３０２が反転参照画像２１４と、反転参照画像付随情報２１７と、ブロック分割部３０１から送られた反転入力画像ブロック３１０を用いて予測信号を生成している点のみであり、その他は全て同一である。

【００６３】

図４に示す予測信号生成部３０２において、反転参照画像付随情報２１７として反転動きベクトルを用いて、反転入力画像ブロック３１０と反転参照画像２１４から符号化対象ブロックの予測信号を生成する方法は次の通りである。すなわち図６のように、予測信号生成部３０２は、符号化対象のブロックと同一の位置の反転動きベクトルを参照し、反転参照画像上において、反転動きベクトルの指す点を探索中心として反転入力画像ブロックに最も類似する信号パターンを持つブロックを探索して、そのブロックの信号パターンを符号化対象ブロックの予測信号とする。

【００６４】

また、予測信号生成部３０２は符号化対象のブロックの位置から反転入力画像ブロックに最も類似する信号パターンを持つブロックまでの変位のベクトルを、反転局所復号化画像付随情報２２０として出力する。さらに、反転動きベクトルの指す点である探索中心から、反転入力画像ブロックに最も類似する信号パターンを持つブロックまでの変位のベクトルを、動きベクトル差分値として符号化情報３１２に含めて符号化する。なお予測信号生成部３０２は、参照画像と参照画像に付随する動きベクトルと入力画像を用いて、入力画像の予測信号を生成するその他のあらゆる方式を用いても良い。

【００６５】

次に、図７を用いて、本発明にかかわる動画像符号化装置２０の動作を説明する。本発明に係る動画像符号化装置２０の動作は、プログラムにより実行可能である。

【００６６】

まず、入力部２０１が入力された動画像信号２１０をフレーム画像に分離する（ステップＳ６０１）。次に、画像反転部２０４が、入力部２０１から送られた入力画像２１１を、反転なし、上下方向反転、左右方向反転、上下左右方向反転の４種類の中から選んで（ステップＳ６０２）反転し、反転入力画像２１３を作成する（ステップＳ６０３）。また、画像反転部２０４が参照画像蓄積部２０２から送られた参照画像２１２を、入力画像２１１の反転方向と同じ方向に反転して、反転参照画像２１４を作成する（ステップＳ６０

４）また、参照画像付随情報反転部２０５が、画像反転部２０４から送られた反転方向情報２１５を用いて、参照画像付随情報２１６を入力画像の反転方向と同じ方向に合わせて反転し、反転参照画像付随情報２１７を作成する（ステップＳ６０５）。

【００６７】

次に、符号化部２０６が、画像反転部２０４から送られた反転参照画像２１４と、参照画像付随情報反転部２０５から送られた反転参照画像付随情報２１７を用いて、画像反転部２０４から送られた反転入力画像２１３の予測信号を生成し、反転された入力画像の符号化を行う（ステップＳ６０６）。

【００６８】

次に、画像逆反転部２０７が、画像反転部２０４から送られた反転方向情報２１５を用いて、符号化部２０６から送られた反転局所復号化画像２１９を入力画像の反転方向と逆方向に反転して局所復号化画像２２１を生成する（ステップＳ６０７）。また、参照画像付随情報逆反転部２０８が、画像反転部２０４から送られた反転方向情報２１５を用いて、符号化部２０６から送られた反転局所復号化画像付随情報を入力画像の反転方向と逆方向に反転して局所復号化画像付随情報２２２を生成する（ステップＳ６０８）。

【００６９】

また、出力部２０９は、画像反転部２０４から送られた反転方向情報２１５と符号化部２０６から送られた圧縮データ２１８を合成し（ステップＳ６０９）、符号化データ２２３として外部へ伝送する（ステップＳ６１０）。

【００７０】

次に、図８を用いて、本発明に係わる動画像復号化装置を説明する。

【００７１】

本発明に係る動画像復号化装置７０は、その機能的な構成要素として、分離部７０１（分離手段）と、参照画像蓄積部７０２（参照画像蓄積手段）と、参照画像付随情報蓄積部７０３（参照画像付随情報蓄積手段）と、画像反転部７０４（画像変更手段）と、参照画像付随情報反転部７０５（参照画像付随情報変更手段）と、復号化部７０６（復号化手段）と、画像逆反転部７０７（画像逆反転手段）と、参照画像付随情報逆反転部７０８（参照画像付随情報逆反転手段）とを備えて構成される。

【００７２】

分離部７０１は、外部から伝送された入力された符号化データ７０９を圧縮データ７１０と反転方向情報７１１に分離する。分離部７０１は、圧縮データ７１０を復号化部７０６に送る。また、分離部７０１は、反転方向情報７１１を画像反転部７０４と、参照画像付随情報反転部７０５と、画像逆反転部７０７と、参照画像付随情報逆反転部７０８に送る。なお、反転方向情報７１１は、反転なしが「００」、上下方向反転が「０１」、左右方向反転が「１０」、上下左右方向反転が「１１」のようにフレームごとに２ビットの情報とする。また、反転方向情報７１１は反転方向を示すあらゆる方法を用いることができる。

【００７３】

参照画像蓄積部７０２は、過去の復号化済み画像である参照画像を蓄積する部分である。参照画像蓄積部７０２は参照画像７１２を画像反転部７０４に送る。

【００７４】

画像反転部７０４は、分離部７０１から送られた反転方向情報７１１を用いて、参照画像蓄積部７０２から送られた参照画像７１２を反転して反転参照画像７１３を生成し、復号化部７０６に送る。

【００７５】

参照画像付随情報蓄積部７０３は、過去の復号化済み画像である参照画像に付随する情報である参照画像付随情報を蓄積する部分である。参照画像付随情報蓄積部７０３は参照画像付随情報７１４を参照画像付随情報反転部７０５に送る。

【００７６】

参照画像付随情報反転部７０５は、分離部７０１から送られた反転方向情報７１１用い

て、参照画像付随情報蓄積部７０３から送られた参照画像付随情報７１４を反転して反転参照画像付随情報７１５を作成し、復号化部７０６に送る。

【００７７】

復号化部７０６は、分離部７０１から送られた圧縮データ７１０と、画像反転部７０４から送られた反転参照画像７１３と、参照画像付随情報反転部７０５から送られた反転参照画像付随情報７１５を用いて、復号化画像の予測信号を生成し、反転された復号対象である復号化画像の復号化を行う。復号化部７０６は、反転されて復号化された反転復号化画像７１６を画像逆反転部７０７に送る。さらに復号化部７０６は、反転復号化画像付随情報７１７を参照画像付随情報逆反転部７０８に送る。

【００７８】

画像逆反転部７０７は、分離部７０１から送られた反転方向情報７１１を用いて、復号化部７０６から送られた反転復号化画像７１６を反転方向情報７１１の反転方向と逆方向に反転して復号化画像７１８を生成し、次フレーム以降で参照画像として用いられるために参照画像蓄積部７０２に送る。また、画像逆反転部７０７は復号化画像７１８を動画像表示装置などの外部機器(図示せず)へ出力する。

【００７９】

参照画像付随情報逆反転部７０８は、分離部７０１から送られた反転方向情報７１１を用いて、復号化部７０６から送られた反転復号化画像付随情報７１７を反転方向情報の反転方向と逆方向に反転して復号化画像付随情報７１９を生成し、次フレーム以降で参照画像付随情報として用いられるために参照画像付随情報蓄積部７０３に送る。

【００８０】

なお、参照画像付随情報の一例としては、参照画像を生成する際に用いられた動きベクトルが挙げられる。この場合、参照画像付随情報蓄積部７０３は参照画像を生成する際に用いられた動きベクトルを蓄積する。また、参照画像付随情報反転部７０５は、分離部７０１から送られた反転方向情報７１１を用いて、参照画像付随情報蓄積部７０３から送られた動きベクトルを反転方向情報の反転方向と同じ方向に合わせて反転し、反転参照画像付随情報７１５を生成する。

【００８１】

具体的には、参照画像付随情報反転部７０５は、参照画像付随情報蓄積部７０３から送られた動きベクトルが（ＭＶ３ｘ、ＭＶ３ｙ）であった場合、反転方向情報７１１が反転なしのときは反転参照画像付随情報として反転動きベクトルを（ＭＶ３ｘ、ＭＶ３ｙ）とし、反転方向情報７１１が上下方向反転のときは反転参照画像付随情報として反転動きベクトルを（ＭＶ３ｘ、-ＭＶ３ｙ）とし、反転方向情報７１１が左右方向反転ときは反転参照画像付随情報として反転動きベクトルを（-ＭＶ３ｘ、ＭＶ３ｙ）とし、反転方向情報７１１が上下左右方向反転ときは反転参照画像付随情報として反転動きベクトルを（-ＭＶ３ｘ、-ＭＶ３ｙ）として生成する。また、動きベクトルのフレーム内での位置も反転方向に応じて反転される。

【００８２】

さらに、参照画像付随情報逆反転部７０８は、分離部７０１から送られた反転方向情報７１１を用いて、復号化部７０６から送られた反転動きベクトルを反転方向情報の反転方向と逆方向に反転して復号化画像付随情報７１９を生成する。具体的には、参照画像付随情報逆反転部７０８は、復号化部７０６から送られた反転動きベクトルが（ＭＶ４ｘ、ＭＶ４ｙ）であった場合、反転方向情報７１１が反転なしのときは復号化画像付随情報として動きベクトルを（ＭＶ４ｘ、ＭＶ４ｙ）とし、反転方向情報７１１が上下方向反転のときは復号化画像付随情報として動きベクトルを（ＭＶ４ｘ、-ＭＶ４ｙ）とし、反転方向情報７１１が左右方向反転ときは復号化画像付随情報として動きベクトルを（-ＭＶ４ｘ、ＭＶ４ｙ）とし、反転方向情報７１１が上下左右方向反転ときは局所復号化画像付随情報として動きベクトルを（-ＭＶ４ｘ、-ＭＶ４ｙ）として生成する。また、動きベクトルのフレーム内での位置も反転方向に応じて逆方向に反転される。但し、参照画像付随情報は上記の動きベクトルに限らず、参照画像を生成する際に用いられたあらゆる付随情報を

用いることができる。

【００８３】

また、復号化部７０６で使用する復号化方式の一例としては、Ｈ．２６４／ＡＶＣ復号化方式が挙げられる。但し、上記のＨ．２６４／ＡＶＣ復号化方式に限らず、参照画像と参照画像に付随する情報から復号化画像の予測信号を生成して復号化を行うあらゆる方式の復号化法を適用することができる。

【００８４】

図９を用いて復号化部７０６をさらに詳細に説明する。

【００８５】

復号化部７０６は、その機能的な構成要素として、エントロピー復号化部８０１と、予測信号生成部８０２と、逆量子化部８０３と、逆変換部８０４と加算器８０５とを備えて構成される。

【００８６】

エントロピー復号化部８０１は、入力された圧縮データ７１０から量子化直交変換係数８０６と符号化情報８０７を復号化し、量子化直交変換係数８０６を逆量子化部８０３に送り、符号化情報８０７を予測信号生成部８０２に送る。

【００８７】

予測信号生成部８０２は、エントロピー復号化部８０１から送られた符号化情報８０７と、反転参照画像７１３と、反転参照画像付随情報７１５を用いて復号化対象のブロックの予測信号８０８を生成し、加算器８０５に送る。また、予測信号生成部８０２は、反転復号化画像付随情報７１７を出力する。

【００８８】

逆量子化部８０３は、エントロピー復号化部８０１から送られた量子化直交変換係数８０６を逆量子化して復号化直交変換係数８０９を生成し、逆変換部８０４に送る。

【００８９】

逆変換部８０４は、逆量子化部８０３から送られた復号化直交変換係数８０９を逆直交変換して復号化残差信号８１０を生成し、加算器８０５に送る。

【００９０】

加算器８０５は、予測信号生成部８０２から送られた予測信号８０８と、逆変換部８０４から送られた復号化残差信号８１０を加算して反転復号化画像７１６を生成し、出力する。

【００９１】

なお、反転参照画像付随情報の一例として、反転動きベクトルが挙げられる。この場合、予測信号生成部８０２は、Ｈ．２６４／ＡＶＣ符号化方式におけるＢピクチャの時間ダイレクトモードの予測方式を用いて、反転参照画像と反転動きベクトルを利用して復号化対象のブロックの予測値を生成しても良い。また、図６のように、予測信号生成部８０２は復号化対象のブロックと同一の位置の反転動きベクトルが指す点を探索中心とし、反転参照画像上で探索中心から符号化情報８０７に含まれる動きベクトル差分値のベクトルだけ移動した位置の信号パターンを復号化対象のブロックの予測値としてもよい。予測信号生成部８０２は参照画像と参照画像に付随する動きベクトルから復号化画像の予測信号を生成するその他のあらゆる方式を用いることができる。

【００９２】

次に、図１０を用いて、本発明にかかわる動画像復号化装置７０の動作を説明する。本発明に係る動画像復号化装置７０の動作は、プログラムにより実行可能である。

【００９３】

まず、分離部７０１が、外部から伝送された入力された符号化データ７０９を圧縮データ７１０と反転方向情報７１１に分離し（ステップＳ９０１）、反転方向を判別する（ステップＳ９０２）。

【００９４】

次に、画像反転部７０４が、分離部７０１から送られた反転方向情報７１１を用いて、

参照画像蓄積部７０２から送られた参照画像７１２を反転して反転参照画像７１３を生成する（ステップＳ９０３）。また、参照画像付随情報反転部７０５が、分離部７０１から送られた反転方向情報７１１用いて、参照画像付随情報蓄積部７０３から送られた参照画像付随情報７１４を反転して反転参照画像付随情報７１５を作成する（ステップＳ９０４）。

【００９５】

次に、復号化部７０６が、分離部７０１から送られた圧縮データ７１０と、画像反転部７０４から送られた反転参照画像７１３と、参照画像付随情報反転部７０５から送られた反転参照画像付随情報７１５を用いて、復号化画像の予測信号を生成し、反転された復号化画像の復号化を行う（ステップＳ９０５）。

【００９６】

次に、画像逆反転部７０７が、分離部７０１から送られた反転方向情報７１１を用いて、復号化部７０６から送られた反転復号化画像７１６を反転方向情報７１１の反転方向と逆方向に反転して復号化画像７１８を生成する（ステップＳ９０６）。また、画像逆反転部７０７が復号化画像７１８を動画像表示装置などの外部機器(図示せず)へ出力する（ステップＳ９０７）。

【００９７】

また、参照画像付随情報逆反転部７０８が、分離部７０１から送られた反転方向情報７１１を用いて、復号化部７０６から送られた反転復号化画像付随情報を反転方向情報の反転方向と逆方向に反転して復号化画像付随情報７１９を生成する（ステップＳ９０８）。

【００９８】

以上述べた第１実施形態によれば、動画像符号化装置２０において、参照画像および参照画像に付随する情報を入力画像の反転方向に合わせて反転して予測信号を生成するので、入力画像を正しく符号化することができる。また、動画像復号化装置７０において、参照画像および参照画像に付随する情報を伝送された反転方向情報に合わせて反転して予測信号を生成することで復号化画像を正しく復号化することができる。すなわち、的確な予測信号を生成してより効率的に画像の符号化及び復号化を行うことができる。

【００９９】

また、動画像符号化装置２０において、局所復号化された局所復号化画像を逆変更し、局所復号化画像に付随する情報を逆変更するので、次に入力される入力画像に対応した参照画像と参照画像付随情報とを生成することができる。また、動画像復号化装置７０において、復号化された復号化画像を逆変更し、復号化された復号化画像に付随する情報を逆変更するので、次に入力される復号化画像に対応した参照画像と参照画像付随情報とを生成することができる。

【０１００】

なお、入力画像を反転させる単位は、上記フレームごと以外に、スライスごと、ブロックごとでも良い。図１９に、フレーム内の複数列のブロック群からなるスライスごとに入力画像を反転させた場合の例を示す。ブロック０～１５で構成されるスライスは上下左右方向に、ブロック１６～３１で構成されるスライスは上下方向に、ブロック３２～３９で構成されるスライスは左右方向に反転されている。この場合、符号化装置は各スライス単位で反転方向情報、および参照画像での対応するスライスの位置までの垂直方向の変位量を伝送する。また、復号化装置は各スライス単位で反転方向情報、および参照画像での対応するスライスの位置までの垂直方向の変位量を受信することとする。

【０１０１】

さらに図２０に、フレーム内の任意形状のブロック群からなるスライスごとに入力画像を反転させた場合の例を示す。ブロック１２～１４と２０～２２と２７～３０からなるスライスは上下方向に、残りのブロックからなるスライスは左右方向に反転されている。この場合、符号化装置は各スライス単位で反転方向情報、およびスライス内のブロック番号に基づく参照画像での対応するスライスの位置と形状を指示する情報を伝送する。また、復号化装置は各スライス単位で反転方向情報、およびスライス内のブロック番号に基づく

参照画像での対応するスライスの位置と形状を指示する情報を受信することとする。

【０１０２】

なお、動画像符号化装置２０において、符号化部２０６が画像反転部２０４および参照画像付随情報反転部２０５の機能を有していてもよい。また、動画像復号化装置７０において、復号化部７０６が画像反転部７０４および参照画像付随情報反転部７０５の機能を有していてもよい。

【０１０３】

（第２実施形態）

図１１を用いて、本発明に係わる動画像符号化装置を説明する。

【０１０４】

本発明に係る動画像符号化装置１００は、その機能的な構成要素として、入力部１００１（入力手段）と、参照画像蓄積部１００２（参照画像蓄積手段）と、参照画像付随情報蓄積部１００３（参照画像付随情報蓄積手段）と、画像変更部１００４（画像変更手段）と、参照画像付随情報変更部１００５（参照画像付随情報変更手段）と、符号化部１００６（符号化手段）と、画像逆変更部１００７（画像逆変更部）と、参照画像付随情報逆変更部１００８（参照画像付随情報逆変更手段）と、出力部１００９（出力手段）とを備えて構成される。

【０１０５】

入力部１００１は、入力された動画像信号１０１０をフレーム画像に分離し、フレーム画像を入力画像１０１１として画像変更部１００４に送る。

【０１０６】

参照画像蓄積部１００２は、過去に符号化された画像の局所復号化済み画像である参照画像を蓄積する部分である。参照画像蓄積部１００２は参照画像１０１２を画像変更部１００４に送る。

【０１０７】

画像変更部１００４は、入力部１００１から送られた入力画像１０１１を、回転、拡大、縮小などの変更を行って、変更入力画像１０１３を作成し、符号化部１００６に送る。また、画像変更部１００４は参照画像蓄積部１００２から送られた参照画像１０１２を、入力画像１０１１の変更方法と同じ方法で変更して、変更参照画像１０１４を作成し、符号化部１００６に送る。また、画像変更部１００４は、入力画像１０１１の変更方法を示す変更方法情報１０１５を参照画像付随情報変更部１００５と、画像逆変更部１００７と、参照画像付随情報逆変更部１００８と、出力部１００９に送る。

【０１０８】

参照画像付随情報蓄積部１００３は、過去に符号化された画像の局所復号化済み画像である参照画像に付随する情報である参照画像付随情報を蓄積する部分である。参照画像付随情報蓄積部１００３は参照画像付随情報１０１６を参照画像付随情報変更部１００５に送る。

【０１０９】

参照画像付随情報変更部１００５は、画像変更部１００４から送られた変更方法情報１０１５を用いて、参照画像付随情報蓄積部１００３から送られた参照画像付随情報１０１６を入力画像の変更方法と同じ方法で変更し、変更参照画像付随情報１０１７を作成し、符号化部１００６に送る。

【０１１０】

符号化部１００６は、画像変更部１００４から送られた変更参照画像１０１４と、参照画像付随情報変更部１００５から送られた変更参照画像付随情報１０１７を用いて、画像変更部１００４から送られた変更入力画像１０１３の予測信号を生成し、変更された入力画像の符号化を行う。符号化部１００６は変更された入力画像を符号化した圧縮データ１０１８を出力部１００９に送る。また符号化部１００６は、変更されて局所復号化された変更局所復号化画像１０１９を画像逆変更部１００７に送る。さらに符号化部１００６は、変更局所復号化画像付随情報１０２０を参照画像付随情報逆変更部１００８に送る。

【０１１１】
画像逆変更部１００７は、画像変更部１００４から送られた変更方法情報１０１５を用いて、符号化部１００６から送られた変更局所復号化画像１０１９を入力画像の変更方法と逆の方法で変更して局所復号化画像１０２１を生成し、次フレーム以降で参照画像として用いられるために参照画像蓄積部１００２に送る。
【０１１２】
参照画像付随情報逆変更部１００８は、画像変更部１００４から送られた変更方法情報１０１５を用いて、符号化部１００６から送られた変更局所復号化画像付随情報を入力画像の変更方法と逆の方法で変更して局所復号化画像付随情報１０２２を生成し、次フレーム以降で参照画像付随情報として用いられるために参照画像付随情報蓄積部１００３に送る。
【０１１３】
出力部１００９は、画像変更部１００４から送られた変更方法情報１０１５と符号化部１００６から送られた圧縮データ１０１８を合わせて、符号化データ１０２３として外部へ伝送する。
【０１１４】
なお、上記変更方法は画像および参照画像付随情報の回転、拡大、縮小に限られるものではなく、第１実施形態における画像の反転を含む、あらゆる変更方法を用いることができる。また、上記逆の方法の変更方法は、画像および参照画像付随情報の逆回転、縮小、拡大に限られるものではなく、上記変更の効果を除去するあらゆる変更方法を用いることができる。
【０１１５】
また、符号化部１００６で使用する符号化方式の一例としては、Ｈ．２６４／ＡＶＣ符号化方式が挙げられる。但し、上記のＨ．２６４／ＡＶＣ符号化方式に限らず、参照画像と参照画像に付随する情報から入力画像の予測信号を生成して符号化を行うあらゆる方式の符号化法を適用することができる。
【０１１６】
さらに、符号化部１００６の詳細な説明は、第１実施形態における符号化部２０６の詳細な説明と同一である。
【０１１７】
次に、図１２を用いて、本発明にかかわる動画像符号化装置１００の動作を説明する。本発明に係る動画像符号化装置１００の動作は、プログラムにより実行可能である。
【０１１８】
まず、入力部１００１が入力された動画像信号１０１０をフレーム画像に分離する（ステップＳ１１０１）。次に、画像変更部１００４が、入力部１００１から送られた入力画像１０１１を、回転、拡大、縮小などの変更法を決定して（ステップＳ１１０２）変更し、変更入力画像１０１３を作成する（ステップＳ１１０３）。また、画像変更部１００４が参照画像蓄積部１００２から送られた参照画像１０１２を、入力画像１０１１の変更方法と同じ方法で変更して、変更参照画像１０１４を作成する（ステップＳ１１０４）また、参照画像付随情報変更部１００５が、画像変更部１００４から送られた変更方法情報１０１５を用いて、参照画像付随情報１０１６を入力画像の変更方法と同じ方法で変更し、変更参照画像付随情報１０１７を作成する（ステップＳ１１０５）。
【０１１９】
次に、符号化部１００６が、画像変更部１００４から送られた変更参照画像１０１４と、参照画像付随情報変更部１００５から送られた変更参照画像付随情報１０１７を用いて、画像変更部１００４から送られた変更入力画像１０１３の予測信号を生成し、変更された入力画像の符号化を行う（ステップＳ１１０６）。
【０１２０】
次に、画像逆変更部１００７が、画像変更部１００４から送られた変更方法情報１０１５を用いて、符号化部１００６から送られた変更局所復号化画像１０１９を入力画像の変

更方法と逆の方法で変更して局所復号化画像１０２１を生成する（ステップＳ１１０７）。また、参照画像付随情報逆変更部１００８が、画像変更部１００４から送られた変更方法情報１０１５を用いて、符号化部１００６から送られた変更局所復号化画像付随情報を入力画像の変更方法と逆の方法で変更して局所復号化画像付随情報１０２２を生成する（ステップＳ１１０８）。

【０１２１】

また、出力部１００９は、画像変更部１００４から送られた変更方法情報１０１５と符号化部１００６から送られた圧縮データ１０１８を合成し（ステップＳ１１０９）、符号化データ１０２３として外部へ伝送する（ステップＳ１１１０）。

【０１２２】

次に、図１３を用いて、本発明に係わる動画像復号化装置を説明する。

【０１２３】

本発明に係る動画像復号化装置１２０は、その機能的な構成要素として、分離部１２０１（分離手段）と、参照画像蓄積部１２０２（参照画像蓄積手段）と、参照画像付随情報蓄積部１２０３（参照画像付随情報蓄積手段）と、画像変更部１２０４（画像変更手段）と、参照画像付随情報変更部１２０５（参照画像付随情報変更手段）と、復号化部１２０６（復号化手段）と、画像逆変更部１２０７（画像逆変更手段）と、参照画像付随情報逆変更部１２０８（参照画像付随情報逆変更手段）とを備えて構成される。

【０１２４】

分離部１２０１は、外部から伝送された入力された符号化データ１２０９を圧縮データ１２１０と変更方法情報１２１１に分離する。分離部１２０１は、圧縮データ１２１０を復号化部１２０６に送る。また、分離部１２０１は、変更方法情報１２１１を画像変更部１２０４と、参照画像付随情報変更部１２０５と、画像逆変更部１２０７と、参照画像付随情報逆変更部１２０８に送る。

【０１２５】

参照画像蓄積部１２０２は、過去の復号化済み画像である参照画像を蓄積する部分である。参照画像蓄積部１２０２は参照画像１２１２を画像変更部１２０４に送る。

【０１２６】

画像変更部１２０４は、分離部１２０１から送られた変更方法情報１２１１を用いて、参照画像蓄積部１２０２から送られた参照画像１２１２を変更して変更参照画像１２１３を生成し、復号化部１２０６に送る。

【０１２７】

参照画像付随情報蓄積部１２０３は、過去の復号化済み画像である参照画像に付随する情報である参照画像付随情報を蓄積する部分である。参照画像付随情報蓄積部１２０３は参照画像付随情報１２１４を参照画像付随情報変更部１２０５に送る。

【０１２８】

参照画像付随情報変更部１２０５は、分離部１２０１から送られた変更方法情報１２１１用いて、参照画像付随情報蓄積部１２０３から送られた参照画像付随情報１２１４を変更して変更参照画像付随情報１２１５を作成し、復号化部１２０６に送る。

【０１２９】

復号化部１２０６は、分離部１２０１から送られた符号化データ１２１０と、画像変更部１２０４から送られた変更参照画像１２１３と、参照画像付随情報変更部１２０５から送られた変更参照画像付随情報１２１５を用いて、復号化画像の予測信号を生成し、変更された復号化画像の復号化を行う。復号化部１２０６は、変更されて復号化された変更復号化画像１２１６を画像逆変更部１２０７に送る。さらに復号化部１２０６は、変更復号化画像付随情報１２１７を参照画像付随情報逆変更部１２０８に送る。

【０１３０】

画像逆変更部１２０７は、分離部１２０１から送られた変更方法情報１２１１を用いて、復号化部１２０６から送られた変更復号化画像１２１６を変更方法情報１２１１の変更方法と逆の方法で変更して復号化画像１２１８を生成し、次フレーム以降で参照画像とし

て用いられるために参照画像蓄積部１２０２に送る。また、画像逆変更部１２０７は復号化画像１２１８を動画像表示装置などの外部機器(図示せず)へ出力する。

【０１３１】

参照画像付随情報逆変更部１２０８は、分離部１２０１から送られた変更方法情報１２１１を用いて、復号化部１２０６から送られた変更復号化画像付随情報１２１７を変更方法情報の変更方法と逆の方法で変更して復号化画像付随情報１２１９を生成し、次フレーム以降で参照画像付随情報として用いられるために参照画像付随情報蓄積部１２０３に送る。

【０１３２】

なお、上記変更方法は画像および参照画像付随情報の回転、拡大、縮小に限られるものではなく、第１実施形態における画像の反転を含む、あらゆる変更方法を用いることができる。また、上記逆の方法の変更方法は、画像および参照画像付随情報の逆回転、縮小、拡大に限られるものではなく、上記変更の効果を除去するあらゆる変更方法を用いることができる。

【０１３３】

また、復号化部１２０６で使用する復号化方式の一例としては、Ｈ．２６４／ＡＶＣ復号化方式が挙げられる。但し、上記のＨ．２６４／ＡＶＣ復号化方式に限らず、参照画像と参照画像に付随する情報から復号化画像の予測信号を生成して復号化を行うあらゆる方式の復号化法を適用することができる。

【０１３４】

さらに、復号化部１２０６の詳細な説明は、第１実施形態における復号化部７０６の詳細な説明と同一である。

【０１３５】

次に、図１４を用いて、本発明にかかわる動画像復号化装置１２０の動作を説明する。本発明に係る動画像復号化装置１２０の動作は、プログラムにより実行可能である。

【０１３６】

まず、分離部１２０１が、外部から伝送された入力された符号化データ１２０９を圧縮データ１２１０と変更方法情報１２１１に分離し（ステップＳ１３０１）、変更方法を判別する（ステップＳ１３０２）。

【０１３７】

次に、画像変更部１２０４が、分離部１２０１から送られた変更方法情報１２１１を用いて、参照画像蓄積部１２０２から送られた参照画像１２１２を変更して変更参照画像１２１３を生成する（ステップＳ１３０３）。また、参照画像付随情報変更部１２０５が、分離部１２０１から送られた変更方法情報１２１１用いて、参照画像付随情報蓄積部１２０３から送られた参照画像付随情報１２１４を変更して変更参照画像付随情報１２１５を作成する（ステップＳ１３０４）。

【０１３８】

次に、復号化部１２０６が、分離部１２０１から送られた符号化データ１２１０と、画像変更部１２０４から送られた変更参照画像１２１３と、参照画像付随情報変更部１２０５から送られた変更参照画像付随情報１２１５を用いて、復号化画像の予測信号を生成し、変更された復号化画像の復号化を行う（ステップＳ１３０５）。

【０１３９】

次に、画像逆変更部１２０７が、分離部１２０１から送られた変更方法情報１２１１を用いて、復号化部１２０６から送られた変更復号化画像１２１６を変更方法情報１２１１の変更方法と逆の方法で変更して復号化画像１２１８を生成する（ステップＳ１３０６）。また、画像逆変更部１２０７が復号化画像１２１８を動画像表示装置などの外部機器(図示せず)へ出力する（ステップＳ１３０７）。

【０１４０】

また、参照画像付随情報逆変更部１２０８が、分離部１２０１から送られた変更方法情報１２１１を用いて、復号化部１２０６から送られた変更復号化画像付随情報を変更方法

情報の変更方法と逆の方法で変更して復号化画像付随情報１２１９を生成する（ステップＳ１３０８）。

【０１４１】

以上述べた第２実施形態によれば、参照画像および参照画像に付随する情報を入力画像の変更方法に合わせて変更して予測信号を生成するので、入力画像を正しく符号化することができる。また、参照画像および参照画像に付随する情報を伝送された変更方法情報に合わせて変更して予測信号を生成することで復号化画像を正しく復号化することができる。すなわち、的確な予測信号を生成してより効率的に画像の符号化及び復号化を行うことができる。

【０１４２】

なお、入力画像を変更させる単位は上記のフレームごと以外に、スライスごとでも、ブロックごとでも良く、この場合、符号化装置は各単位で変更方法情報を伝送し、復号化装置は各単位で変更方法情報を受信することとする。

【０１４３】

（第２実施形態の変更例１）

次に、第２実施形態の変更例１について説明する。本変更例は、入力画像と参照画像の方向や大きさが異なる場合、参照画像および参照画像に付随する情報を入力画像の方向や大きさに合わせることにより、高い符号化効率で符号化および復号化する動画像符号化装置および動画像復号化装置について述べる。

【０１４４】

図１５を用いて、本発明に係わる動画像符号化装置を説明する。

【０１４５】

本発明に係る動画像符号化装置１４０は、その機能的な構成要素として、入力部１４０１と、参照画像蓄積部１４０２と、参照画像付随情報蓄積部１４０３と、画像変更部１４０４と、参照画像付随情報変更部１４０５と、符号化部１４０６と、出力部１４０７とを備えて構成される。

【０１４６】

入力部１４０１は、入力された動画像信号１４０８をフレーム画像に分離し、フレーム画像を入力画像１４０９として画像変更部１４０４と符号化部１４０６に送る。

【０１４７】

参照画像蓄積部１４０２は、過去に符号化された画像の局所復号化済み画像である参照画像を蓄積する部分である。参照画像蓄積部１４０２は参照画像１４１０を画像変更部１４０４に送る。

【０１４８】

画像変更部１４０４は、入力部１４０１から送られた入力画像１４０９と参照画像蓄積部１４０２から送られた参照画像１４１０を比較して、入力画像１４０９に合うように参照画像１４１０を変更して変更参照画像１４１１を作成し、符号化部１４０６に送る。また、画像変更部１４０４は参照画像１４１０の変更方法を示す変更方法情報１４１２を参照画像付随情報変更部１４０５と出力部１４０７に送る。このようにすることにより、本発明の動画像符号化装置１４０において画像逆変更部を省くことができる。

【０１４９】

参照画像付随情報蓄積部１４０３は、過去に符号化された画像の局所復号化済み画像である参照画像に付随する情報である参照画像付随情報を蓄積する部分である。参照画像付随情報蓄積部１４０３は参照画像付随情報１４１３を参照画像付随情報変更部１４０５に送る。

【０１５０】

参照画像付随情報変更部１４０５は、画像変更部１４０４から送られた変更方法情報１４１２を用いて、参照画像付随情報蓄積部１４０３から送られた参照画像付随情報１４１３を変更し、変更参照画像付随情報１４１４を作成し、符号化部１４０６に送る。このように参照画像付随情報変更部１４０５は、画像変更部１４０４から送られた変更方法情報

１４１２を用いて変更参照画像付随情報１４１４を作成するので、本発明の動画像符号化装置１４０において、参照画像付随情報逆変更部を省くことができる。

【０１５１】

符号化部１４０６は、入力部１４０１から送られた入力画像１４０９と、画像変更部１４０４から送られた変更参照画像１４１１と、参照画像付随情報変更部１４０５から送られた変更参照画像付随情報１４１４を用いて、入力画像１４０９の予測信号を生成し、入力画像の符号化を行う。符号化部１００６は入力画像を符号化した圧縮データ１４１５を出力部１４０７に送る。また符号化部１４０６は、局所復号化された局所復号化画像１４１６を生成し、次フレーム以降で参照画像として用いられるために参照画像蓄積部１４０２に送る。さらに符号化部１４０６は、変更局所復号化画像付随情報１４１７を生成し、次フレーム以降で参照画像付随情報として用いられるために参照画像付随情報蓄積部１４０３に送る。

【０１５２】

出力部１４０７は、画像変更部１４０４から送られた変更方法情報１４１２と符号化部１４０６から送られた圧縮データ１４１５を合わせて、符号化データ１４１８として外部へ伝送する。

【０１５３】

なお、上記変更方法は画像および参照画像付随情報の回転、拡大、縮小に限られるものではなく、第１実施形態における画像の反転を含む、あらゆる変更方法を用いることができる。

【０１５４】

また、符号化部１４０６で使用する符号化方式の一例としては、Ｈ．２６４／ＡＶＣ符号化方式が挙げられる。但し、上記のＨ．２６４／ＡＶＣ符号化方式に限らず、参照画像と参照画像に付随する情報から入力画像の予測信号を生成して符号化を行うあらゆる方式の符号化法を適用することができる。

【０１５５】

さらに、符号化部１４０６の詳細な説明は、第１実施形態における符号化部２０６の詳細な説明とほぼ同一である。符号化部２０６との違いは、符号化部２０６が反転入力画像２１３を入力するのに対して、符号化部１４０６が入力画像１４０９を入力する点だけである。

【０１５６】

次に、図１６を用いて、本発明にかかわる動画像符号化装置１４０の動作を説明する。本発明に係る動画像符号化装置１４０の動作は、プログラムにより実行可能である。

【０１５７】

まず、入力部１４０１が入力された動画像信号１４０８をフレーム画像に分離する（ステップＳ１５０１）。次に、画像変更部１４０４が、入力部１４０１から送られた入力画像１４０９と参照画像蓄積部１４０２から送られた参照画像１４１０を比較し（ステップＳ１５０２）、入力画像１４０９に合うように参照画像１４１０を変更する変更法を決定して（ステップＳ１５０３）、変更参照画像１４１１を作成する（ステップＳ１５０４）。また、参照画像付随情報変更部１４０５が、画像変更部１４０４から送られた変更方法情報１４１２を用いて、参照画像付随情報蓄積部１４０３から送られた参照画像付随情報１４１３を変更する（ステップＳ１５０５）。

【０１５８】

次に符号化部１４０６が、入力部１４０１から送られた入力画像１４０９と、画像変更部１４０４から送られた変更参照画像１４１１と、参照画像付随情報変更部１４０５から送られた変更参照画像付随情報１４１４を用いて、入力画像１４０９の予測信号を生成し、入力画像の符号化を行う（ステップＳ１５０６）。

【０１５９】

次に出力部１４０７が、画像変更部１４０４から送られた変更方法情報１４１２と符号化部１４０６から送られた圧縮データ１４１５を合成し（ステップＳ１５０７）、符号化

データ１４１８として外部へ伝送する（ステップＳ１５０８）。

【０１６０】

次に、図１７を用いて、本発明に係わる動画像復号化装置を説明する。

【０１６１】

本発明に係る動画像復号化装置１５０は、その機能的な構成要素として、分離部１６０１と、参照画像蓄積部１６０２と、参照画像付随情報蓄積部１６０３と、画像変更部１６０４と、参照画像付随情報変更部１６０５と、復号化部１６０６とを備えて構成される。

【０１６２】

分離部１６０１は、外部から伝送された入力された符号化データ１６０７を圧縮データ１６０８と変更方法情報１６０９に分離する。分離部１６０１は、圧縮データ１６０８を復号化部１６０６に送る。また、分離部１６０１は、変更方法情報１６０９を画像変更部１６０４と、参照画像付随情報変更部１６０５に送る。

【０１６３】

参照画像蓄積部１６０２は、過去の復号化済み画像である参照画像を蓄積する部分である。参照画像蓄積部１６０２は参照画像１６１０を画像変更部１６０４に送る。

【０１６４】

画像変更部１６０４は、分離部１６０１から送られた変更方法情報１６０９を用いて、参照画像蓄積部１６０２から送られた参照画像１６１０を入力画像に合うように変更して変更参照画像１６１１を生成し、復号化部１６０６に送る。このようにすることにより、本発明の動画像復号化装置１５０において、画像逆変更部を省くことができる。

【０１６５】

参照画像付随情報蓄積部１６０３は、過去の復号化済み画像である参照画像に付随する情報である参照画像付随情報を蓄積する部分である。参照画像付随情報蓄積部１６０３は参照画像付随情報１６１２を参照画像付随情報変更部１６０５に送る。

【０１６６】

参照画像付随情報変更部１６０５は、分離部１６０１から送られた変更方法情報１６０９用いて、参照画像付随情報蓄積部１６０３から送られた参照画像付随情報１６１２を変更して変更参照画像付随情報１６１３を作成し、復号化部１６０６に送る。このように、参照画像付随情報変更部１６０５は、分離部１６０１から送られた変更方法情報１６０９用いて変更参照画像付随情報１６１３を作成するので、本発明の動画像復号化装置１５０において、参照画像付随情報逆変更部を省くことができる。

【０１６７】

復号化部１６０６は、分離部１６０１から送られた圧縮データ１６０８と、画像変更部１６０４から送られた変更参照画像１６１１と、参照画像付随情報変更部１６０５から送られた変更参照画像付随情報１６１３を用いて、復号化画像の予測信号を生成し、復号化画像の復号化を行う。復号化部１６０６は、復号化された復号化画像１６１４を次フレーム以降で参照画像として用いられるために参照画像蓄積部１６０２に送る。さらに復号化部１２０６は、復号化された復号化画像１６１４を動画像表示装置などの外部機器(図示せず)へ出力する。また、復号化部１６０６は、復号化画像付随情報１６１５を次フレーム以降で参照画像付随情報として用いられるために参照画像付随情報蓄積部１６０３に送る。

【０１６８】

なお、上記変更方法は画像および参照画像付随情報の回転、拡大、縮小に限られるものではなく、第１実施形態における画像の反転を含む、あらゆる変更方法を用いることができる。

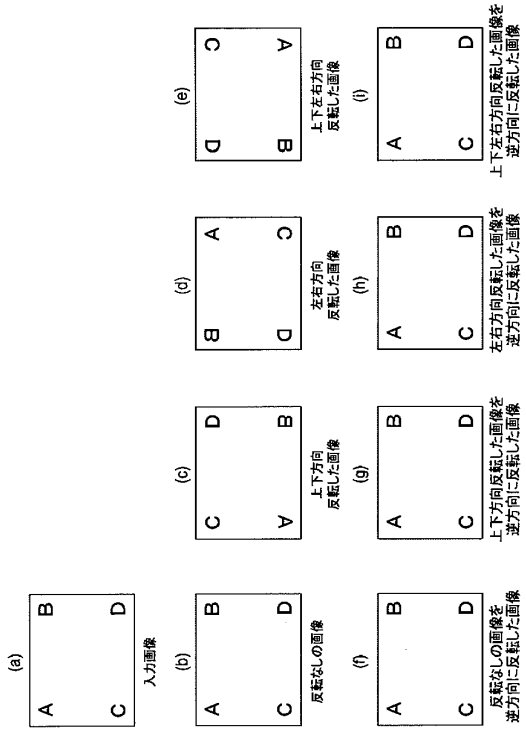
【０１６９】

また、復号化部１６０６で使用する復号化方式の一例としては、Ｈ．２６４／ＡＶＣ復号化方式が挙げられる。但し、上記のＨ．２６４／ＡＶＣ復号化方式に限らず、参照画像と参照画像に付随する情報から復号化画像の予測信号を生成して復号化を行うあらゆる方式の復号化法を適用することができる。

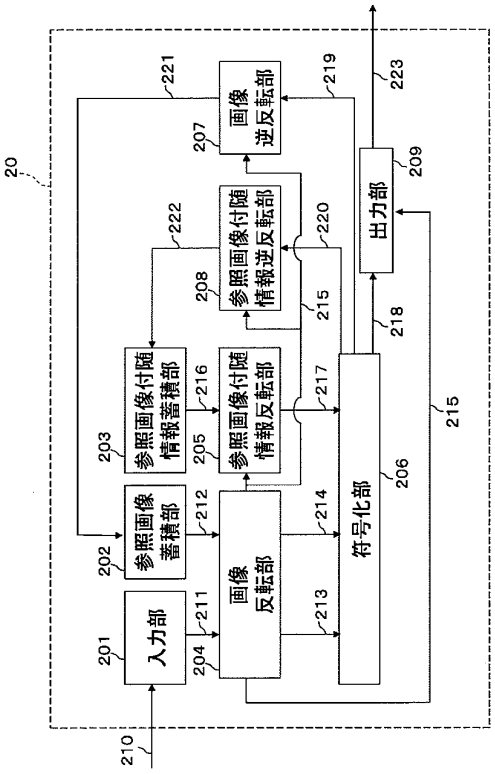
【０１７０】
さらに、復号化部１６０６の詳細な説明は、第１実施形態における復号化部７０６の詳細な説明と同一である。
【０１７１】
次に、図１８を用いて、本発明にかかわる動画像復号化装置１５０の動作を説明する。本発明に係る動画像復号化装置１５０の動作は、プログラムにより実行可能である。
【０１７２】
まず、分離部１６０１が、外部から伝送された入力された符号化データ１６０７を圧縮データ１６０８と変更方法情報１６０９に分離し（ステップＳ１７０１）、変更方法を判別する（ステップＳ１７０２）。
【０１７３】
次に、画像変更部１６０４が、分離部１６０１から送られた変更方法情報１６０９を用いて、参照画像蓄積部１６０２から送られた参照画像１６１０を変更して変更参照画像１６１１を生成する（ステップＳ１７０３）。また、参照画像付随情報変更部１６０５が、分離部１６０１から送られた変更方法情報１６０９用いて、参照画像付随情報蓄積部１６０３から送られた参照画像付随情報１６１２を変更して変更参照画像付随情報１６１３を作成する（ステップＳ１７０４）。
【０１７４】
次に、復号化部１６０６が、分離部１６０１から送られた圧縮データ１６０８と、画像変更部１６０４から送られた変更参照画像１６１１と、参照画像付随情報変更部１６０５から送られた変更参照画像付随情報１６１３を用いて、復号化画像の予測信号を生成し、復号化画像の復号化を行う（ステップＳ１７０５）。また、復号化部１６０６が、復号化された復号化画像１６１４を動画像表示装置などの外部機器(図示せず)へ出力する（ステップ１７０６）。
【０１７５】
以上述べた第２実施形態の変更例１によれば、画像変更部が入力画像と参照画像を比較し、参照画像および参照画像に付随する情報を入力画像に合わせて変更して予測信号を生成するので、入力画像を高い効率で符号化することができる。また、参照画像および参照画像に付随する情報を伝送された変更方法情報に合わせて変更して予測信号を生成することで復号化画像を正しく復号化することができる。すなわち、的確な予測信号を生成してより効率的に画像の符号化及び復号化を行うことができる。
【図面の簡単な説明】
【０１７６】
【図１】従来の符号化装置における入力画像の処理方法について説明するための図である。
【図２】本発明の第１実施形態に係る動画像符号化装置の構成図である。
【図３】本発明の第１実施形態に係る動画像符号化装置に含まれる符号化部の構成図である。
【図４】本発明の第１実施形態に係る動画像符号化装置に含まれる符号化部の変形例ある。
【図５】本発明の第１実施形態に係る参照画像付随情報の処理方法について説明するための図である。
【図６】本発明の第１実施形態に係る反転局所復号化画像付随情報について説明するための図である。
【図７】本発明の第１実施形態に係る動画像符号化方法を示すフローチャートである。
【図８】本発明の第１実施形態に係る動画像復号化装置の構成図である。
【図９】本発明の第１実施形態に係る動画像復号化装置に含まれる復号化部の構成図である。
【図１０】本発明の第１実施形態に係る動画像復号化方法を示すフローチャートである。
【図１１】本発明の第２実施形態に係る動画像符号化装置の構成図である。

【図１２】本発明の第２実施形態に係る動画像符号化方法を示すフローチャートである。
【図１３】本発明の第２実施形態に係る動画像復号化装置の構成図である。
【図１４】本発明の第２実施形態に係る動画像復号化方法を示すフローチャートである。
【図１５】本発明の第２実施形態の第１変形例に係る動画像符号化装置の構成図である。
【図１６】本発明の第２実施形態の第１変形例に係る動画像符号化方法を示すフローチャートである。
【図１７】本発明の第２実施形態の第１変形例に係る動画像復号化装置の構成図である。
【図１８】本発明の第２実施形態の第１変形例に係る動画像復号化方法を示すフローチャートである。
【図１９】本発明の第１実施形態に係る、複数列のブロック群からなるスライス単位で入力画像を反転する場合について説明するための図である。
【図２０】本発明の第１実施形態に係る、任意形状のブロック群からなるスライス単位で入力画像を反転する場合について説明するための図である。
【符号の説明】
【０１７７】
２０…動画像符号化装置、７０…動画像復号化装置、２０１…入力部、２０２…参照画像蓄積部、２０３…参照画像付随情報蓄積部、２０４…画像反転部、２０５…参照画像付随情報反転部、２０６…符号化部、２０７…画像逆反転部、２０８…参照画像付随情報逆反転部、２０９…出力部、２１０…動画像信号、２１１…入力画像、２１２…参照画像、２１３…反転入力画像、２１４…反転参照画像、２１５…反転方向情報、２１６…参照画像付随情報、２１７…反転参照画像付随情報、２１８…圧縮データ、２１９…反転局所復号化画像、２２０…反転局所復号化画像付随情報、２２１…局所復号化画像、２２２…局所復号化画像付随情報、２２３…符号化データ、７０１…分離部、７０２…参照画像蓄積部、７０３…参照画像付随情報蓄積部、７０４…画像反転部、７０５…参照画像付随情報反転部、７０６…復号化部、７０７…画像逆反転部、７０８…参照画像付随情報逆反転部、７０９…符号化データ、７１０…圧縮データ、７１１…反転方向情報、７１２…参照画像、７１３…反転参照画像、７１４…参照画像付随情報、７１５…反転参照画像付随情報、７１６…反転復号化画像、７１７…反転復号化画像付随情報、７１８…復号化画像、７１９…復号化画像付随情報。

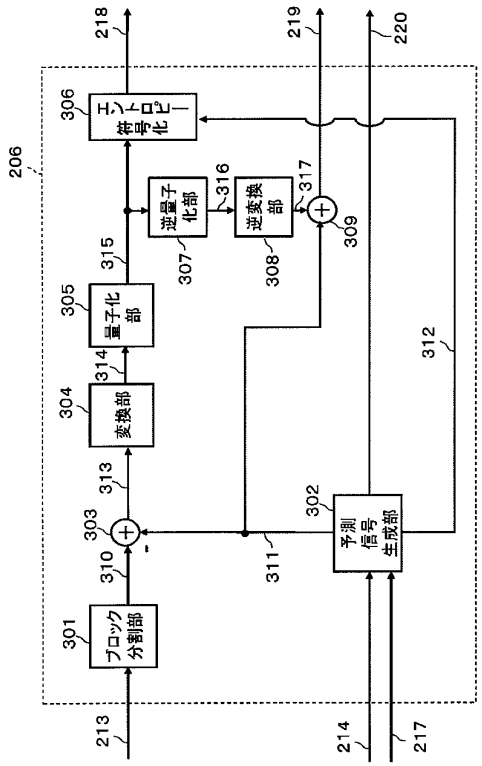
【図１】


(a)
A B C D
入力画像
(b)
反転なしの画像
(c)
上下方向反転した画像
(d)
左右方向反転した画像
(e)
上下左右方向反転した画像
(f)
反転なしの画像を逆方向に反転した画像
(g)
上下方向反転した画像を逆方向に反転した画像
(h)
左右方向反転した画像を逆方向に反転した画像
(i)
上下左右方向反転した画像を逆方向に反転した画像

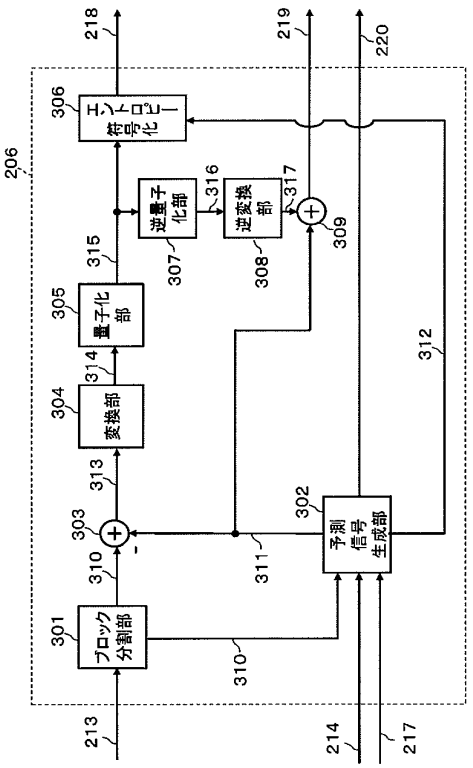
【図２】


20
201 入力部
202 参照画像蓄積部
203 参照画像付随情報蓄積部
204
205
206 符号化部
207 画像逆反転部
208 参照画像付随情報逆反転部
209 出力部
210
211 画像反転部
212
213
214
215
216
217
218
219
220
221
222
223

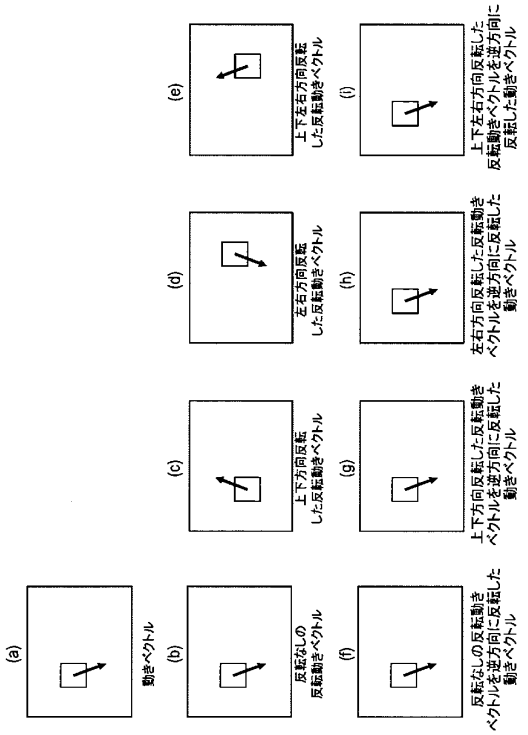
【図３】


206
301 ブロック分割部
302 予測信号生成部
303
304 変換部
305 量子化部
306 エントロピー符号化
307 逆量子化部
308 逆変換部
309
310
311
312
313
314
315
316
317
213
214
217
218
219
220

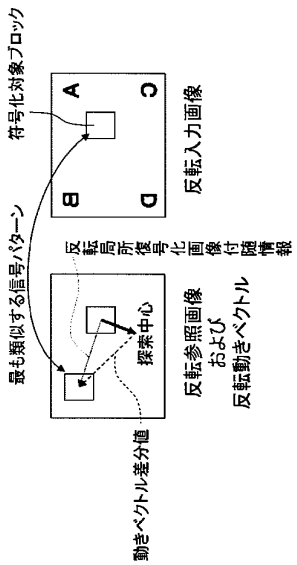
【図４】


206
301 ブロック分割部
302 予測信号生成部
303
304 変換部
305 量子化部
306 エントロピー符号化
307 逆量子化部
308 逆変換部
309
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312
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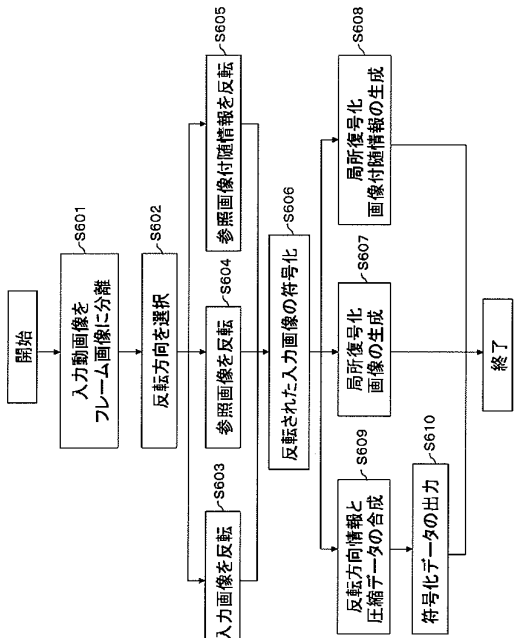
【図５】


(a)
動きベクトル
(b)
反転なしの
反転動きベクトル
(c)
上下方向反転
した反転動きベクトル
(d)
左右方向反転
した反転動きベクトル
(e)
上下左右方向反転
した反転動きベクトル
(f)
反転なしの反転動き
ベクトルを逆方向に反転した
動きベクトル
(g)
上下方向反転した反転動き
ベクトルを逆方向に反転した
動きベクトル
(h)
左右方向反転した反転動き
ベクトルを逆方向に反転した
動きベクトル
(i)
上下左右方向反転した
反転動きベクトルを逆方向に
反転した動きベクトル

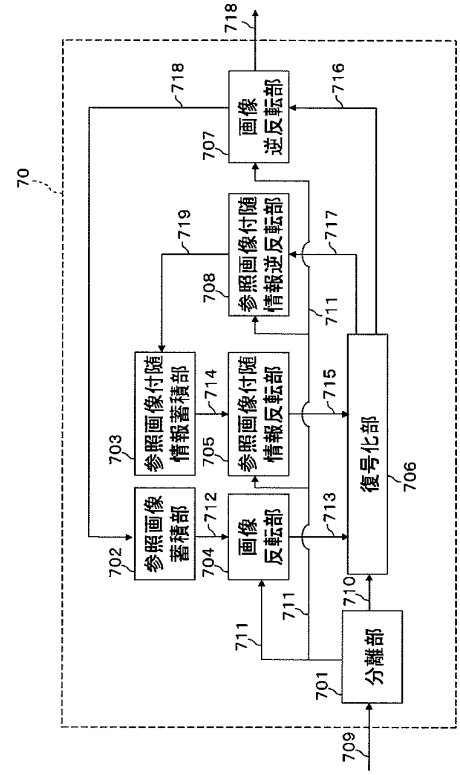
【図６】


符号化対象ブロック
最も類似する信号パターン
A
B
C
D
反転入力画像
反転局所復号化画像付随情報
探索中心
反転参照画像
および
反転動きベクトル
動きベクトル差分値

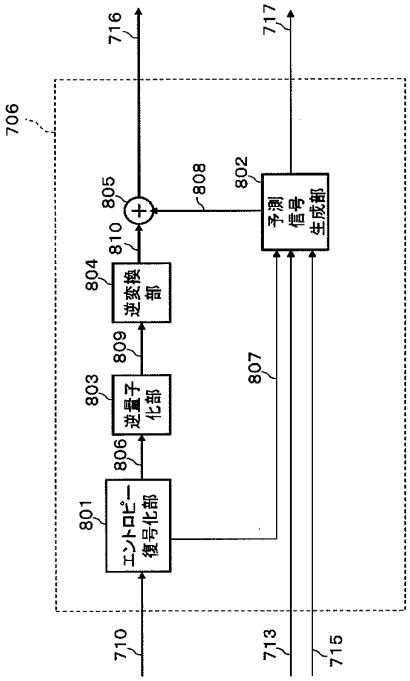
【図７】


開始
入力動画像を
フレーム画像に分離
S601
反転方向を選択
S602
参照画像を反転
S604
参照画像付随情報を反転
S605
入力画像を反転
S603
反転された入力画像の符号化
S606
局所復号化
画像の生成
S607
局所復号化
画像付随情報の生成
S608
反転方向情報と
圧縮データの合成
S609
符号化データの出力
S610
終了

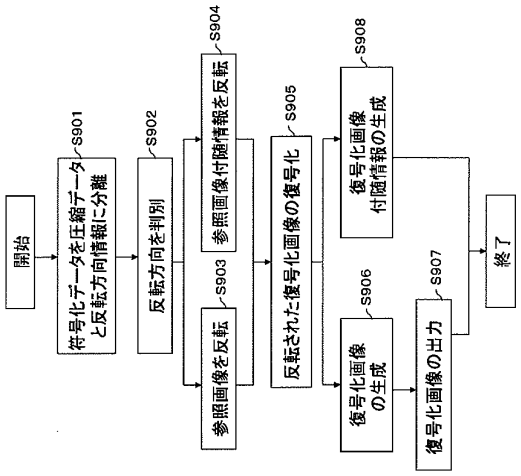
【図８】


70
701
分離部
702
参照画像
蓄積部
703
参照画像付随
情報蓄積部
704
画像
反転部
705
参照画像付随
情報反転部
706
復号化部
707
画像
逆反転部
708
参照画像付随
情報逆反転部
709
710
711
712
713
714
715
716
717
718
719

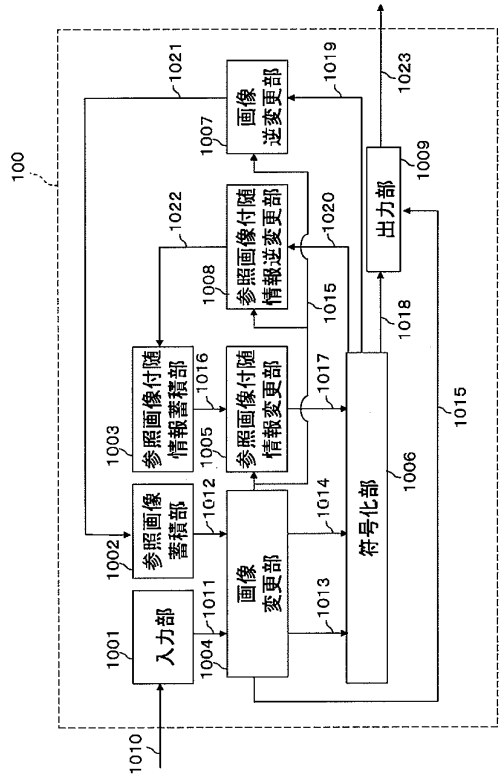
【図９】



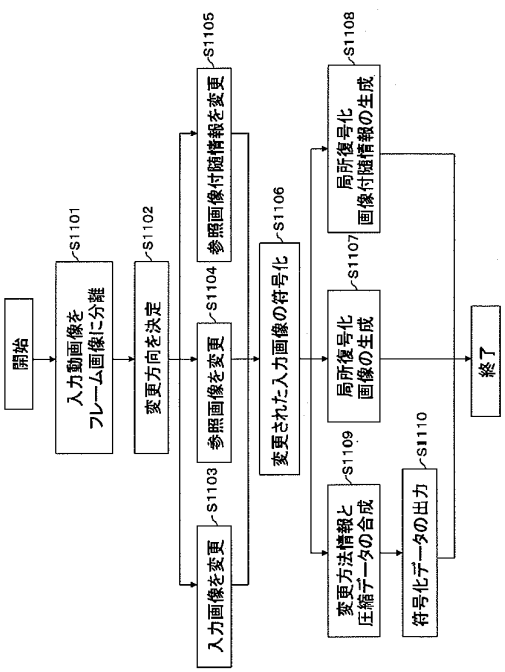
【図１０】



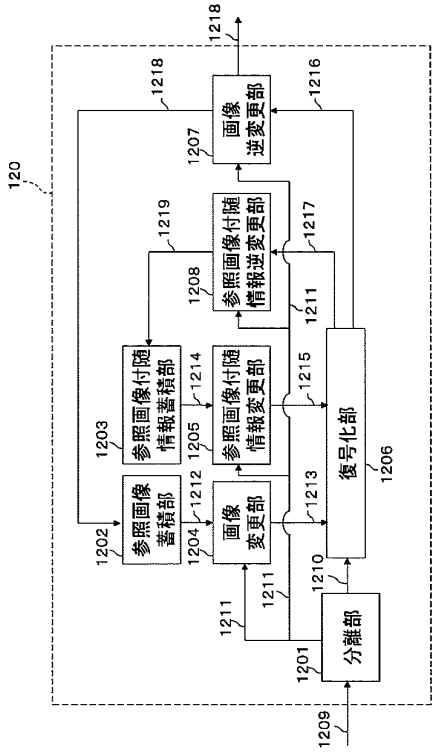
【図１１】



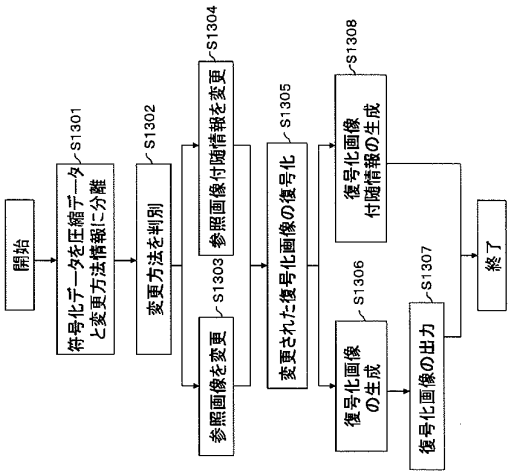
【図１２】



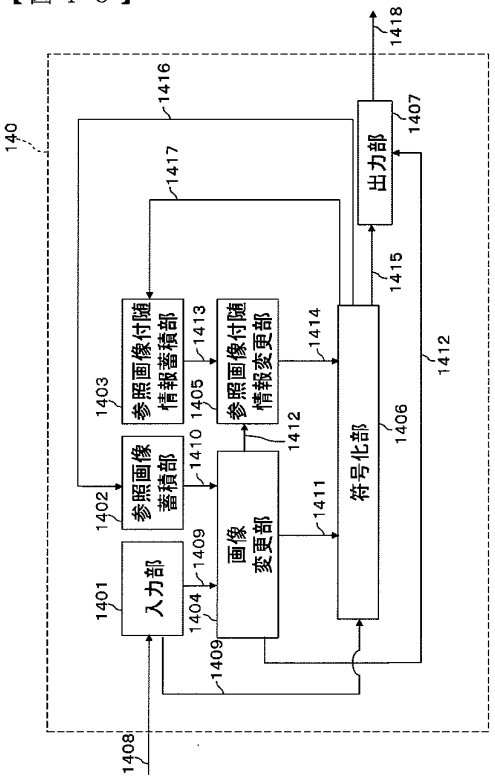
【図１３】



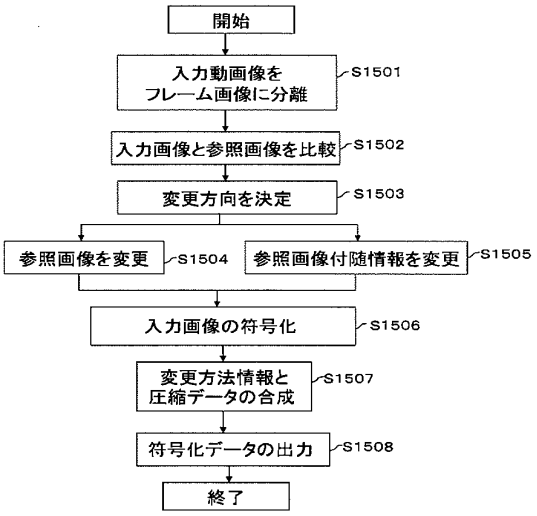
【図１４】



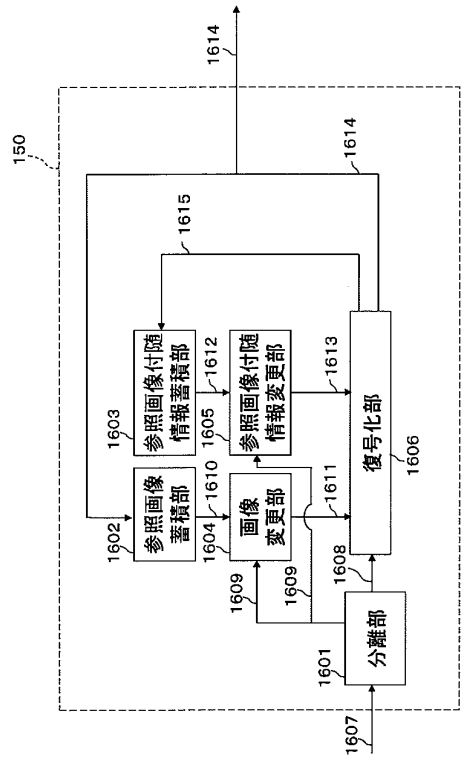
【図１５】



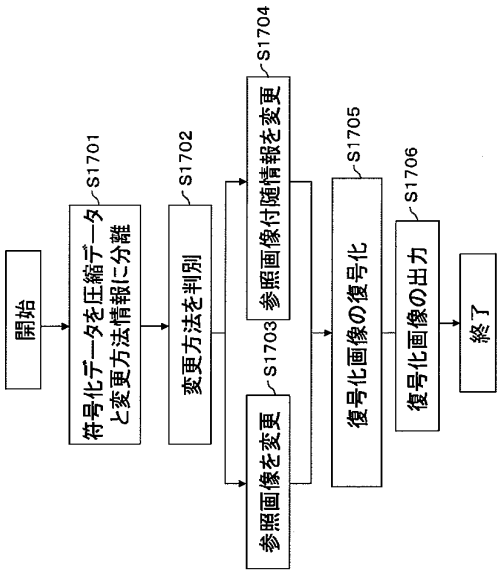
【図１６】



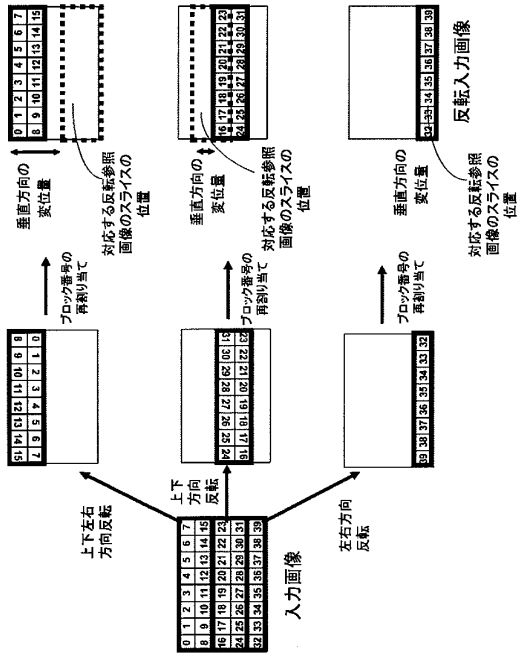
【図１７】



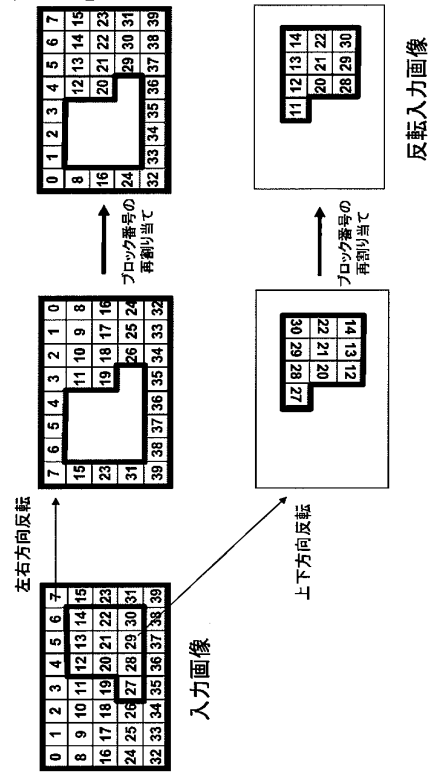
【図１８】



【図１９】



【図２０】



フロントページの続き

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Ｆターム(参考) 5C059 LA00 MA00 MA05 MA12 MA21 MC11 MC38 ME01 NN01 NN21
PP05 PP06 PP07
5J064 AA02 BB01 BB03 BC01 BC26

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/995,039	11/29/2010	Satoru Sakazume	31181U

CONFIRMATION NO. 7504

20529
THE NATH LAW GROUP
112 South West Street
Alexandria, VA 22314

PUBLICATION NOTICE

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Title:MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYTEM, MOVING PICTURE REENCODING METHOD, AND MOVING PICTURE REENCODING PROGRAM

Publication No.US-2011-0075734-A1
Publication Date:03/31/2011

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The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

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U.S. APPLICATION NUMBER NO.	FIRST NAMED APPLICANT	ATTY. DOCKET NO.
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20529
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INTERNATIONAL APPLICATION NO.	
PCT/JP2009/059801	
I.A. FILING DATE	PRIORITY DATE
05/28/2009	05/30/2008

CONFIRMATION NO. 7504
371 ACCEPTANCE LETTER

OC000000045089115

Date Mailed: 12/23/2010

NOTICE OF ACCEPTANCE OF APPLICATION UNDER 35 U.S.C 371 AND 37 CFR 1.495

The applicant is hereby advised that the United States Patent and Trademark Office in its capacity as a Designated / Elected Office (37 CFR 1.495), has determined that the above identified international application has met the requirements of 35 U.S.C. 371, and is ACCEPTED for national patentability examination in the United States Patent and Trademark Office.

The United States Application Number assigned to the application is shown above and the relevant dates are:

11/29/2010	11/29/2010
DATE OF RECEIPT OF 35 U.S.C. 371(c)(1), (c)(2) and (c)(4) REQUIREMENTS	DATE OF COMPLETION OF ALL 35 U.S.C. 371 REQUIREMENTS

A Filing Receipt (PTO-103X) will be issued for the present application in due course. **THE DATE APPEARING ON THE FILING RECEIPT AS THE " FILING DATE" IS THE DATE ON WHICH THE LAST OF THE 35 U.S.C. 371 (c)(1), (c)(2) and (c)(4) REQUIREMENTS HAS BEEN RECEIVED IN THE OFFICE. THIS DATE IS SHOWN ABOVE.** *The filing date of the above identified application is the international filing date of the international application (Article 11(3) and 35 U.S.C. 363).* Once the Filing Receipt has been received, send all correspondence to the Group Art Unit designated thereon.

The following items have been received:

- Copy of the International Application filed on 11/29/2010
- English Translation of the IA filed on 11/29/2010
- Copy of the International Search Report filed on 11/29/2010
- Preliminary Amendments filed on 11/29/2010
- Information Disclosure Statements filed on 11/29/2010
- Oath or Declaration filed on 11/29/2010
- Request for Immediate Examination filed on 11/29/2010
- U.S. Basic National Fees filed on 11/29/2010
- Assignee Statement for PGPUB filed on 11/29/2010
- Priority Documents filed on 11/29/2010
- Specification filed on 11/29/2010
- Claims filed on 11/29/2010
- Abstracts filed on 11/29/2010
- Drawings filed on 11/29/2010

FORM PCT/DO/EO/903 (371 Acceptance Notice)

Applicant is reminded that any communications to the United States Patent and Trademark Office must be mailed to the address given in the heading and include the U.S. application no. shown above (37 CFR 1.5)

BRIAN A HARDEN

Telephone: (703) 756-1815

FORM PCT/DO/EO/903 (371 Acceptance Notice)

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 12/995,039

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	330
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	430
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	220
TOTAL CLAIMS (37 CFR 1.16(i))	25 minus 20 =	* 5			OR	x 52 =	260
INDEPENDENT CLAIMS (37 CFR 1.16(h))	16 minus 3 =	* 13				x 220 =	2860
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $270 ($135 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						270
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	4370

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
12/995,039	11/29/2010		4370	31181U	25	16

CONFIRMATION NO. 7504

20529
THE NATH LAW GROUP
112 South West Street
Alexandria, VA 22314

FILING RECEIPT



Date Mailed: 12/23/2010

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

Satoru Sakazume, Kanagawa-ken, JAPAN;

Assignment For Published Patent Application

VICTOR COMPANY OF JAPAN, LIMITED, Yokohama-shi, Kanagawa, JP

Power of Attorney: The patent practitioners associated with Customer Number 20529

Domestic Priority data as claimed by applicant

This application is a 371 of PCT/JP2009/059801 05/28/2009

Foreign Applications

JAPAN P2009-123960 05/22/2009
JAPAN P2008-142433 05/30/2008

If Required, Foreign Filing License Granted: 12/21/2010

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 12/995,039**

Projected Publication Date: 03/31/2011

Non-Publication Request: No

Early Publication Request: No

Title

MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE

REENCODING SYTEM, MOVING PICTURE REENCODING METHOD, AND MOVING PICTURE REENCODING PROGRAM

Preliminary Class

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier

license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

MULTIPLE DEPENDENT CLAIM FEE CALCULATION SHEET Substitute for Form PTO-1360 (For use with Form PTO/SB/06)	Application Number 12995039	Filing Date
	Applicant(s) Satoru SAKAZUME	
	* May be used for additional claims or amendments	

CLAIMS	AS FILED		AFTER FIRST AMENDMENT		AFTER SECOND AMENDMENT	
	Indep	Depend	Indep	Depend	Indep	Depend
1	1		---	---		
2		1	1			
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Total Indep	14		16		0	
Total Depend	8	↵	9	↵	0	↵
Total Claims	22		25		0	

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	Indep	Depend	Indep	Depend	Indep	Depend
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PTO-1390 (Rev. 09-08)
Approved for use through 2/28/2010. OMB 0651-0021
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A SUBMISSION UNDER 35 U.S.C. 371

		ATTORNEY'S DOCKET NUMBER: 31181U
		U.S. APPLICATION NO. (If known, see 37 CFR 1.5): Not Yet Assigned
INTERNATIONAL APPLICATION NO.: PCT/JP2009/059801	INTERNATIONAL FILING DATE: 28 May 2009 (28.05.2009)	PRIORITY DATE CLAIMED: 30 May 2008 (30.05.2008)

TITLE OF INVENTION: MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING....

APPLICANT(S) FOR DO/EO/US: SAKAZUME, Satoru

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☑ This is a **FIRST** submission of items concerning a submission under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a submission under 35 U.S.C. 371.
3. ☑ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☑ The US has been elected (Article 31).
5. ☑ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☑ is attached hereto (required only if not communicated by the International Bureau).
   b. ☐ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☑ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☑ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☑ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☑ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☑ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. ☑ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☑ A preliminary amendment.
14. ☑ An Application Data Sheet under 37 CFR 1.76.
15. ☐ A substitute specification.
16. ☑ A power of attorney and/or change of address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13*ter*.3 and 37 CFR 1.821- 1.825.
18. ☐ A second copy of the published International Application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).

This collection of information is required by 37 CFR 1.414 and 1.491-1.492. The information is required to obtain or retain a benefit by the public, which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 15 minutes to complete, including gathering information, preparing, and submitting the completed form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Mail Stop PCT, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

PTO-1390 (Rev. 09-08)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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U.S. APPLICATION NO. (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
Not Yet Assigned	PCT/JP2009/059801	31181U

20. Other items or information:

Form PCT/IB304, one (1) page; Form /IB/308, one (1) page; Form PCT/ISA/210, three (3) pages; Form PCT/ISA/237, three (3) pages.

The following fees have been submitted	CALCULATIONS	PTO USE ONLY
21. ☑ Basic national fee (37 CFR 1.492(a))..... **$330**	$ 330	
22. ☑ Examination fee (37 CFR 1.492(c)) If the written opinion prepared by ISA/US or the international preliminary examination report prepared by IPEA/US indicates all claims satisfy provisions of PCT Article 33(1)-(4)..... **$0** All other situations..... **$220**	$ 220	
23. ☑ Search fee (37 CFR 1.492(b)) If the written opinion of the ISA/US or the International preliminary examination report prepared by IPEA/US indicates all claims satisfy provisions of PCT Article 33(1)-(4)..... **$0** Search fee (37 CFR 1.445(a)(2)) has been paid on the international application to the USPTO as an International Searching Authority..... **$100** International Search Report prepared by an ISA other than the US and provided to the Office or previously communicated to the US by the IB..... **$430** All other situations..... **$540**	$ 430	
TOTAL OF 21, 22 and 23 =	$980	

☐ Additional fee for specification and drawings filed in paper over 100 sheets (excluding sequence listing in compliance with 37 CFR 1.821(c) or (e) in an electronic medium or computer program listing in an electronic medium) (37 CFR 1.492(j)).
The fee is **$270** for each additional 50 sheets of paper or fraction thereof.

Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof (round **up** to a whole number)	RATE	
149 - 100 =	1 /50 =		x $**270**	$ 270

Surcharge of **$130.00** for furnishing any of the search fee, examination fee, or the oath or declaration after the date of commencement of the national stage (37 CFR 1.492(h)).	$ 0	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	$	
Total claims	25 - 20 =	5	x $ **52**	$ 260	
Independent claims	16 - 3 =	13	x **$220**	$ 2860	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ **$390**	$ 0	
			TOTAL OF ABOVE CALCULATIONS =	$ 4370	
☐ Applicant claims small entity status. See 37 CFR 1.27. Fees above are reduced by ½.					
			SUBTOTAL =	$ 4370	
Processing fee of **$130.00** for furnishing the English translation later than 30 months from the earliest claimed priority date (37 CFR 1.492(i)). +				$ 0	
			TOTAL NATIONAL FEE =	$ 4370	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$ 0	
			TOTAL FEES ENCLOSED =	$ 4370	
			Amount to be refunded:	$	
			Amount to be charged	$	

a. ☐ A check in the amount of $ _____ to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of $ _____ to cover the above fees.

c. ☑ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 14-0112.

d. ☑ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038. The PTO-2038 should only be mailed or faxed to the USPTO. However, when paying the basic national fee, the PTO-2038 may NOT be faxed to the USPTO.

ADVISORY: If filing by EFS-Web, do **NOT** attach the PTO-2038 form as a PDF along with your EFS-Web submission. Please be advised that this is **not** recommended and by doing so your **credit card information may be displayed via PAIR**. To protect your information, it is recommended paying fees online by using the electronic payment method.

NOTE: Where an appropriate time limit under 37 CFR 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the International Application to pending status.

SEND ALL CORRESPONDENCE TO:

Customer Number 20529

/Jerald L. Meyer/
SIGNATURE

Jerald L. Meyer
NAME

41194
REGISTRATION NUMBER

Privacy Act Statement

The **Privacy Act of 1974** (**P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/SB/14 (11-08)
Approved for use through 06/30/2010. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	31181U
	Application Number	
Title of Invention	MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYTEM,	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Applicant Information:

Applicant 1 Remove

Applicant Authority ◉ Inventor ○ Legal Representative under 35 U.S.C. 117 ○ Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Satoru		SAKAZUME	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Kanagawa-ken	Country Of Residence[i]	JP
Citizenship under 37 CFR 1.41(b)[i]	JP		

Mailing Address of Applicant:

Address 1	12, Moriya-cho 3-chome, Kanagawa-ku,		
Address 2			
City	Yokohama-shi, Kanagawa	State/Province	
Postal Code		Country[i]	JP

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	20529		
Email Address		Add Email	Remove Email

PTO/SB/14 (11-08)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	31181U
	Application Number	
Title of Invention	MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYTEM,	

Application Information:

Title of the Invention	MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYTEM, MOVING PICTURE REENCODING METHOD, AND MOVING PICTURE REENCODING PROGRAM		
Attorney Docket Number	31181U	**Small Entity Status Claimed** ☐	
Application Type	Nonprovisional		
Subject Matter	Utility		
Suggested Class (if any)		**Sub Class (if any)**	
Suggested Technology Center (if any)			
Total Number of Drawing Sheets (if any)	25	**Suggested Figure for Publication (if any)**	

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S. C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

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This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78(a)(2) or CFR 1.78(a)(4), and need not otherwise be made part of the specification.

Prior Application Status			Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	a 371 of international	PCT/JP2009/059801	2009-05-28

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PTO/SB/14 (11-08)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	31181U
	Application Number	
Title of Invention	MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYTEM,	

This section allows for the applicant to claim benefit of foreign priority and to identify any prior foreign application for which priority is not claimed. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(a).

Remove

Application Number	Country [i]	Parent Filing Date (YYYY-MM-DD)	Priority Claimed
P2008-142433	JP	2008-05-30	(•) Yes ( ) No

Remove

Application Number	Country [i]	Parent Filing Date (YYYY-MM-DD)	Priority Claimed
P2009-123960	JP	2009-05-22	(•) Yes ( ) No

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Assignee Information:

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Assignee 1 Remove

If the Assignee is an Organization check here. ☒			
Organization Name	VICTOR COMPANY OF JAPAN, LIMITED		
Mailing Address Information:			
Address 1	12, Moriya-cho 3-chome, Kanagawa-ku		
Address 2			
City	Yokohama-shi, Kanagawa	**State/Province**	
Country [i] JP		Postal Code	
Phone Number		Fax Number	
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Signature:

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 10.18. Please see 37 CFR 1.4(d) for the form of the signature.

Signature	/ Jerald L. Meyer/			Date (YYYY-MM-DD)	2010-11-29
First Name	Jerald L.	Last Name	Meyer	Registration Number	41194

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This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Attorney Docket: 31181U

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Satoru SAKAZUME

Appl. No.:	Not Yet Assigned	Conf. No.:	TBD
Filed:	November 29, 2010	Examiner:	TBD
		Art Unit:	TBD

Intl. Application No.: PCT/JP2009/059801

Intl. Filing Date: 28 May 2009 (28.05.2009)

Title: **MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYSTEM, MOVING PICTURE REENCODING METHOD, AND MOVING PICTURE REENCODING PROGRAM.**

PRELIMINARY AMENDMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

Prior to examination on the merits and calculating the filing fees for the national phase application under 35 U.S.C. 371, filed herewith, please enter the following amendments:

Amendment to the Title begins on page 2 of this paper.

Amendments to the Specification begins on page 3 of this paper.

Amendments to the Claims begin on page 4 of this paper.

Amendments to the Abstract begins on page 23 of this paper.

Amendments to the Drawings begin on page 24 of this paper.

Remarks begin on page 25 of this paper.

A **Conclusion** appears at page 26 of this paper.

Amendment to the Title:

Please amend the following Title:

~~DYNAMIC IMAGE ENCODER, DYNAMIC IMAGE ENCODING METHOD, DYNAMIC IMAGE ENCODING PROGRAM, DYNAMIC IMAGE DECODER, DYNAMIC IMAGE DECODING METHOD, DYNAMIC IMAGE DECODING PROGRAM, DYNAMIC IMAGE RE-ENCODER, DYNAMIC IMAGE RE-ENCODING METHOD, DYNAMIC IMAGE REENCODING PROGRAM.~~

MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYSTEM, MOVING PICTURE REENCODING METHOD, AND MOVING PICTURE REENCODING PROGRAM.

Amendments to the Specification:

On page 1 of the Specification, please insert a cross-reference to a prior application after the title and before the heading of the first paragraph (Technical Field) by adding the following:

-- This is a National Phase Application filed under 35 U.S.C. 371 as a national stage of PCT/JP2009/059801, filed May 28, 2009, an application claiming the benefit from Japanese Application No. 2008-142433, filed May 30, 2008, and claiming benefit from Japanese Application No. 2009-123960, filed May 22, 2009, the content of each of which is hereby incorporated by reference in its entirety. --

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Canceled).

2. (Currently Amended) ~~The~~ A moving picture encoding system ~~according to claim 1~~ comprising:

a first encoder configured to work on a subsequence of a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to work on the subsequence of the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a first resolution converter configured to work on the set of super-resolution enlarged pictures to implement a process for a first resolution conversion to create a set of super-resolution enlarged and converted pictures with the standard resolution; and

a second encoder configured to have the set of super-resolution enlarged and converted pictures from the first resolution converter as a set of encoding target pictures to implement a second combination of processes for a prediction and an encoding to create a second sequence of encoded bits,

wherein the second encoder is configured to have the set of decoded pictures from the first encoder as a set of reference pictures to implement the second combination of processes for the prediction and the encoding to create the second sequence of encoded bits.

3. (Currently Amended) ~~The~~ A moving picture encoding system ~~according to claim 1 or 2,~~ comprising:

a first encoder configured to work on a subsequence of a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to work on the subsequence of the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a first resolution converter configured to work on the set of super-resolution enlarged pictures to implement a process for a first resolution conversion to create a set of super-resolution enlarged and converted pictures with the standard resolution;

a second encoder configured to have the set of super-resolution enlarged and converted pictures from the first resolution converter as a set of encoding target pictures to implement a second combination of processes for a prediction and an encoding to create a second sequence of encoded bits;

a second super-resolution enlarger configured to acquire the set of decoded pictures with the standard resolution from the first encoder to implement thereon a process for a second super-resolution enlargement to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution; and

a second resolution converter configured to work on the set of super-resolution enlarged decoded pictures to implement a process for a second resolution conversion to create a set of super-resolution enlarged and converted decoded pictures with the standard resolution,

wherein the second encoder is configured to have the set of super-resolution enlarged and converted decoded pictures from the second resolution converter as a set of reference pictures to implement the second combination of processes for the prediction and the encoding to create the second sequence of encoded bits.

4. (Currently Amended) The moving picture encoding system according to ~~any one of claims 1 to 3~~ claim 2, wherein the first super-resolution enlarger comprises:

a positioner configured to work in a processing for super-resolution enlargement, on a combination of a base picture constituting a base therein and one or more observation pictures to be based on, to make a positioning to pixel positions of a desirable high resolution, for an interval-unequal sampling to create nonhomogeneous high resolution pictures;

an interpolator configured to work on nonhomogeneous high resolution pictures created at the positioner, to implement a process for a prescribed nonhomogeneous interpolation to create interpolated pictures with a desirable high resolution;

an estimated picture creator configured to acquire interpolated pictures created at the interpolator, to implement thereon a process for a prescribed reconstruction to create estimated pictures with a desirable resolution; and

a repetition determiner configured to acquire a nonhomogeneous high resolution picture from the positioner and a nonhomogeneous estimated picture from the estimated picture creator, for employment of the acquired pictures to follow a prescribed determination method to determine whether or not a repetition of the processing for super-resolution enlargement is necessary, and work depending on a result thereof, to operate as the repetition is necessary, to provide the interpolator with information for a control to continue the processing, and operate as the repetition is unnecessary, to provide the estimated picture creator with information for a control to output a set of estimated pictures with a high resolution after super-resolution enlargement.

5. (Currently Amended) The moving picture encoding system according to ~~any one of claims 1 to 4~~ claim 2, comprising a multiplexer configured to operate complying with a prescribed syntax structure to multiplex the first sequence of encoded bits from the first encoder, the second sequence of encoded bits from the second encoder, and information on encoding parameters of respective types used in the encoding at the first encoder and the encoding at the second encoder.

6. (Currently Amended) The moving picture encoding system according to ~~any one of claims 2 to 5~~ claim 2, comprising:

a first accumulation buffer configured to work in a course before the first encoder and the first super-resolution enlarger, to accumulate subsequences of the sequence of moving pictures with the standard resolution;

a second accumulation buffer configured to work in a course between the first encoder and the second encoder, to accumulate sets of decoded pictures from the first encoder;

an accumulation controller configured to work for detections of buffer accumulation amounts at the first accumulation buffer, the second accumulation buffer, the first encoder, and the second encoder, to control the buffer accumulation amounts; and

a code rate controller configured to work on bases of the detections of buffer accumulation amounts at the accumulation controller, to control code rates at the first encoder and the second encoder.

7. (Original) A moving picture encoding system comprising:

a first encoder configured to work on a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a second super-resolution enlarger configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a second super-resolution enlargement to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution;

a third resolution converter configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a third resolution conversion to create a set of resolution converted enlarged decoded pictures with a resolution higher than the standard resolution; and

a third encoder configured to have the set of super-resolution enlarged pictures from the first super-resolution enlarger as a set of encoding target pictures, employing the set of super-resolution enlarged decoded pictures from the second super-resolution enlarger and the set of resolution converted enlarged decoded pictures from the third resolution converter as sets of reference pictures, to implement thereon a third combination of processes for a prediction and an encoding to create a third sequence of encoded bits.

8. (Original) A moving picture encoding system comprising:

a first encoder configured to work on a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a third resolution converter configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a third resolution conversion to create a set of resolution converted enlarged decoded pictures with a resolution higher than the standard resolution; and

a third encoder configured to have the set of super-resolution enlarged pictures from the first super-resolution enlarger as a set of encoding target pictures, employing the set of resolution converted enlarged decoded pictures from the third resolution converter as a set of reference pictures, to implement thereon a third combination of processes for a prediction and an encoding to create a third sequence of encoded bits.

9. (Original) A moving picture encoding system comprising:

a first encoder configured to work on a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a second super-resolution enlarger configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a second super-resolution enlargement to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution; and

a third encoder configured to have the set of super-resolution enlarged pictures from the first super-resolution enlarger as a set of encoding target pictures, employing the set of super-resolution enlarged decoded pictures from the second super-resolution enlarger as a set of reference pictures, to implement thereon a third combination of processes for a prediction and an encoding to create a third sequence of encoded bits.

10. (Original) A moving picture encoding system comprising:

a first encoder configured to work on a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a first resolution converter configured to work on the set of super-resolution enlarged pictures to implement a process for a first resolution conversion to create a set of super-resolution enlarged and converted pictures with the standard resolution;

a second super-resolution enlarger configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a second super-resolution enlargement to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution;

a second resolution converter configured to work on the set of super-resolution enlarged decoded pictures from the second super-resolution enlarger to implement a process for a second resolution conversion to create a set of super-resolution enlarged and converted decoded pictures with the standard resolution;

a second encoder configured to have the set of super-resolution enlarged and converted pictures from the first resolution converter as a set of encoding target pictures, employing the set of decoded pictures from the first encoder and the set of super-resolution enlarged and converted decoded pictures with the standard resolution from the second resolution converter as sets of reference pictures, to implement thereon a second combination of processes for a prediction and an encoding to create a second sequence of encoded bits;

a third resolution converter configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a third resolution conversion to create a set of resolution converted enlarged decoded pictures with a resolution higher than the standard resolution; and

a third encoder configured to have the set of super-resolution enlarged pictures from the first super-resolution enlarger as a set of encoding target pictures, employing the set of super-resolution enlarged decoded pictures from the second super-resolution enlarger and the set of resolution converted enlarged decoded pictures from the third resolution converter as sets of reference pictures, to implement thereon a third combination of processes for a prediction and an encoding to create a third sequence of encoded bits.

11. (Currently Amended) A moving picture encoding method comprising:

a step of implementing a first combination of processes for an encoding and a decoding on a sequence of moving pictures with a standard resolution, creating a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a step of implementing a process for a first super-resolution enlargement on the sequence of moving pictures with the standard resolution, creating a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a step of implementing a process for a first resolution conversion on the set of super-resolution enlarged pictures, creating a set of super-resolution enlarged and converted pictures with the standard resolution; and

a step of having the set of super-resolution enlarged and converted pictures as a set of encoding target pictures, implementing thereon a second combination of processes for a prediction and an encoding, creating a second sequence of encoded bits,

wherein the step of creating the second sequence of encoding bits further comprises a step of having the set of decoded pictures from the first encoder as a set of reference pictures to implement the second combination of processes for the prediction and the encoding to create the second sequence of encoded bits.

12. (Currently Amended) A recording medium storing a moving picture encoding program configured to have a computer execute:

a step of implementing a first combination of processes for an encoding and a decoding on a sequence of moving pictures with a standard resolution, creating a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a step of implementing a process for a first super-resolution enlargement on the sequence of moving pictures with the standard resolution, creating a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a step of implementing a process for a first resolution conversion on the set of super-resolution enlarged pictures, creating a set of super-resolution enlarged and converted pictures with the standard resolution; and

a step of having the set of super-resolution enlarged and converted pictures as a set of encoding target pictures, implementing thereon a second combination of processes for a prediction and an encoding, creating a second sequence of encoded bits,

wherein the step of creating the second sequence of encoding bits further comprises a step of having the set of decoded pictures from the first encoder as a set of reference pictures to implement the second combination of processes for the prediction and the encoding to create the second sequence of encoded bits.

13. (Original) A moving picture decoding system comprising:

a demultiplexer configured to work on a sequence of input encoded bits to implement a process for a prescribed demultiplexing to output at least a first and a second sequence of encoded bits;

a first decoder configured to acquire the first sequence of encoded bits obtained with a standard resolution at the demultiplexer to implement thereon a process for a prescribed first decoding to create a sequence of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to acquire the sequence of decoded pictures created with the standard resolution at the first decoder to implement thereon a process for a prescribed super-resolution enlargement to create a sequence of super-resolution enlarged decoded pictures;

a first resolution converter configured to acquire the sequence of super-resolution enlarged decoded pictures created at the first super-resolution enlarger to implement thereon a process for a prescribed resolution conversion to create a sequence of super-resolution decoded pictures with the standard resolution; and

a second decoder configured to acquire the second sequence of encoded bits obtained with the standard resolution at the demultiplexer, the sequence of decoded pictures created with the standard resolution at the first decoder, and the sequence of super-resolution decoded pictures created with the standard resolution at the first resolution converter, to implement thereon a combination of processes for a prescribed prediction and a prescribed second decoding being a decoding with an extension of the standard resolution, to create a sequence of super-resolution pictures decoded with the standard resolution.

14. (Original) The moving picture decoding system according to claim 13, comprising:

the demultiplexer being configured to work on the sequence of input encoded bits to implement the process for the prescribed demultiplexing to further output a third sequence of encoded bits;

a second resolution converter configured to acquire the sequence of decoded pictures with the standard resolution from the first decoder to implement thereon a process for a prescribed resolution conversion to create a sequence of enlarged decoded pictures with a high resolution as a resolution higher than the standard resolution; and

a third decoder configured to acquire the third sequence of encoded bits obtained with the high resolution at the demultiplexer, the sequence of super-resolution enlarged decoded pictures created at the first super-resolution enlarger, and the sequence of enlarged decoded pictures with the high resolution from the second resolution converter, to implement thereon a combination of processes for a prescribed prediction and a prescribed third decoding being a decoding with an extension of the high resolution, to create a sequence of super-resolution enlarged pictures as decoded.

15. (Original) A moving picture reencoding system comprising:

a demultiplexer configured to work on a sequence of input encoded bits to implement a process for a prescribed demultiplexing to output at least a first and a second sequence of encoded bits;

a first decoder configured to acquire the first sequence of encoded bits obtained with a standard resolution at the demultiplexer to implement thereon a process for a prescribed first decoding to create a sequence of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to acquire the sequence of decoded pictures created with the standard resolution at the first decoder to implement thereon a process for a prescribed super-resolution enlargement to create a sequence of super-resolution enlarged decoded pictures;

a first resolution converter configured to acquire the sequence of super-resolution enlarged decoded pictures created at the first super-resolution enlarger to

implement thereon a process for a prescribed resolution conversion to create a sequence of super-resolution decoded pictures with the standard resolution;

a second decoder configured to acquire the second sequence of encoded bits obtained with the standard resolution at the demultiplexer, the sequence of decoded pictures created with the standard resolution at the first decoder, and the sequence of super-resolution decoded pictures created with the standard resolution at the first resolution converter, to implement thereon a process for a prescribed second decoding being a decoding with an extension of the standard resolution, to create a sequence of super-resolution pictures decoded with the standard resolution;

a reencoder configured to acquire from the first decoder information on coefficients of orthogonal transform in a course of decoding thereof, and from the second decoder information on coefficients of orthogonal transform in an extension layer of the standard resolution in a course of decoding thereof, to make a synthesis of respective information on coefficients of orthogonal transform and implement thereon a process for a prescribed entropy encoding to create a sequence of encoded bits as reencoded; and

a multiplexer configured to acquire the sequence of encoded bits reencoded at the reencoder, to implement thereon a process for a multiplexing complying with a prescribed syntax structure, inserting encoding information inclusive of identification information for identification of information on encoding modes and parameters of respective types used, to create a sequence of encoded bits as multiplexed.

16. (Original) The moving picture reencoding system according to claim 15, wherein the reencoder is configured to acquire the sequence of decoded pictures with the standard resolution from the first decoder, the sequence of super-resolution decoded pictures with the standard resolution from the first resolution converter, and the sequence of super-resolution pictures with the standard resolution from the second decoder, to implement thereon a process for a prescribed encoding to create a sequence of encoded bits as reencoded.

17. (Original) A moving picture decoding method comprising:

a step of implementing a process for a prescribed demultiplexing on a sequence of input encoded bits, outputting at least a first and a second sequence of encoded bits;

a step of acquiring the first sequence of encoded bits obtained with a standard resolution through the process for the prescribed demultiplexing, implementing thereon a process for a prescribed first decoding, creating a sequence of decoded pictures with the standard resolution;

a step of acquiring the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, implementing thereon a process for a prescribed super-resolution enlargement, creating a sequence of super-resolution enlarged decoded pictures;

a step of acquiring the sequence of super-resolution enlarged decoded pictures created through the process for the prescribed super-resolution enlargement, implementing thereon a process for a prescribed resolution conversion, creating a sequence of super-resolution decoded pictures with the standard resolution; and

a step of acquiring the second sequence of encoded bits obtained with the standard resolution through the process for the prescribed demultiplexing, the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, and the sequence of super-resolution decoded pictures created with the standard resolution through the process for the prescribed resolution conversion, implementing thereon a combination of processes for a prescribed prediction and a prescribed second decoding being a decoding with an extension of the standard resolution, creating a sequence of super-resolution pictures decoded with the standard resolution.

18. (Original) The moving picture decoding method according to claim 17, comprising:

a step of implementing the process for the prescribed demultiplexing on the sequence of input encoded bits, outputting a third sequence of encoded bits;

a step of acquiring the sequence of decoded pictures created with the standard

resolution through the process for the prescribed first decoding, implementing thereon a process for a prescribed resolution conversion, creating a sequence of enlarged decoded pictures with a high resolution as a resolution higher than the standard resolution; and

a step of acquiring the third sequence of encoded bits obtained with the high resolution through the process for the prescribed demultiplexing, the sequence of super-resolution enlarged decoded pictures created through the process for the prescribed super-resolution enlargement, and the sequence of enlarged decoded pictures created with the high resolution through the process for the prescribed resolution conversion, implementing thereon a combination of processes for a prescribed prediction and a prescribed third decoding being a decoding with an extension of the high resolution, creating a sequence of super-resolution enlarged pictures as decoded.

19. (Original) A moving picture reencoding method comprising:

a step of implementing a process for a prescribed demultiplexing on a sequence of input encoded bits;

a step of acquiring a first sequence of encoded bits obtained with a standard resolution through the process for the prescribed demultiplexing, implementing thereon a process for a prescribed first decoding, creating a sequence of decoded pictures with the standard resolution;

a step of acquiring the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, implementing thereon a process for a prescribed super-resolution enlargement, creating a sequence of super-resolution enlarged decoded pictures;

a step of acquiring the sequence of super-resolution enlarged decoded pictures created through the process for the prescribed super-resolution enlargement, implementing thereon a process for a prescribed resolution conversion, creating a sequence of super-resolution decoded pictures with the standard resolution;

a step of acquiring a second sequence of encoded bits obtained with the standard resolution through the process for the prescribed demultiplexing, the sequence

of decoded pictures created with the standard resolution through the process for the prescribed first decoding, and the sequence of super-resolution decoded pictures created with the standard resolution through the process for the prescribed resolution conversion, implementing thereon a process for a prescribed second decoding being a decoding with an extension of the standard resolution, creating a sequence of super-resolution pictures decoded with the standard resolution;

a step of acquiring information on coefficients of orthogonal transform in a course of decoding in the process for the prescribed first decoding, and information on coefficients of orthogonal transform in an extension layer of the standard resolution in a course of decoding in the process for the prescribed second decoding being a decoding with an extension of the standard resolution, making a synthesis of respective information on coefficients of orthogonal transform, implementing thereon a process for a prescribed entropy encoding, creating a sequence of encoded bits as reencoded; and

a step of acquiring the sequence of encoded bits as reencoded, implementing thereon a process for a multiplexing complying with a prescribed syntax structure, inserting encoding information inclusive of identification information for identification of information on encoding modes and parameters of respective types used, creating a sequence of encoded bits as multiplexed.

20. (Currently Amended) A recording medium storing a moving picture decoding program configured to have a computer execute:

a step of implementing a process for a prescribed demultiplexing on a sequence of input encoded bits, outputting at least a first and a second sequence of encoded bits;

a step of acquiring the first sequence of encoded bits obtained with a standard resolution through the process for the prescribed demultiplexing, implementing thereon a process for a prescribed first decoding, creating a sequence of decoded pictures with the standard resolution;

a step of acquiring the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, implementing thereon a

process for a prescribed super-resolution enlargement, creating a sequence of super-resolution enlarged decoded pictures;

a step of acquiring the sequence of super-resolution enlarged decoded pictures created through the process for the prescribed super-resolution enlargement, implementing thereon a process for a prescribed resolution conversion, creating a sequence of super-resolution decoded pictures with the standard resolution; and

a step of acquiring the second sequence of encoded bits obtained with the standard resolution through the process for the prescribed demultiplexing, the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, and the sequence of super-resolution decoded pictures created with the standard resolution through the process for the prescribed resolution conversion, implementing thereon a combination of processes for a prescribed prediction and a prescribed second decoding being a decoding with an extension of the standard resolution, creating a sequence of super-resolution pictures decoded with the standard resolution.

21. (Currently Amended) A recording medium storing a moving picture reencoding program configured to have a computer execute:

a step of implementing a process for a prescribed demultiplexing on a sequence of input encoded bits;

a step of acquiring a first sequence of encoded bits obtained with a standard resolution through the process for the prescribed demultiplexing, implementing thereon a process for a prescribed first decoding, creating a sequence of decoded pictures with the standard resolution;

a step of acquiring the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, implementing thereon a process for a prescribed super-resolution enlargement, creating a sequence of super-resolution enlarged decoded pictures;

a step of acquiring the sequence of super-resolution enlarged decoded pictures created through the process for the prescribed super-resolution enlargement,

implementing thereon a process for a prescribed resolution conversion, creating a sequence of super-resolution decoded pictures with the standard resolution;

a step of acquiring a second sequence of encoded bits obtained with the standard resolution through the process for the prescribed demultiplexing, the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, and the sequence of super-resolution decoded pictures created with the standard resolution through the process for the prescribed resolution conversion, implementing thereon a process for a prescribed second decoding being a decoding with an extension of the standard resolution, creating a sequence of super-resolution pictures decoded with the standard resolution;

a step of acquiring information on coefficients of orthogonal transform in a course of decoding in the process for the prescribed first decoding, and information on coefficients of orthogonal transform in an extension layer of the standard resolution in a course of decoding in the process for the prescribed second decoding being a decoding with an extension of the standard resolution, making a synthesis of respective information on coefficients of orthogonal transform, implementing thereon a process for a prescribed entropy encoding, creating a sequence of encoded bits as reencoded; and

a step of acquiring the sequence of encoded bits as reencoded, implementing thereon a process for a multiplexing complying with a prescribed syntax structure, inserting encoding information inclusive of identification information for identification of information on encoding modes and parameters of respective types used, creating a sequence of encoded bits as multiplexed.

22. (New) The moving picture encoding system according to claim 3, wherein the first super-resolution enlarger comprises:

a positioner configured to work in a processing for super-resolution enlargement, on a combination of a base picture constituting a base therein and one or more observation pictures to be based on, to make a positioning to pixel positions of a desirable high resolution, for an interval-unequal sampling to create nonhomogeneous high resolution pictures;

an accumulation controller configured to work for detections of buffer accumulation amounts at the first accumulation buffer, the second accumulation buffer, the first encoder, and the second encoder, to control the buffer accumulation amounts; and

a code rate controller configured to work on bases of the detections of buffer accumulation amounts at the accumulation controller, to control code rates at the first encoder and the second encoder.

25. (New) A moving picture encoding method comprising:

a step of implementing a first combination of processes for an encoding and a decoding on a sequence of moving pictures with a standard resolution, creating a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a step of implementing a process for a first super-resolution enlargement on the sequence of moving pictures with the standard resolution, creating a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a step of implementing a process for a first resolution conversion on the set of super-resolution enlarged pictures, creating a set of super-resolution enlarged and converted pictures with the standard resolution;

a step of having the set of super-resolution enlarged and converted pictures as a set of encoding target pictures, implementing thereon a second combination of processes for a prediction and an encoding, creating a second sequence of encoded bits;

a step of acquiring the set of decoded pictures with the standard resolution from the first encoder to implement thereon a process for a second super-resolution enlargement to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution; and

a step of working on the set of super-resolution enlarged decoded pictures to implement a process for a second resolution conversion to create a set of super-resolution enlarged and converted decoded pictures with the standard resolution,

wherein the step of creating the second sequence of encoding bits further comprises a step of having the set of super-resolution enlarged and converted

decoded pictures from the second resolution converter as a set of reference pictures to implement the second combination of processes for the prediction and the encoding to create the second sequence of encoded bits.

26. (New) A recording medium storing a moving picture encoding program configured to have a computer execute:

a step of implementing a first combination of processes for an encoding and a decoding on a sequence of moving pictures with a standard resolution, creating a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a step of implementing a process for a first super-resolution enlargement on the sequence of moving pictures with the standard resolution, creating a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a step of implementing a process for a first resolution conversion on the set of super-resolution enlarged pictures, creating a set of super-resolution enlarged and converted pictures with the standard resolution;

a step of having the set of super-resolution enlarged and converted pictures as a set of encoding target pictures, implementing thereon a second combination of processes for a prediction and an encoding, creating a second sequence of encoded bits;

a step of acquiring the set of decoded pictures with the standard resolution from the first encoder to implement thereon a process for a second super-resolution enlargement to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution; and

a step of working on the set of super-resolution enlarged decoded pictures to implement a process for a second resolution conversion to create a set of super-resolution enlarged and converted decoded pictures with the standard resolution,

wherein the step of creating the second sequence of encoding bits further comprises a step of having the set of super-resolution enlarged and converted decoded pictures from the second resolution converter as a set of reference pictures to implement the second combination of processes for the prediction and the encoding to create the second sequence of encoded bits.

Amendments to the Abstract:

Please place the following Abstract on a new last page of the Specification following the Claims and before the Drawings.

A first super-resolution enlarger 103 works on moving pictures input with a standard resolution, implementing a process for a super-resolution enlargement including information on frequency components in the spatial direction and the temporal direction that has been potentially contained in the input moving pictures but unable to express to a sufficient degree by the standard resolution, and provides super-resolution enlarged signals, which are returned to the standard resolution at a first resolution converter 104, and the super-resolution enlarged signals as returned to the standard resolution are encoded at a second encoder 107. There is a first encoder 102 for encoding moving pictures input with the standard resolution, and a multiplexer 109 working to multiplex a sequence of encoded bits from the first encoder 102, a sequence of encoded bits from the second encoder 107, and the like. The second encoder 107 is adaptive to employ local decoded signals in the first encoder 102 or processed signals thereof, as reference signals.

Amendments to the Drawings:

Please enter the 3 sheets of Replacement Formal Drawings attached hereto.

REMARKS

The specification to the Title has been made to effectively describe the invention.

The specification has been amended to incorporate by reference to the earlier filed applications.

Amendments to the claims have been presented to reduce excess claim fees and to conform them to U.S. practice. Upon entry of the above amendments, claims 1 is canceled, claims 2-6, 11, 12, 20 and 21 are amended, and claims 22-26 are newly added. Claims 2-26 are pending in this application. The claim amendments do not introduce new matter within the meaning of 35 U.S.C. §132.

Applicant reserves the right to reintroduce any cancelled subject matter to this application or to any child applications, or to reintroduce the full scope of any claim amended herein.

An Abstract has been newly added and is in proper U.S. form.

The replacement drawings submitted herewith is to amend Figure 3, 4 and Figure 24, to correct typographical errors in the text. No new matter has been added.

Accordingly, the Examiner is respectfully requested to enter the above amendments before examination. Favorable consideration is requested.

CONCLUSION

The Examiner is welcomed to telephone the undersigned attorney if he has any questions or comments.

Please charge any fee deficiency or credit any overpayment to Deposit Account No. 14-0112.

Respectfully submitted,

THE NATH LAW GROUP

Date: November 29, 2010

/ Jerald L. Meyer/
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JLM/sw

FIG. 3

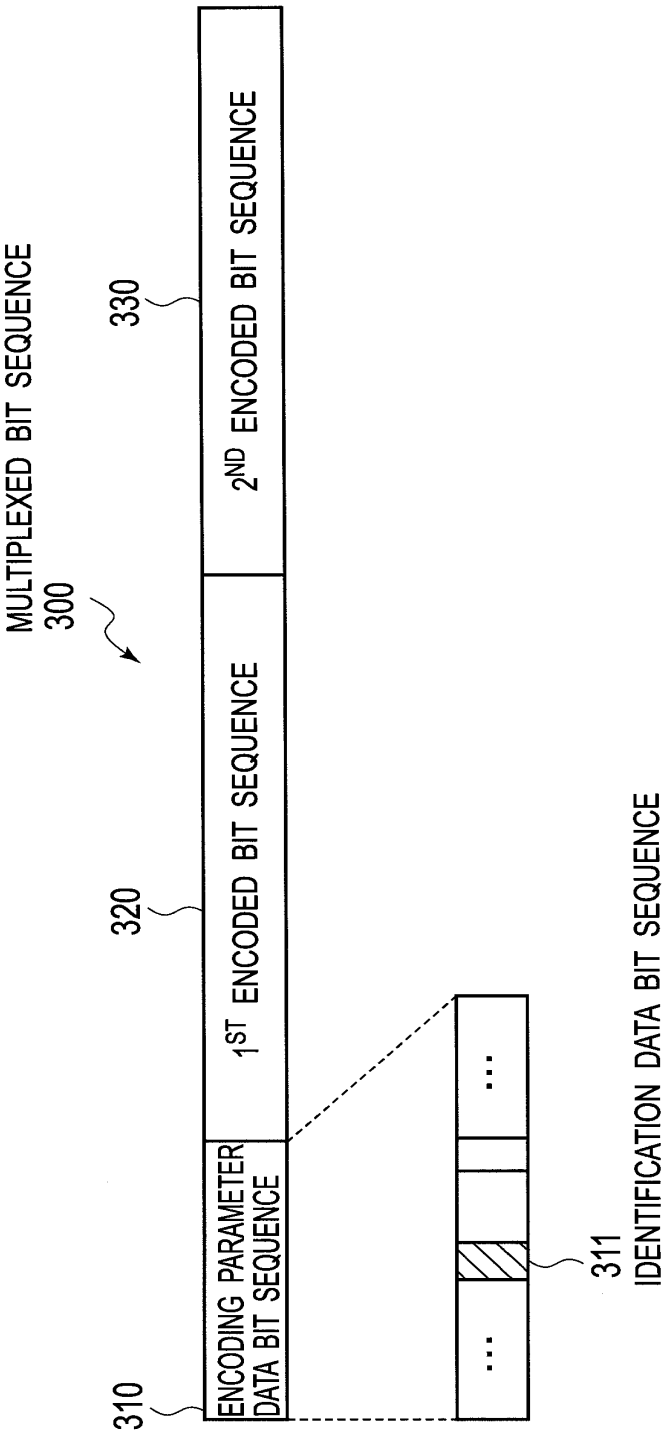

MULTIPLEXED BIT SEQUENCE
300
330
2ND ENCODED BIT SEQUENCE
320
1ST ENCODED BIT SEQUENCE
310
ENCODING PARAMETER DATA BIT SEQUENCE
311
IDENTIFICATION DATA BIT SEQUENCE

FIG. 4

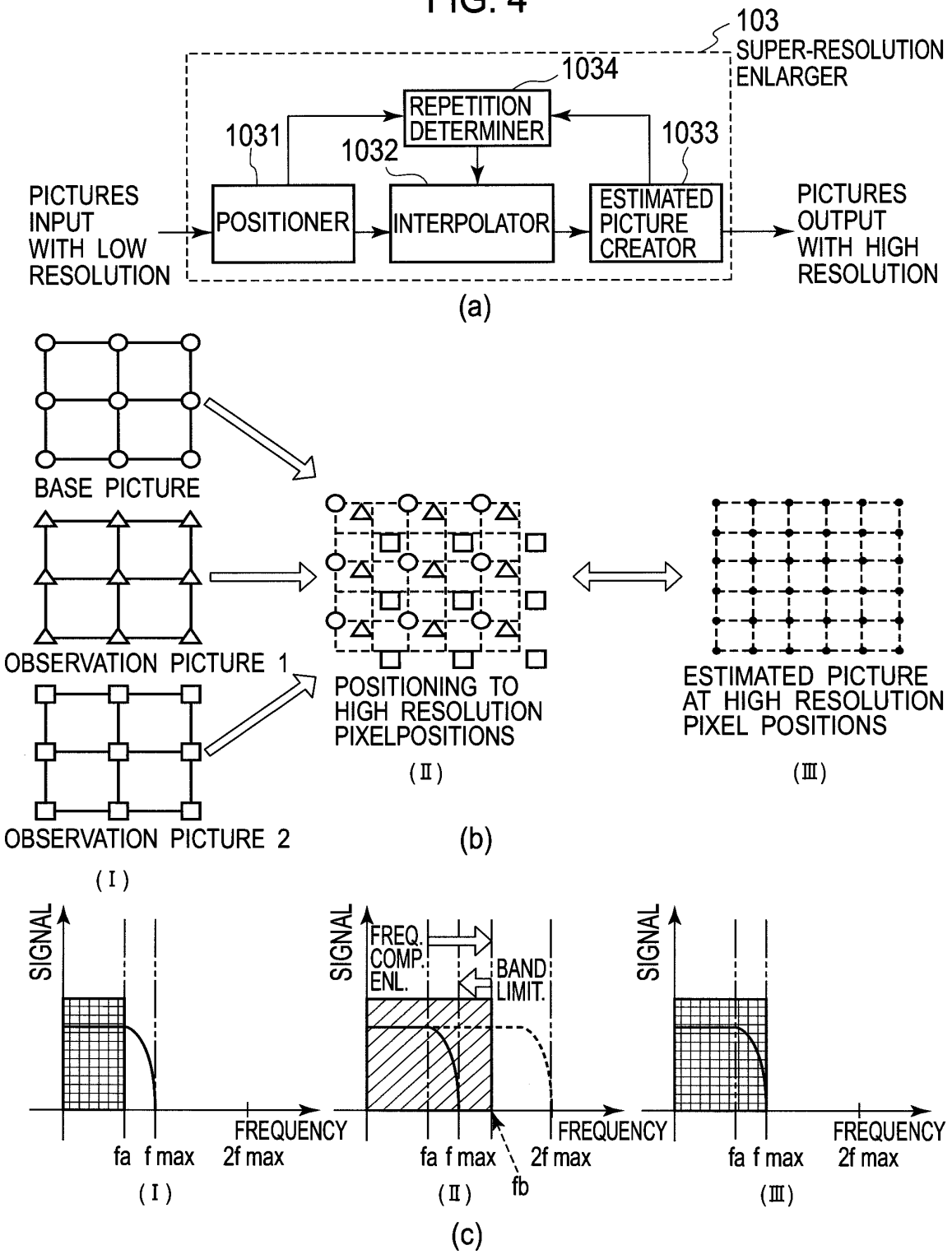
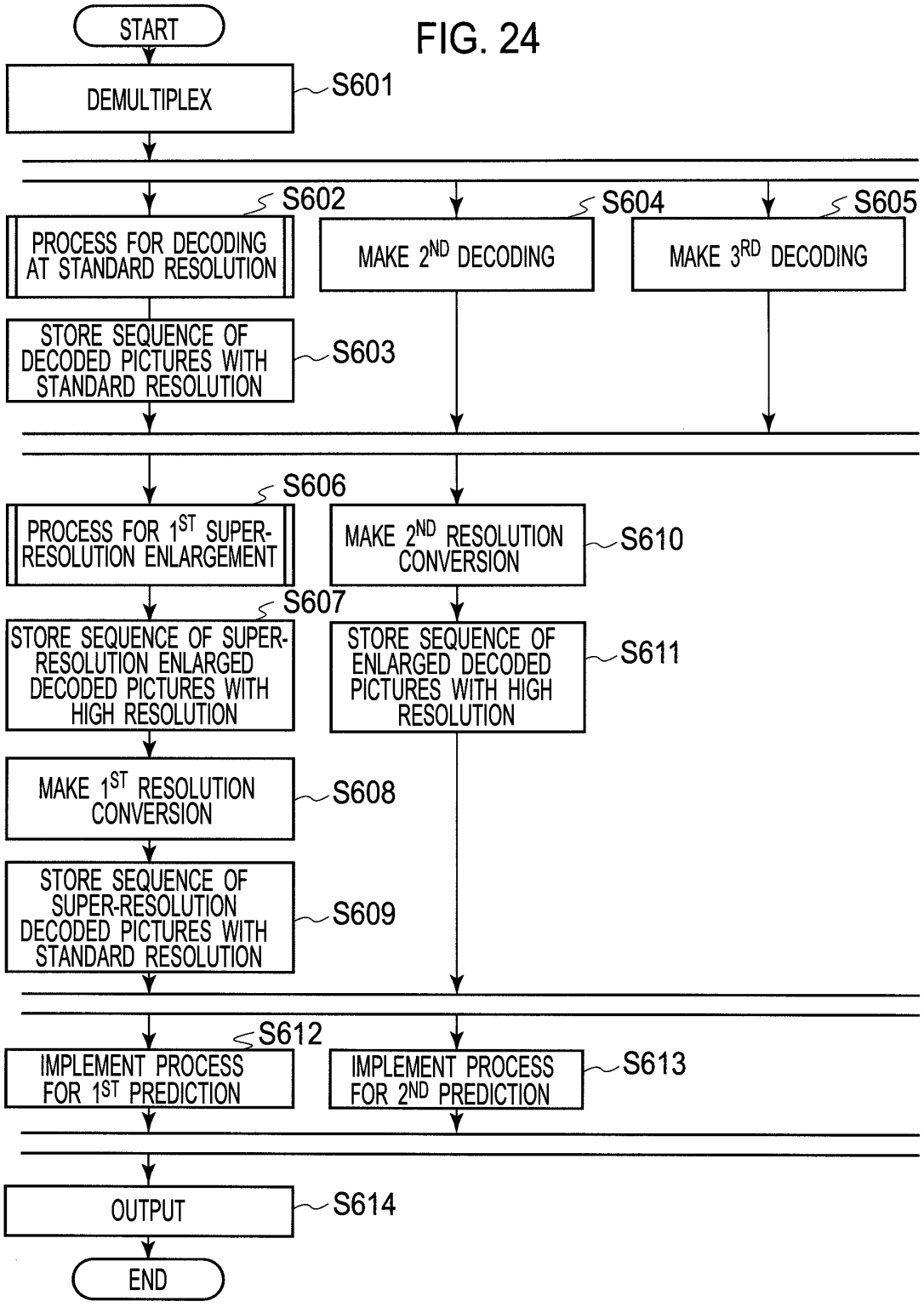

103
SUPER-RESOLUTION ENLARGER
1034
REPETITION DETERMINER
1031
1032
1033
PICTURES INPUT WITH LOW RESOLUTION
POSITIONER
INTERPOLATOR
ESTIMATED PICTURE CREATOR
PICTURES OUTPUT WITH HIGH RESOLUTION
(a)
BASE PICTURE
OBSERVATION PICTURE 1
OBSERVATION PICTURE 2
(I)
POSITIONING TO HIGH RESOLUTION PIXELPOSITIONS
(II)
ESTIMATED PICTURE AT HIGH RESOLUTION PIXEL POSITIONS
(III)
(b)
SIGNAL
FREQUENCY
fa f max 2f max
(I)
FREQ. COMP. ENL.
BAND LIMIT.
fb
(II)
(III)
(c)

FIG. 24


START
DEMULTIPLEX
S601
S602
PROCESS FOR DECODING AT STANDARD RESOLUTION
S604
MAKE 2ND DECODING
S605
MAKE 3RD DECODING
STORE SEQUENCE OF DECODED PICTURES WITH STANDARD RESOLUTION
S603
S606
PROCESS FOR 1ST SUPER-RESOLUTION ENLARGEMENT
MAKE 2ND RESOLUTION CONVERSION
S610
S607
STORE SEQUENCE OF SUPER-RESOLUTION ENLARGED DECODED PICTURES WITH HIGH RESOLUTION
STORE SEQUENCE OF ENLARGED DECODED PICTURES WITH HIGH RESOLUTION
S611
MAKE 1ST RESOLUTION CONVERSION
S608
STORE SEQUENCE OF SUPER-RESOLUTION DECODED PICTURES WITH STANDARD RESOLUTION
S609
S612
IMPLEMENT PROCESS FOR 1ST PREDICTION
IMPLEMENT PROCESS FOR 2ND PREDICTION
S613
OUTPUT
S614
END

an interpolator configured to work on nonhomogeneous high resolution pictures created at the positioner, to implement a process for a prescribed nonhomogeneous interpolation to create interpolated pictures with a desirable high resolution;

an estimated picture creator configured to acquire interpolated pictures created at the interpolator, to implement thereon a process for a prescribed reconstruction to create estimated pictures with a desirable resolution; and

a repetition determiner configured to acquire a nonhomogeneous high resolution picture from the positioner and a nonhomogeneous estimated picture from the estimated picture creator, for employment of the acquired pictures to follow a prescribed determination method to determine whether or not a repetition of the processing for super-resolution enlargement is necessary, and work depending on a result thereof, to operate as the repetition is necessary, to provide the interpolator with information for a control to continue the processing, and operate as the repetition is unnecessary, to provide the estimated picture creator with information for a control to output a set of estimated pictures with a high resolution after super-resolution enlargement.

23. (New) The moving picture encoding system according to claim 3, further comprising a multiplexer configured to operate complying with a prescribed syntax structure to multiplex the first sequence of encoded bits from the first encoder, the second sequence of encoded bits from the second encoder, and information on encoding parameters of respective types used in the encoding at the first encoder and the encoding at the second encoder.

24. (New) The moving picture encoding system according to claim 3, further comprising:

a first accumulation buffer configured to work in a course before the first encoder and the first super-resolution enlarger, to accumulate subsequences of the sequence of moving pictures with the standard resolution;

a second accumulation buffer configured to work in a course between the first encoder and the second encoder, to accumulate sets of decoded pictures from the first encoder;

Electronic Patent Application Fee Transmittal	
Application Number:	
Filing Date:	
Title of Invention:	MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYSTEM, MOVING PICTURE REENCODING METHOD, AND MOVING PICTURE REENCODING PROGRAM
First Named Inventor/Applicant Name:	Satoru SAKAZUME
Filer:	Stanley Protigal/Samuel woldeyesus
Attorney Docket Number:	31181U
Filed as Large Entity	

U.S. National Stage under 35 USC 371 Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
National Stage Fee	1631	1	330	330
Natl Stage Search Fee - Report provided	1642	1	430	430
National Stage Exam - all other cases	1633	1	220	220
Pages:				
Natl Stage Appl Sz fee per 50 pgs >100	1681	1	270	270
Claims:				
Claims in excess of 20	1615	5	52	260
Independent claims in excess of 3	1614	13	220	2860

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**4370**

Electronic Acknowledgement Receipt	
EFS ID:	8918952
Application Number:	12995039
International Application Number:	PCT/JP2009/059801
Confirmation Number:	7504
Title of Invention:	MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYSTEM, MOVING PICTURE REENCODING METHOD, AND MOVING PICTURE REENCODING PROGRAM
First Named Inventor/Applicant Name:	Satoru SAKAZUME
Customer Number:	20529
Filer:	Stanley Protigal/Samuel Woldeyesus
Filer Authorized By:	Stanley Protigal
Attorney Docket Number:	31181U
Receipt Date:	29-NOV-2010
Filing Date:	
Time Stamp:	16:23:21
Application Type:	U.S. National Stage under 35 USC 371

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1	Oath or Declaration filed	ExecutedDeclaration_31181U.pdf	678739 ce69aa8f28a1df6c75eb033107cdf2fa0717e66e	no	2
Warnings:					
Information:					
2	Documents submitted with 371 Applications	FormPCTIB304_31181U.pdf	179819 13ad416ab131a05e2813ff1ed3190a0e6ef78222	no	1
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Warnings:					
Information:					
6	Information Disclosure Statement (IDS) Filed (SB/08)	updated_IDS_1.pdf	612372 c0ab1ccbb16b504dfcdb54cd0ad2f69981d079f5	no	4
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8	Foreign Reference	JP07162870_31181U.pdf	3262493 f80270bc8321305f7716c41a6391740805ecd916	no	24
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9	Foreign Reference	200853848_31181U.pdf	1327841 acf9f95d42ec85ecf37ebc26782fa802937926f6	no	8
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10		SpecClaimsAbDrawings_31181U.pdf	16309629 2918072dd016501b98eb72277bb70ae06ad2f5e9	yes	149
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	Documents submitted with 371 Applications		1	1	
	Specification		2	109	
	Claims		110	124	
	Drawings-only black and white line drawings		125	149	
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11	Transmittal of New Application	pto-1390_1.pdf	4929407 e7daded74c97635087f651194c53836403500b25	no	4
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12	Application Data Sheet	sb0014_1fill.pdf	1104536 44b893d3128b3cd41aec0adcc6fe30f541a8f273	no	5
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13		PreliminaryAmendment_31181U.pdf	2881023 2eb12f2300468c1a8a495f50c392b88aea77d6e0	yes	29
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	Preliminary Amendment		1	1	
	Specification		2	3	
	Claims		4	22	
	Abstract		23	23	

	Drawings-only black and white line drawings		24	24	
	Applicant Arguments/Remarks Made in an Amendment		25	26	
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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

DECLARATION FOR PATENT APPLICATION	Attorney Docket: 31181U Page 1 of 2

As a below-named inventor(s), I/we hereby declare that:

My/Our residence(s), post office address(es) and citizenship(s) is/are as stated below next to my/our name(s).

I/We believe I/we am/are the original inventor, first and sole *(if only one name is listed below)* or the original, first and joint inventors *(if plural names are listed below)* of the subject matter which is claimed, and for which a patent is sought on the invention entitled:
MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYSTEM, MOVING PICTURE REENCODING METHOD, AND MOVING PICTURE REENCODING PROGRAM
the specification of which: (check one)

[ ] is attached hereto.

[X] was filed on May 28, 2009, as Serial No. PCT/JP2009/059801,

and was amended on _____ (if applicable).

We hereby state that we have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

We acknowledge the duty to disclose information which is material to the patentability of this application as defined by 37 CFR § 1.56.

We hereby claim foreign priority benefits under 35 U.S.C. § 119 of any foreign application(s) for patent or inventor's certificate listed below, and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Applications:

(Application No.)	(Country)	(Day/Month/Year Filed)		
P2008-142433	JAPAN	30/May/2008	[X] Yes	[ ] No
P2009-123960	JAPAN	22/May/2009	[ ] Yes	[ ] No
_____	_____	/ /	[ ] Yes	[ ] No
_____	_____	/ /	[ ] Yes	[ ] No
_____	_____	/ /	[ ] Yes	[ ] No
_____	_____	/ /	[ ] Yes	[ ] No

I/We hereby appoint the Practitioners associated with the following Customer Number:

Customer Number 20529

Direct Telephone Calls to:

Gary M. Nath
(703) 548-6284

Send Correspondence to:
Customer Number 20529
THE NATH LAW GROUP
112 South West Street
Alexandria, VA 22314
U.S.A.

We hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by 35 U.S.C. § 112, first paragraph, I/we acknowledge the duty to disclose material information as defined in 37 CFR § 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(U.S. Application Serial No.) (U.S. Filing Date) (Status--patented, pending, abandoned)

(U.S. Application Serial No.) (U.S. Filing Date) (Status--patented, pending, abandoned)

DECLARATION FOR PATENT APPLICATION	Attorney Docket: 31181U Page 2 of 2

I/we hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below:

Application Number(s) _____ Filing Date _____

We hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. ' 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor: **Satoru SAKAZUME**

Inventor's Signature Satoru Sakazume Date: November 02, 2010

Residence: Kanagawa-ken, Japan

Country of Citizenship: Japan

Post Office Address: 12, Moriya-cho 3-chome, Kanagawa-ku, Yokohama-shi, Kanagawa, Japan

Full name of second inventor: _____

Inventor's Signature _____ Date: _____

Residence: _____

Country of Citizenship: _____

Post Office Address: _____

_____

Full name of third inventor: _____

Inventor's Signature _____ Date: _____

Residence: _____

Country of Citizenship: _____

Post Office Address: _____

_____

Full name of fourth inventor: _____

Inventor's Signature _____ Date: _____

Residence: _____

Country of Citizenship: _____

Post Office Address: _____

_____

Full name of fifth inventor: _____

Inventor's Signature _____ Date: _____

Residence: _____

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1050001
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Date of mailing *(day/month/year)* 25 August 2009 (25.08.2009)	
Applicant's or agent's file reference JJVC-275-PCT	IMPORTANT NOTIFICATION
International application No. PCT/JP2009/059801	International filing date *(day/month/year)* 28 May 2009 (28.05.2009)
International publication date *(day/month/year)* **Not yet published**	Priority date *(day/month/year)* 30 May 2008 (30.05.2008)
Applicant VICTOR COMPANY OF JAPAN, LIMITED et al	

1. By means of this Form, which replaces any previously issued notification concerning submission or transmittal of priority documents, the applicant is hereby notified of the date of receipt by the International Bureau of the priority document(s) relating to all earlier application(s) whose priority is claimed. Unless otherwise indicated by the letters "NR", in the right-hand column or by an asterisk appearing next to a date of receipt, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).

2. *(If applicable)* The **letters "NR"** appearing in the right-hand column denote **a priority document which, on the date of mailing of this Form, had not yet been received by the International Bureau** under Rule 17.1(a) or (b). Where, under Rule 17.1(a), the priority document must be submitted by the applicant to the receiving Office or the International Bureau, but the applicant fails to submit the priority document within the applicable time limit under that Rule, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

3. *(If applicable)***An asterisk (*)** appearing next to a date of receipt, in the right-hand column, denotes **a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b)** (the priority document was received after the time limit prescribed in Rule 17.1(a) or the request to prepare and transmit the priority document was submitted to the receiving Office after the applicable time limit under Rule 17.1(b)). Even though the priority document was not furnished in compliance with Rule 17.1(a) or (b), the International Bureau will nevertheless transmit a copy of the document to the designated Offices, for their consideration. In case such a copy is not accepted by the designated Office as the priority document, Rule 17.1(c) provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

Priority date	Priority application No.	Country or regional Office or PCT receiving Office	Date of receipt of priority document
30 May 2008 (30.05.2008)	2008-142433	JP	03 July 2009 (03.07.2009)
22 May 2009 (22.05.2009)	2009-123960	JP	03 July 2009 (03.07.2009)

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

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Authorized officer
Yoshiko Kuwahara
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Telephone No. +41 22 338 74 07

PATENT COOPERATION TREATY

WO 2009/145271
PCT/JP2009/059801

From the INTERNATIONAL BUREAU

PCT

SECOND AND SUPPLEMENTARY NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION (TO DESIGNATED OFFICES WHICH APPLY THE 30 MONTH TIME LIMIT UNDER ARTICLE 22(1))

(PCT Rule 47.1(c))

To:

MIYOSHI, Hidekazu
Toranomon Kotohira Tower, 2-8, Toranomon 1-chome,
Minato-ku, Tokyo
1050001
JAPON

Date of mailing *(day/month/year)*	
30 September 2010 (30.09.2010)	
Applicant's or agent's file reference	IMPORTANT NOTICE
JJVC-275-PCT	

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/JP2009/059801	28 May 2009 (28.05.2009)	30 May 2008 (30.05.2008)

Applicant: VICTOR COMPANY OF JAPAN, LIMITED et al

1. **ATTENTION**: For any designated Office(s), for which the time limit under Article 22(1), as in force from 1 April 2002 (30 months from the priority date), **does not apply**, please see Form PCT/IB/308(First Notice) issued previously.

2. Notice is hereby given that the following designated Office(s), for which the time limit under Article 22(1), as in force from 1 April 2002, **does apply**, has/have requested that the communication of the international application, as provided for in Article 20, be effected under Rule 93*bis*.1. The International Bureau has effected that communication on the date indicated below:
03 December 2009 (03.12.2009)

   AU, AZ, BY, CN, CO, DZ, EP, HU, KG, KP, KR, MD, MK, MY, MZ, NA, NG, PG, RU, SY, TM, US

   In accordance with Rule 47.1(c-*bis*)(i), those Offices will accept the present notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

3. The following designated Offices, for which the time limit under Article 22(1), as in force from 1 April 2002, **does apply**, have not requested, as at the time of mailing of the present notice, that the communication of the international application be effected under Rule 93*bis*.1 :

   AE, AG, AL, AM, AO, AP, AT, BA, BB, BG, BH, BR, BW, BZ, CA, CH, CR, CU, CZ, DE, DK, DM, DO, EA, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, ID, IL, IN, IS, KE, KM, KN, KZ, LA, LC, LK, LR, LS, LT, LY, MA, ME, MG, MN, MW, MX, NI, NO, NZ, OA, OM, PH, PL, PT, RO, RS, SC, SD, SE, SG, SK, SL, SM, ST, SV, TJ, TN, TR, TT, UA, UZ, VC, VN, ZA, ZM, ZW

   In accordance with Rule 47.1(c-*bis*)(ii), those Offices accept the present notice as conclusive evidence that the Contracting State for which that Office acts as a designated Office does not require the furnishing, under Article 22, by the applicant of a copy of the international application.

4. **TIME LIMITS for entry into the national phase**

   For the designated or elected Office(s) listed above, the applicable time limit for entering the national phase will, **subject to what is said in the following paragraph,** be **30 MONTHS** from the priority date.

   In practice, **time limits other than the 30-month time limit** will continue to apply, for various periods of time, in respect of certain of the designated or elected Office(s) listed above. For **regular updates on the applicable time limits** (30 or 31 months, or other time limit), Office by Office, refer to the *PCT Gazette*, the *PCT Newsletter* and the *PCT Applicant's Guide*, Volume II, National Chapters, all available from WIPO's Internet site, at http://www.wipo.int/pct/en/index.html.

   It is the applicant's **sole responsibility** to monitor all these time limits.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

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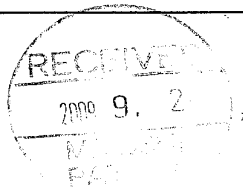
Authorized officer
Gijsbertus Beijer

e-mail: pt07.pct@wipo.int

特 許 協 力 条 約

発信人　日本国特許庁（国際調査機関）

代理人
　三好　秀和



様

あて名
〒105-0001
日本国東京都港区虎ノ門１丁目２番８号　虎ノ門琴平タワー

ＰＣＴ
国際調査機関の見解書
（法施行規則第 40 条の 2）
〔ＰＣＴ規則 43 の 2.1〕

出願人又は代理人の書類記号　JJVC-275-PCT	発送日（日.月.年）　01．09．2009 今後の手続きについては、下記２を参照すること。

国際出願番号	国際出願日	優先日
ＰＣＴ／ＪＰ２００９／０５９８０１	（日.月.年）　２８．０５．２００９	（日.月.年）　３０．０５．２００８

国際特許分類（ＩＰＣ）Int.Cl. H04N7/32(2006.01)i

出願人（氏名又は名称）
日本ビクター株式会社

１．この見解書は次の内容を含む。

- ☑ 第Ⅰ欄　見解の基礎
- ☐ 第Ⅱ欄　優先権
- ☐ 第Ⅲ欄　新規性、進歩性又は産業上の利用可能性についての見解の不作成
- ☐ 第Ⅳ欄　発明の単一性の欠如
- ☑ 第Ⅴ欄　ＰＣＴ規則 43 の 2.1(a)(i)に規定する新規性、進歩性又は産業上の利用可能性についての見解、それを裏付けるための文献及び説明
- ☐ 第Ⅵ欄　ある種の引用文献
- ☐ 第Ⅶ欄　国際出願の不備
- ☐ 第Ⅷ欄　国際出願に対する意見

２．今後の手続き
国際予備審査の請求がされた場合は、出願人がこの国際調査機関とは異なる国際予備審査機関を選択し、かつ、その国際予備審査機関がＰＣＴ規則 66.1 の 2(b)の規定に基づいて国際調査機関の見解書を国際予備審査機関の見解書とみなさない旨を国際事務局に通知していた場合を除いて、この見解書は国際予備審査機関の最初の見解書とみなされる。

この見解書が上記のように国際予備審査機関の見解書とみなされる場合、様式ＰＣＴ／ＩＳＡ／２２０を送付した日から３月又は優先日から２２月のうちいずれか遅く満了する期限が経過するまでに、出願人は国際予備審査機関に、適当な場合は補正書とともに、答弁書を提出することができる。

さらなる選択肢は、様式ＰＣＴ／ＩＳＡ／２２０を参照すること。

３．さらなる詳細は、様式ＰＣＴ／ＩＳＡ／２２０の備考を参照すること。

見解書を作成した日
２０．０８．２００９

名称及びあて先	特許庁審査官（権限のある職員）	５Ｃ	２９５４
日本国特許庁（ＩＳＡ／ＪＰ） 郵便番号１００－８９１５ 東京都千代田区霞が関三丁目４番３号	坂本　聡生 電話番号　０３－３５８１－１１０１　内線　３５４１		

様式ＰＣＴ／ＩＳＡ／２３７（表紙）（２００７年４月）

国際調査機関の見解書

国際出願番号　ＰＣＴ／ＪＰ２００９／０５９８０１

第Ⅰ欄　見解の基礎

１．言語に関し、この見解書は以下のものに基づき作成した。

☑ 出願時の言語による国際出願

☐ 出願時の言語から国際調査のための言語である＿＿＿＿＿＿＿＿語に翻訳された、この国際出願の翻訳文
（ＰＣＴ規則12.3(a)及び23.1(b)）

２．☐ この見解書は、ＰＣＴ規則91の規定により国際調査機関が認めた又は国際調査機関に通知された明らかな誤りの訂正を考慮して作成した（ＰＣＴ規則43の2.1(b)）。

３．この国際出願で開示されたヌクレオチド又はアミノ酸配列に関して、以下に基づき見解書を作成した。

ａ．タイプ　☐ 配列表

☐ 配列表に関連するテーブル

ｂ．フォーマット　☐ 紙形式

☐ 電子形式

ｃ．提出時期　☐ 出願時の国際出願に含まれていたもの

☐ この国際出願と共に電子形式により提出されたもの

☐ 出願後に、調査のために、この国際調査機関に提出されたもの

４．☐ さらに、配列表又は配列表に関連するテーブルを提出した場合に、出願後に提出した配列若しくは追加して提出した配列が出願時に提出した配列と同一である旨、又は、出願時の開示を超える事項を含まない旨の陳述書の提出があった。

５．補足意見：

国際調査機関の見解書

国際出願番号　ＰＣＴ／ＪＰ２００９／０５９８０１

第Ⅴ欄　新規性、進歩性又は産業上の利用可能性についてのＰＣＴ規則43の2.1(a)(i)に定める見解、それを裏付ける文献及び説明

１．　見解

新規性（Ｎ）	請求項	１－２１	有
	請求項		無
進歩性（ＩＳ）	請求項	２－３，７－１０，１３－２１	有
	請求項	１，４－６，１１－１２	無
産業上の利用可能性（ＩＡ）	請求項	１－２１	有
	請求項		無

２．　文献及び説明

文献１：ＪＰ　２００８－４２４０７　Ａ（日本放送協会）２００８．０２．２１，段落【００２０】－【００２６】，第１図

文献２：ＪＰ　２００８－５３８４８　Ａ（沖電気工業株式会社）２００８．０３．０６，段落【０００１】－【０００４】

請求の範囲１，４－６，１１－１２に係る発明は、国際調査報告で引用された文献１、文献２により進歩性を有しない。文献１に記載された、基準となる低解像度画像を符号化・復号化する手段と、基準となる低解像度画像を高解像度化する手段と、高解像度化された画像を符号化する手段と、を有する符号化装置において、高解像度化を行う際に、文献２に記載された周知である超解像処理、及び、周知である他の解像度変換処理によって高解像度化を行うことは、当業者にとって容易である。

請求の範囲２－３，７－１０，１３－２１に係る発明は、国際調査報告で引用されたいずれの文献にも記載されておらず、当業者にとって自明なものでない。

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/059801

A. CLASSIFICATION OF SUBJECT MATTER
H04N7/32(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04N7/32

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2009
Kokai Jitsuyo Shinan Koho 1971-2009 Toroku Jitsuyo Shinan Koho 1994-2009

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2008-42407 A (Nippon Hoso Kyokai), 21 February, 2008 (21.02.08), Par. Nos. [0020] to [0026]; Fig. 1 (Family: none)	1,4-6,11-12 2-3,7-10, 13-21
Y	JP 2008-53848 A (Oki Electric Industry Co., Ltd.), 06 March, 2008 (06.03.08), Par. Nos. [0001] to [0004] (Family: none)	1,4-6,11-12

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 August, 2009 (20.08.09)	01 September, 2009 (01.09.09)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2007)

特 許 協 力 条 約

PCT

国際調査報告

（法８条、法施行規則第 40、41 条）
〔ＰＣＴ18 条、ＰＣＴ規則 43、44〕

RECEIVED
2009 9. 2
MIYOSHI
PATENT

出願人又は代理人 の書類記号　JJVC-275-PCT	今後の手続きについては、様式ＰＣＴ／ＩＳＡ／２２０ 及び下記５を参照すること。	
国際出願番号 ＰＣＴ／ＪＰ２００９／０５９８０１	国際出願日 (日.月.年)　２８．０５．２００９	優先日 (日.月.年)　３０．０５．２００８
出願人（氏名又は名称） 日本ビクター株式会社		

国際調査機関が作成したこの国際調査報告を法施行規則第41条（ＰＣＴ18条）の規定に従い出願人に送付する。
この写しは国際事務局にも送付される。

この国際調査報告は、全部で　2　ページである。

☐ この調査報告に引用された先行技術文献の写しも添付されている。

１．国際調査報告の基礎
ａ．言語に関し、この国際調査は以下のものに基づき行った。
☑ 出願時の言語による国際出願
☐ 出願時の言語から国際調査のための言語である＿＿＿＿＿＿＿＿ 語に翻訳された、
この国際出願の翻訳文（ＰＣＴ規則12.3(a)及び23.1(b)）

ｂ．☐ この国際調査報告は、ＰＣＴ規則91の規定により国際調査機関が認めた又は国際調査機関に通知された明らかな誤りの訂正を考慮して作成した（ＰＣＴ規則43.6の2(a)）。

ｃ．☐ この国際出願は、ヌクレオチド又はアミノ酸配列を含んでいる（第Ｉ欄参照）。

２．☐ 請求の範囲の一部の調査ができない（第Ⅱ欄参照）。

３．☐ 発明の単一性が欠如している（第Ⅲ欄参照）。

４．発明の名称は
☑ 出願人が提出したものを承認する。
☐ 次に示すように国際調査機関が作成した。

＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿

５．要約は
☑ 出願人が提出したものを承認する。
☐ 第Ⅳ欄に示されているように、法施行規則第47条第１項（ＰＣＴ規則38.2）の規定により国際調査機関が作成した。出願人は、この国際調査報告の発送の日から１月以内にこの国際調査機関に意見を提出することができる。

６．図面に関して
ａ．要約書とともに公表される図は、
第　1　図とする。
☑ 出願人が示したとおりである。
☐ 出願人は図を示さなかったので、国際調査機関が選択した。
☐ 本図は発明の特徴を一層よく表しているので、国際調査機関が選択した。

ｂ．☐ 要約とともに公表される図はない。

国際調査報告

国際出願番号　ＰＣＴ／ＪＰ２００９／０５９８０１

Ａ．　発明の属する分野の分類（国際特許分類（ＩＰＣ））

Int.Cl.　H04N7/32(2006.01)i

Ｂ．　調査を行った分野

調査を行った最小限資料（国際特許分類（ＩＰＣ））

Int.Cl.　H04N7/32

最小限資料以外の資料で調査を行った分野に含まれるもの

日本国実用新案公報	１９２２－１９９６年
日本国公開実用新案公報	１９７１－２００９年
日本国実用新案登録公報	１９９６－２００９年
日本国登録実用新案公報	１９９４－２００９年

国際調査で使用した電子データベース（データベースの名称、調査に使用した用語）

Ｃ．　関連すると認められる文献

引用文献のカテゴリー＊	引用文献名　及び一部の箇所が関連するときは、その関連する箇所の表示	関連する請求項の番号
Ｙ	ＪＰ　２００８－４２４０７　Ａ（日本放送協会）２００８．０２．２１，段落【００２０】－【００２６】，第１図（ファミリーなし）	１，４－６，１１－１２
Ａ		２－３，７－１０，１３－２１
Ｙ	ＪＰ　２００８－５３８４８　Ａ（沖電気工業株式会社）２００８．０３．０６，段落【０００１】－【０００４】（ファミリーなし）	１，４－６，１１－１２

☐　Ｃ欄の続きにも文献が列挙されている。

☐　パテントファミリーに関する別紙を参照。

＊　引用文献のカテゴリー
「Ａ」特に関連のある文献ではなく、一般的技術水準を示すもの
「Ｅ」国際出願日前の出願または特許であるが、国際出願日以後に公表されたもの
「Ｌ」優先権主張に疑義を提起する文献又は他の文献の発行日若しくは他の特別な理由を確立するために引用する文献（理由を付す）
「Ｏ」口頭による開示、使用、展示等に言及する文献
「Ｐ」国際出願日前で、かつ優先権の主張の基礎となる出願の日の後に公表された文献
「Ｔ」国際出願日又は優先日後に公表された文献であって出願と矛盾するものではなく、発明の原理又は理論の理解のために引用するもの
「Ｘ」特に関連のある文献であって、当該文献のみで発明の新規性又は進歩性がないと考えられるもの
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Art Unit	TBD
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	1	2008-042407	JP	A	2008-02-21	NIPPON HOSO KYOKAI <NHK>		☒
	2	2008-053848	JP	A	2008-03-06	OKI ELECTRIC IND CO LTD		☒
	3	07-162870	JP	A	1995-06-23	AT & T CORP BELL COMMUN RES INC		☒

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PATENT ABSTRACTS OF JAPAN

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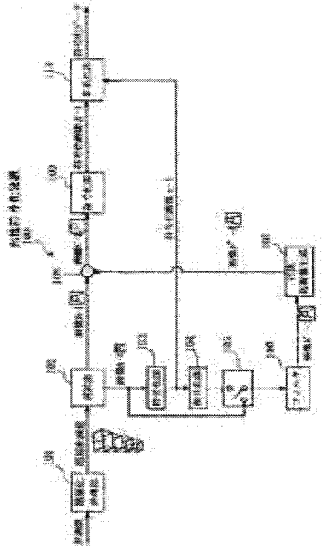
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(72)Inventor : GOSHI SEIICHI
SAKAIDA SHINICHI
IGUCHI KAZUHISA

(54) IMAGE ENCODING DEVICE AND DECODING DEVICE USING TV METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an image encoding device and image decoding device capable of reducing an encoded data amount and reproducing a high resolution image based on a low resolution image.
SOLUTION: A hierarchization processing part 101 hierarchizes an original image and generates a plurality of images in different resolutions, and a selecting part 102 selects two images among the plurality of images in different resolutions. A TV method high resolution part 107 applies high resolution by the TV method to a low resolution image between the two images selected by the selecting part 102, and a subtracting part 108 calculates a difference image between the high resolution image and the image subjected to high resolution. An encoding part 103 encodes the low resolution image, and an encoding part 109 encodes the difference image in high resolution.



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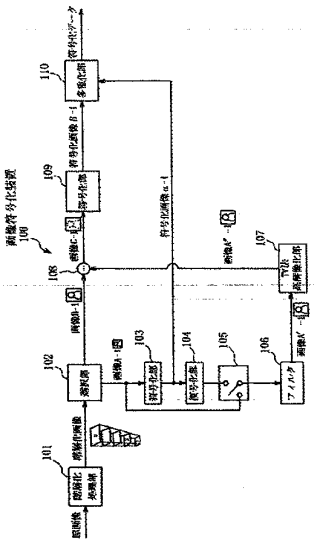
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最終頁に続く

(54)【発明の名称】ＴＶ法を用いた画像符号化装置及び復号化装置

(57)【要約】
【課題】符号化データ量を低減すると共に、低解像度画像に基づいて高解像度画像を再生することが可能な画像符号化装置及び画像復号化装置を提供する。
【解決手段】階層化処理部１０１は、原画像に階層化処理を施し、解像度の異なる複数の画像を生成し、選択部１０２は、解像度の異なる複数の画像のうちの２つの画像を選択する。ＴＶ法高解像化部１０７は、選択部１０２により選択された２つの画像のうちの低解像度画像に、ＴＶ法による高解像化を施し、減算部１０８は、高解像度画像と高解像化された画像との間の差分画像を算出する。そして、符号化部１０３は低解像度画像を符号化し、符号化部１０９は高解像度の差分画像を符号化する。
【選択図】図１



【特許請求の範囲】
【請求項１】
原画像に階層化処理を施し、解像度の異なる複数の画像を生成する階層化処理部と、
該階層化処理部により生成された解像度の異なる複数の画像のうち、２つの画像を選択する選択部と、
該選択部により選択された２つの画像のうちの低解像度の画像に、ＴＶ（Ｔｏｔａｌ Ｖａｒｉａｔｉｏｎ）法による高解像化を施す第１のＴＶ法高解像化部と、
前記選択部により選択された２つの画像のうちの高解像度の画像と、第１のＴＶ法高解像化部により高解像化された画像との間の差分の画像を算出する減算部と、
該減算部により算出された高解像度の差分画像に符号化を施す第１の符号化部と、
前記選択部により選択された２つの画像のうちの低解像度の画像に符号化を施す第２の符号化部と
を備えたことを特徴とする画像符号化装置。
【請求項２】
請求項１に記載の画像符号化装置において、
さらに、前記第２の符号化部により符号化された画像に復号化を施す復号化部と、
前記選択部により選択された２つの画像のうちの低解像度の画像、及び復号化部により復号化された画像のうちのいずれか一方に切り替えて出力する切り替え部とを備え、
前記第１のＴＶ法高解像化部が、切り替え部により出力された画像に、ＴＶ法による高解像化を施すことを特徴とする画像符号化装置。
【請求項３】
請求項１または２に記載の画像符号化装置において、
さらに、請求項１の選択部により選択された２つの画像のうちの低解像度の画像、または請求項２の復号化部により復号化された画像を拡大するフィルタ部を備え、
前記第１のＴＶ法高解像化部が、フィルタ部により拡大された画像に、ＴＶ法による高解像化を施すことを特徴とする画像符号化装置。
【請求項４】
請求項３に記載の画像符号化装置において、
前記フィルタ部が、選択部により選択された２つの画像のうちの高解像度の画像と同一の画素数になるように拡大処理を施すことを特徴とする画像符号化装置。
【請求項５】
請求項１から４までのいずれか一項に記載の画像符号化装置において、
さらに、前記第１の符号化部により符号化された高解像度の差分画像の符号化データと、第２の符号化部により符号化された低解像度の画像の符号化データとを多重する多重化部を備えたことを特徴とする画像符号化装置。
【請求項６】
請求項１から４までのいずれか一項に記載の画像符号化装置において、
前記第１の符号化部により符号化された高解像度の差分画像の符号化データと、第２の符号化部により符号化された低解像度の画像の符号化データとを別々のストリームとして伝送することを特徴とする画像符号化装置。
【請求項７】
請求項１から６までのいずれか一項の画像符号化装置による符号化データに復号化を施し、原画像を再生する画像復号化装置において、
前記高解像度の差分画像の符号化データに復号化を施す第１の復号化部と、
前記低解像度の画像の符号化データに復号化を施す第２の復号化部と、
該第２の復号化部により復号化された低解像度の画像に、ＴＶ法による高解像化を施す第２のＴＶ法高解像化部と、
前記第１の復号化部により復号化された高解像度の差分画像と、第２のＴＶ法高解像化部により高解像化された画像とを加算する加算部と
を備えたことを特徴とする画像復号化装置。

【発明の詳細な説明】
【技術分野】
【０００１】
本発明は、画像符号化装置及び画像復号化装置に関し、特に、階層化した画像をＴＶ（Ｔｏｔａｌ　Ｖａｒｉａｔｉｏｎ）法を用いて符号化する装置、及び符号化されたデータを復号化する装置に関するものである。
【背景技術】
【０００２】
従来、高解像度画像を解像度の異なる複数の画像に階層化し、これらの階層化した複数の画像を統合的に符号化する画像符号化装置が開示されている（例えば、特許文献１，２を参照）。これらの画像符号化装置は、いずれもウェーブレット変換を用いることにより、画像を低解像度画像から高解像度画像までの解像度の異なる複数の画像に階層的に分類し、いわゆる画像をピラミッド状に構成するものである。このように階層化した複数の画像は、画像毎に符号化されるのではなく、統合的に符号化される。すなわち、解像度の異なる複数の画像の相関を用いて符号化される。これにより、符号化効率の向上を実現することができる。
【０００３】
例えば、画像符号化装置は、階層化した複数の画像のうちの１枚の基本画像の符号化データ、及びこの基本画像と他の画像との間の差分の符号化データを画像復号化装置へ伝送する。画像復号化装置は、伝送された基本画像の符号化データ及び差分の符号化データを復号化し、原画像を再生する。
【０００４】
つまり、画像復号化装置は、画像符号化装置により統合的に符号化されたデータ（基本画像と差分データ）を復号化する。例えば、画像符号化装置が２枚の異なる解像度の画像を用いて符号化した場合には、画像復号化装置は、基本画像と差分データを復号化する。
【０００５】
【特許文献１】特許第３５７６６６０号公報
【特許文献２】特許第３２１３５６１号公報
【発明の開示】
【発明が解決しようとする課題】
【０００６】
このように、従来の画像符号化装置は、階層化された解像度の異なる複数の画像を統合的に符号化し、画像復号化装置は、画像符号化装置により伝送された符号化データを復号化する。この場合、符号化及び復号化処理の負荷を小さくする観点からすると、画像符号化装置が生成する符号化データ量をできる低減することが望ましい。また、画像復号化装置において、低解像度画像に基づいて高解像度画像を再生することができれば、符号化及び復号化の効率上望ましいといえる。
【０００７】
そこで、本発明は前記課題を解決するためになされたものであり、その目的は、符号化データ量を低減すると共に、低解像度画像に基づいて高解像度画像を再生することが可能な画像符号化装置及び画像復号化装置を提供することにある。
【課題を解決するための手段】
【０００８】
前記課題を解決するため、本発明による画像処理装置は、原画像に階層化処理を施し、解像度の異なる複数の画像を生成する階層化処理部と、該階層化処理部により生成された解像度の異なる複数の画像のうち、２つの画像を選択する選択部と、該選択部により選択された２つの画像のうちの低解像度の画像に、ＴＶ法による高解像化を施す第１のＴＶ法高解像化部と、前記選択部により選択された２つの画像のうちの高解像度の画像と、第１のＴＶ法高解像化部により高解像化された画像との間の差分の画像を算出する減算部と、該減算部により算出された高解像度の差分画像に符号化を施す第１の符号化部と、前記選

択部により選択された２つの画像のうちの低解像度の画像に符号化を施す第２の符号化部とを備えたことを特徴とする。

【０００９】

また、本発明による画像符号化装置は、さらに、前記第２の符号化部により符号化された画像に復号化を施す復号化部と、前記選択部により選択された２つの画像のうちの低解像度の画像、及び復号化部により復号化された画像のうちのいずれか一方に切り替えて出力する切り替え部とを備え、前記第１のＴＶ法高解像化部が、切り替え部により出力された画像に、ＴＶ法による高解像化を施すことを特徴とする。

【００１０】

また、本発明による画像符号化装置は、さらに、前記選択部により選択された２つの画像のうちの低解像度の画像、または前記復号化部により復号化された画像を拡大するフィルタ部を備え、前記第１のＴＶ法高解像化部が、フィルタ部により拡大された画像に、ＴＶ法による高解像化を施すことを特徴とする。

【００１１】

また、本発明による画像符号化装置は、前記フィルタ部が、選択部により選択された２つの画像のうちの高解像度の画像と同一の画素数になるように拡大処理を施すことを特徴とする。

【００１２】

また、本発明による画像符号化装置は、さらに、前記第１の符号化部により符号化された高解像度の差分画像の符号化データと、第２の符号化部により符号化された低解像度の画像の符号化データとを多重する多重化部を備えたことを特徴とする。

【００１３】

また、本発明による画像符号化装置は、前記第１の符号化部により符号化された高解像度の差分画像の符号化データと、第２の符号化部により符号化された低解像度の画像の符号化データとを別々のストリームとして伝送することを特徴とする。

【００１４】

以上、画像符号化装置について説明したが、本発明には、前記画像符号化装置による符号化データに復号化を施し、原画像を再生する画像復号化装置も包含される。本発明による画像復号化装置は、前記高解像度の差分画像の符号化データに復号化を施す第１の復号化部と、前記低解像度の画像の符号化データに復号化を施す第２の復号化部と、該第２の復号化部により復号化された低解像度の画像に、ＴＶ法による高解像化を施す第２のＴＶ法高解像化部と、前記第１の復号化部により復号化された高解像度の差分画像と、第２のＴＶ法高解像化部により高解像化された画像とを加算する加算部とを備えたことを特徴とする。

【発明の効果】

【００１５】

以上のように、本発明によれば、ＴＶ法により高解像化された画像は、選択された２つの画像のうちの高解像度の画像に近いものとなる。これにより、高解像度の差分画像のデータ量が少なくなる。したがって、画像符号化装置において、符号化データ量を低減することができ、低いビットレートで符号化データを伝送することができる。また、画像復号化装置は、画像符号化装置からの低解像度の画像及び高解像度の差分画像の符号化データを復号化し、低解像度の画像をＴＶ法により高解像化し、この高解像化した画像と差分画像とを加算することにより、高解像度の画像を再生することができる。

【発明を実施するための最良の形態】

【００１６】

以下、本発明を実施するための最良の形態について図面を用いて詳細に説明する。

〔画像符号化装置〕

まず、画像符号化装置について説明する。図１は、本発明の実施の形態による画像符号化装置の構成を示すブロック図である。この画像符号化装置１００は、原画像について階層化した解像度の異なる複数の画像のうちの１枚の低解像度画像の符号化データを伝送する

と共に、複数の画像のうちの１枚の高解像度画像とＴＶ法により低解像度画像を高解像化した画像との間の差分画像の符号化データを伝送する。この場合、ＴＶ法により高解像化した画像を、複数の画像のうちの１枚の高解像度画像の画素数に近づける。つまり、この画像符号化装置１００は、高解像度画像とＴＶ法により高解像化した画像との間の差分画像について、その符号化データ量の低減化を実現することができるものである。図１を参照して、画像符号化装置１００は、階層化処理部１０１、選択部１０２、符号化部１０３、復号化部１０４、切り替え部１０５、フィルタ部１０６、ＴＶ法高解像化部１０７、減算部１０８、符号化部１０９、及び多重化部１１０を備えている。

【００１７】

階層化処理部１０１は、原画像を入力し、原画像に対して階層化処理により画像を縮小化して分割し、解像度の異なる複数の画像（階層化画像）を選択部１０２に出力する。具体的には、階層化処理部１０１は、直流成分及び交流成分の画像について、直流成分を含み、かつ低周波域から高周波域までの交流成分を段階的にピラミッド状に分割し、この分割により低解像度画像から高解像度画像までの解像度の異なる画像をそれぞれ生成する。

【００１８】

このような解像度の異なる複数の画像は、サブバンド符号化、ウェーブレット変換、直交変換等の各種の手法を用いて生成され、例えば、直流成分のみを含む第１の階層化画像、直流成分及び低周波域の交流成分を含む第２の階層化画像、並びに、直流成分、低周波域及び高周波域の交流成分を含む第３の階層化画像とすることができる（これを、ラプラシアンピラミッド状の階層化画像という。）。図１に示すように、サイズの小さい低解像度の画像１からサイズの大きい高解像度の画像ｎまでの階層化画像が生成される。

【００１９】

尚、階層化処理の詳細については省略する。詳細については、「貴家仁志著、“よくわかる動画静止画の処理技術”、ＣＱ出版社」の第１３７頁、または、前述した特許文献１の段落７８～９４、図２、図３を参照されたい。

【００２０】

選択部１０２は、階層化処理部１０１から解像度の異なる複数の画像（第１の解像度を有する階層化画像，第２の解像度を有する階層化画像，・・・，第ｎの解像度を有する階層化画像）を入力し、基準となる低解像度画像（画像Ａ－１）、及び差分をとる対象となる高解像度画像（画像Ｂ－１）の２つの階層化画像を選択し、低解像度画像（画像Ａ－１）を符号化部１０３及び切り替え部１０５に出力し、高解像度画像（画像Ｂ－１）を減算部１０８に出力する。

【００２１】

符号化部１０３は、選択部１０２から低解像度画像Ａ－１を入力し、符号化を施し、低解像度符号化画像α－１を復号化部１０４及び多重化部１１０に出力する。復号化部１０４は、符号化部１０３から低解像度符号化画像α－１を入力し、復号化を施し、低解像度復号画像を切り替え部１０５に出力する。

【００２２】

切り替え部１０５は、選択部１０２から低解像度画像Ａ－１を入力し、復号化部１０４から低解像度復号画像を入力し、予め設定されたスイッチの選択によりいずれかの画像をフィルタ部１０６に出力する。スイッチは、例えば、符号化部１０３において、低解像度画像Ａ－１に対して高いビットレートを得ることができる（帯域割り当てを十分に得ることができる）ため符号化歪みが発生せず、画像復号化装置において原画像と同等の再生画像を得ることができる場合には、選択部１０２からの低解像度画像Ａ－１を出力するように設定されている。一方、符号化部１０３において、低解像度の画像Ａ－１に対して低いビットレートしか得ることができない（帯域割り当てを十分に得ることができない）ため符号化歪みが発生する場合には、復号化部１０４からの低解像度復号画像を出力するように設定されている。

【００２３】

フィルタ部１０６は、切り替え部１０５から低解像度画像Ａ－１または低解像度復号画

像を入力し、選択部１０２において選択された高解像度画像Ｂ－１のサイズに拡大し（高解像度画像Ｂ－１の画素数と同一になるように拡大し）、拡大画像Ａ’－１をＴＶ法高解像化部１０７に出力する。

【００２４】

ＴＶ法高解像化部１０７は、フィルタ部１０６から拡大画像Ａ’－１を入力し、ＴＶ法によりカートゥーン画像ｕとテクスチャ画像ｖとに分解する。そして、カートゥーン画像ｕとテクスチャ画像ｖとを合成して復元画像である画像Ａ’’－１を生成し、または、カートゥーン画像ｕと、テクスチャ画像ｖを変換して生成した新たなテクスチャ画像ｖ’とを合成して復元画像である画像Ａ’’－１を生成し、減算部１０８に出力する。すなわち、ＴＶ法高解像化部１０７は、ＴＶ法により拡大画像Ａ’－１を高解像化して高周波成分を再生し、高解像度画像Ａ’’－１を生成する。ここで生成される高解像度画像Ａ’’－１は、選択部１０２により選択された高解像度画像Ｂ－１と同じ解像度であり、同じ画素数の画像になる。ＴＶ法高解像化部１０７の処理の詳細については後述する。

【００２５】

減算部１０８は、選択部１０２から高解像度画像Ｂ－１を入力し、ＴＶ法高解像化部１０７から高解像度画像Ａ’’－１を入力し、画像Ｂ－１（の各画素値）から画像Ａ’’－１（の各画素値）を減算し、高解像度差分画像Ｃ－１を符号化部１０９に出力する。

【００２６】

符号化部１０９は、減算部１０８から高解像度差分画像Ｃ－１を入力し、符号化を施し、差分符号化画像β－１を多重化部１１０に出力する。多重化部１１０は、符号化部１０３から低解像度符号化画像α－１を入力し、符号化部１０９から高解像度差分符号化画像β－１を入力し、これらの２つの画像信号を多重化し、符号化データの１本のストリームを伝送する。この場合、多重化することなく、低解像度符号化画像α－１の符号化データと、高解像度差分符号化画像β－１の符号化データとを別々にして、２本のストリームを伝送するようにしてもよい。

【００２７】

以上のように、図１に示した画像符号化装置１００によれば、ＴＶ法高解像化部１０７が、階層化された解像度の異なる複数の画像のうちの低解像度画像Ａ’－１を高解像化して画像Ａ’’－１を生成し、階層化された解像度の異なる複数の画像のうちの高解像度画像Ｂ－１に近づけるようにし、減算部１０８が、高解像度画像Ｂ－１と高解像度の画像Ａ’’－１との間の差分を計算し、符号化部１０９が、その高解像度差分画像Ｃ－１を符号化するようにした。ここで、ＴＶ法は従来の画像処理と異なり、例えば顔図に含まれていない高周波成分を生成する。このため、ＴＶ法により高解像化した画像Ａ’’－１と高解像度画像Ｂ－１との間の差分は、従来のフィルタ部１０６により拡大された拡大画像Ａ’－１と高解像度画像Ｂ－１との間の差分よりも情報量が少なくなる。すなわち、ＴＶ法により生成した高解像度画像Ａ’’－１は高解像度画像Ｂ－１に近い画素分布になるから、画像符号化装置１００は、符号化データ量の低減化を図ることができ、低いビットレートにより符号化データを伝送することができる。この場合、後述する画像復号化装置２００が、低解像度画像から高解像度成分を生成し、高解像度画像を再生するようにしたから、画像符号化装置１００は、高解像度画像の符号化データを伝送する必要がなく、符号化データの低減化を図ることができる。

【００２８】

〔画像復号化装置〕

次に、画像復号化装置について説明する。図２は、本発明の実施の形態による画像復号化装置の構成を示すブロック図である。この画像復号化装置２００は、図１に示した画像符号化装置１００により伝送された符号化データを入力し、低解像度画像と高解像度差分画像とに分離し、高解像度差分画像とＴＶ法により低解像度画像を高解像度画像に高解像化した画像とを合成し、再生画像を生成する。つまり、この画像復号化装置２００は、低解像度画像から再生画像の一部である高解像度成分を生成するものである。図２を参照して、画像復号化装置２００は、分離部２０１、復号化部２０２、復号化部２０３、フィル

タ２０４、ＴＶ法高解像化部２０５、及び加算部２０６を備えている。

【００２９】

分離部２０１は、画像符号化装置１００により伝送された符号化データの１本のストリームを入力し、この１本のストリームに包含される多重化された２つの符号化データを、高解像度差分符号化画像β－２と低解像度符号化画像α－２とに分離し、高解像度差分符号化画像β―２を復号化部２０２に出力し、低解像度符号化画像α－２を復号化部２０３に出力する。尚、画像符号化装置１００が、低解像度符号化画像α－１の符号化データと、高解像度差分符号化画像β－１の符号化データとを別々にして、２本のストリームを伝送した場合には、画像復号化装置２００の分離部２０１は不要となり、それぞれの符号化データが復号化部２０３，２０２に入力される。

【００３０】

復号化部２０２は、分離部２０１から高解像度差分符号化画像β－２を入力し、復号化を施し、復号画像である高解像度差分画像Ｃ－２を加算部２０６に出力する。復号化部２０３は、分離部２０１から低解像度符号化画像α－２を入力し、復号化を施し、復号画像である低解像度画像Ａ－２をフィルタ部２０４に出力する。

【００３１】

フィルタ部２０４は、復号化部２０３から低解像度画像Ａ－２を入力し、画像符号化装置１００の選択部１０２において選択された画像Ｂ－１のサイズに画素数が同一になるように拡大し、拡大画像Ａ’－２をＴＶ法高解像化部２０５に出力する。

【００３２】

ＴＶ法高解像化部２０５は、フィルタ部２０４から拡大画像Ａ’－２を入力し、ＴＶ法によりカートゥーン画像ｕとテクスチャ画像ｖとに分解する。そして、カートゥーン画像ｕとテクスチャ画像ｖとを合成して復元画像である画像Ａ’’－２を生成し、または、カートゥーン画像ｕと、テクスチャ画像ｖを変換して生成した新たなテクスチャ画像ｖ’とを合成して復元画像である画像Ａ’’－２を生成し、加算部２０６に出力する。すなわち、ＴＶ法高解像化部２０５は、ＴＶ法により拡大画像Ａ’－２を高解像化して高周波成分を再生し、高解像度画像Ａ’’－２を生成する。ここで生成される高解像度画像Ａ’’－２は、画像符号化装置１００の選択部１０２により選択された高解像度画像Ｂ－１と同じ解像度であり、同じ画素数の画像である。ＴＶ法高解像化部２０５の処理の詳細については後述する。

【００３３】

加算部２０６は、復号化部２０２から高解像度差分画像Ｃ－２を入力し、ＴＶ法高解像化部２０５から高解像度画像Ａ’’－２を入力し、画像Ｃ－２（の各画素値）と画像Ａ’’－２（の各画素値）とを加算し、高解像度再生画像Ｂ－２を生成する。この高解像度再生画像Ｂ－２は、画像符号化装置１００の選択部１０２により選択された高解像度画像Ｂ－１に近いものとなる。

【００３４】

以上のように、図２に示した画像復号化装置２００によれば、ＴＶ法高解像化部２０５が、復号化部２０３により復号化されフィルタ部２０４により拡大された低解像度画像Ａ’－２を高解像化して高解像度成分を有する画像Ａ’’－２を生成し、加算部２０６が、復号化部２０２による復号化された高解像度差分画像Ｃ－２と高解像度画像Ａ’’－２とを加算し、再生画像Ｂ－２を生成するようにした。これにより、再生画像Ｂ－２は画像符号化装置１００の選択部１０２により選択された高解像度画像Ｂ－１に近いものとすることができ、高解像度画像を再生することができる。

【００３５】

図１３は、従来の画像復号化装置を用いた場合の画像の周波数分布の例である。従来の画像符号化装置は、図１のブロック図において、切り替え部１０５及びＴＶ法高解像化部１０７が存在しない構成になっている。すなわち、従来の画像符号化装置は、高解像度画像Ｂと低解像度画像Ａを拡大した画像Ａ’との差分をとり、差分画像Ｃの符号化データを伝送する。図１３を参照して、（１）は高解像度画像Ｂの周波数分布を、（２）は拡大画

像Ａ’の周波数分布を、（３）は高解像度画像Ｂと拡大画像Ａ’との間の差分画像をそれぞれ示す。（２）に示すように、拡大画像Ａ’は、低解像度画像Ａを拡大した画像に過ぎないから、周波数の巾は、（１）の画像Ｂに比べて狭い。このため、（３）の画像Ｃは、レベルの高い周波数成分が差分として残されていることがわかる。

【００３６】

図１４は、図１に示した画像符号化装置１００を用いた場合の画像の周波数分布の例である。図１４を参照して、（１）は高解像度画像Ｂ－１の周波数分布を、（２）は拡大画像Ａ’をＴＶ法により高解像化した高解像度画像Ａ’’－１の周波数分布を、（３）は高解像度画像Ｂ－１と高解像度画像Ａ’’－１との間の差分画像Ｃ－１をそれぞれ示す。（２）に示すように、高解像度画像Ａ’’－１は、低解像度画像Ａ－１を拡大して高解像度画像Ｂ－１と同一の画素数になるようにした拡大画像Ａ’－１について、この拡大画像Ａ’－１をＴＶ法により高解像化した画像であるから、周波数の巾は、（１）の画像Ｂ－１と同等の巾になっている。このため、（３）の画像Ｃ－１は、レベルの低い周波数成分が差分として残されていることがわかる。図１３に比べて、符号化データ量が少なくて済むことがわかる。

【００３７】

〔ＴＶ法による高解像化処理〕

次に、ＴＶ法により高解像化処理について説明する。この処理は、図１に示したＴＶ法高解像化部１０７、及び図２に示したＴＶ法高解像化部２０５により行われる。図３は、図１に示したＴＶ法高解像化部１０７の第１の構成を示すブロック図である。尚、以下の説明はＴＶ法高解像化部１０７についてのものであるが、図２に示したＴＶ法高解像化部２０５の構成も同様である。

【００３８】

図３を参照して、ＴＶ法高解像化部１０７－１は、分解部１１及び合成部１２を備えている。分解部１１は、画像Ａ’－１である原画像ｆを入力し、ＴＶ法によりカートゥーン画像ｕとテクスチャ画像ｖとに分解する。合成部１２は、分解部１１により分解されたカートゥーン画像ｕとテクスチャ画像ｖとを合成し、画像Ａ’’－１である復元画像を出力する。図１０（Ａ）に原画像ｆを、図１０（Ｂ）にカートゥーン画像ｕを、図１０（Ｃ）にテクスチャ画像ｖの例を示す。

【００３９】

以下、ＴＶ法による画像処理手法について簡単に説明する。尚、詳細については「Journal of Scientific Computing,Vol.19,Nos.1-3,December 2003」を参照されたい。まず、ＴＶ法により分解されるカートゥーン画像ｕは、原画像ｆ内のオブジェクトの形及び大きさを表した骨格画像をいい、平坦部分及び強いエッジ部分を含んでいる。また、テクスチャ画像ｖは、原画像ｆ内のオブジェクトの輝度及び色差の変化による精細部を表す画像をいい、細かな模様のみから成る。

【００４０】

原画像ｆは、後述するパラメータλ，μに応じて、カートゥーン画像ｕとテクスチャ画像ｖとに分解される。ここで、ノイズはテクスチャ画像ｖに含まれておりカートゥーン画像ｕに含まれていないことから、パラメータλ，μの値に応じて、ノイズを低減したテクスチャ画像ｖを生成することができる。すなわち、パラメータλ，μを適切に選択することにより、テクスチャ画像ｖに含まれるノイズを低減することができる。そして、分解した際にノイズを含んでいないカートゥーン画像ｕと、分解した際にノイズを低減したテクスチャ画像ｖとを合成することにより、結果としてノイズを低減した復元画像を得ることができる。

【００４１】

従来はＴＶ法による画像処理手法を用いる代わりに、ローパスフィルタまたはメディアンフィルタを用いていた。この手法ではノイズを含む信号も強調してしまう。これに対し、ＴＶ法による画像処理手法では、ノイズを低減したテクスチャ画像ｖを生成することができるから、従来の画像処理手法に比べて、高画質な画像に復元することができるという

利点がある。

【００４２】

次に、ＴＶ法による画像処理手法において、ノイズを低減する原理の概略を説明する。図８は、ＴＶ法によりノイズが低減する原理を説明するための図である。左上図の画像信号が原画像ｆの信号であり、右上図の画像信号がＴＶ法による画像処理を行って得られた復元画像の信号である。左上図及び右上図において、縦軸が画素値を、横軸が画像における任意の水平ラインをそれぞれ示している。この左上図の波形の画像信号を微分することにより、左下図のような信号を得る。そして、この微分信号に対して、処理後の信号と入力信号との差が大きくなり過ぎないような制約の下で、その面積を最小とする際の信号を得る。微分信号の面積を最小とする際、孤立したエッジａは削除されるが、大きな信号ｄ近傍のエッジｂ，ｃは、信号ｄとの間の相関が高いと判断し、ｂ，ｃ，ｄを結合することによりエッジ成分を最小化する。その波形が右下図である。この場合、左上図の画像信号が、左下図の微分信号に対応するものであるから、右下図の微分信号に対する画像信号は、右上図のように得ることができる。

【００４３】

このように、ＴＶ法による画像処理手法によれば、原画像ｆの孤立したノイズａ１（図８左上図を参照）を抑制する。画像本来の信号に近接した信号ｂ１，ｃ１は、近傍信号と相関が高いと判断して結合される。この結合により、原画像では、ノイズと見られる信号から、原画像に存在しない高周波成分が生成される。通常の画像では、連続するエッジは、光学的、電気的にローパスフィルタがかかり、高周波成分はエッジにまつわりつくノイズ的な信号と本当のノイズ信号とに分類される。このＴＶ法による画像処理手法を用いることにより、ノイズが抑圧される。エッジ周辺のノイズ的高周波成分は、エッジに吸収され、エッジがより以上に鋭くなり、鮮鋭感が増大した画像となる。

【００４４】

図９は、ＴＶ法により、原画像ｆに存在しない高周波成分が生成されることを説明するための図である。図８に示した同様の原理により、左上図の原画像ｆから右上図の復元画像が生成される。この場合、図９に示すように、原画像ｆは、画素値が滑らかに変化する高周波成分のない信号から成るが、復元画像は、画素値が線形に変化する高周波成分を有する信号から成ることがわかる。このように、ＴＶ法による画像処理手法によれば、原画像ｆに存在しない高周波成分が生成される。

【００４５】

次に、ＴＶ法による画像処理手法について、数式を用いて簡単に説明する。ＴＶ法による画像処理は、以下の（１）式により表される最小化問題として扱うことができる。

【数１】

$$\inf_{u\in BV}\left\{F(u)=\int|\nabla u|+\lambda\|v\|_{L^2}^2,\ f=u+v\right\} \qquad (1)$$

ここで、ｆは原画像、ｕはカートゥーン画像、λ及びμはパラメータである。また、原画像ｆを有界変動空間ＢＶのカートゥーン画像（骨格関数）ｕとテクスチャ画像（振動関数）ｖとに分解するために、有界変動空間ＢＶの双対空間である振動関数空間Ｇを利用する。また、ｇ１及びｇ２はベクトル表記した成分であり、以下の（２）式により表され、テクスチャ画像ｖは以下の（３）式となる。

【数２】

$$\vec{g}=(g_1,g_2) \qquad (2)$$

【数３】

$$v = \mathbf{div}\,\vec{g} = \frac{\partial}{\partial x} g_1 + \frac{\partial}{\partial y} g_2 \qquad (3)$$

【００４６】

この表記により、（１）式を発展させた以下の（４）式の最小値問題を解くことにより、カートゥーン画像ｕ及びテクスチャ画像ｖを決定する。

【数４】

$$\inf_{u, g_1, g_2} \left\{ G_p(u, g_1, g_2) = \int |\nabla u| + \lambda \int |f - u - \partial_x g_1 - \partial_y g_2|^2 \, dx\, dy + \mu \left[\int (\sqrt{g_1^2 + g_2^2})^p \, dx\, dy \right]^{1/p} \right\} \qquad (4)$$

これは、（５）式で表されるEuler-Lagrange方程式に帰着する。

【数５】

$$u = f + \frac{1}{2\lambda} \mathrm{div}\left(\frac{\nabla u}{|\nabla u|} \right) \qquad (5)$$

このようにして、カートゥーン画像ｕは、原画像ｆから分解して生成される。

【００４７】

また、振動関数空間Ｇは、（６）式のような分離可能な関数の空間である。

【数６】

$$v = \mathbf{div}\,\vec{g} \qquad (6)$$

ここで、g_1，g_2は振動母関数であり、（７）式で表される。

【数７】

$$\vec{g} = (g_1, g_2), \quad g_1 = -\frac{1}{2\lambda} \frac{u_x}{|\nabla u|}, \quad g_2 = -\frac{1}{2\lambda} \frac{u_y}{|\nabla u|} \qquad (7)$$

すなわち、（８）式のようになる。

【数８】

$$v(x, y) = \partial_x g_1(x, y) + \partial_y g_2(x, y), \; g_1, g_2 \in L^\infty(\mathbb{R}^2) \qquad (8)$$

このようにして、テクスチャ画像ｖは、原画像ｆから分解して生成される。したがって、原画像ｆをカートゥーン画像ｕ及びテクスチャ画像ｖに、パラメータλ，μの値に応じて分解することができる。

【００４８】

このように、分解部１１により、原画像ｆは、エッジ成分を有するカートゥーン画像ｕと、画像の精細部を表すテクスチャ画像ｖとに分解され、合成部１２により、カートゥーン画像ｕとテクスチャ画像ｖとを合成した復元画像が生成される。

【００４９】

次に、ＴＶ法高解像化部１０７の第２の構成を説明する。図４は、図１に示したＴＶ法高解像化部１０７の第２の構成を示すブロック図である。尚、以下の説明はＴＶ法高解像化部１０７についてのものであるが、図２に示したＴＶ法高解像化部２０５の構成も同様である。

【００５０】

図４を参照して、ＴＶ法高解像化部１０７－２は、分解部１１、合成部１２、及び変換部１３を備えている。分解部１１は、画像Ａ’－１である原画像ｆを入力し、ＴＶ法によりカートゥーン画像ｕとテクスチャ画像ｖとに分解し、カートゥーン画像ｕを合成部１２に出力し、テクスチャ画像ｖを変換部１３に出力する。

【００５１】

変換部１３は、分解部１１より分解されたテクスチャ画像ｖを入力し、予め設定された変換テーブルまたは演算式を用いて、入力したテクスチャ画像ｖを変換して新たなテクスチャ画像ｖ’を生成する。

【００５２】

分解部１１により実現されるＴＶ法による画像処理手法では、パラメータλ，μを適切に設定することにより、ノイズを低減することができる。しかし、ノイズを完全には除去できないため、画像の高精細化を実現するには不十分である。そこで、変換部１３において、画素単位に画素値を変換する。この場合、変換部１３が単に画素値を乗数倍したのみでは、ノイズが見えやすくなる。そこで、閾値処理を行い、画素値が小さい第１の領域においては画素値を０に変換し、画素値が大きい第２の領域においては予め設定された最大画素値に変換する。また、中間の画素値を有する第３の領域においては、第１の領域に近い画素値は小さくなるように変換し、第２の領域に近い画素値は大きくなるように変換する。

【００５３】

第１の領域では、画素値が０に近く比較的ノイズ成分が多いことから、強制的に０に変換してノイズ成分を除去する。第２の領域は、画素値が大きいから、予め設定された最大画素値になるように画素値を小さくし精細感を高める。第３の領域では、画素値が小さい場合は一層小さく、画素値が大きい場合は一層大きくすることにより、精細感を高める。この場合、第１の領域としては画素値が０～１、第２の領域としては画素値が１７以上、第３の領域としては画素値が２～１６であることが好ましい。

【００５４】

図５～７は、変換部１３が用いる変換テーブルＴ１～Ｔ３を示す図である。図において、横軸はテクスチャ画像ｖの画素値、縦軸は変換後のテクスチャ画像ｖ’の画素値をそれぞれ示している。尚、横軸に示した画素値は、分解部１１により生成されたテクスチャ画像ｖの画素値であり、実際に表示画面に表示する際の画素値とは異なるものである。図５～７において、第１の領域（ｂからｃまでの範囲）においては画素値を０に変換する。第２の領域（ａより小さい範囲及びｄより大きい範囲）においては画素値を予め設定された最大画素値Ｍまたは最小画素値－Ｍに変換する。また、第３の領域（ａからｂまでの範囲及びｃからｄまでの範囲）においては、画素値は、第１の領域に近い画素値（ａ’からｂまでの範囲及びｃからｃ’までの範囲の画素値）は小さくなるように変換し、第２の領域に近い画素値（ａからａ’までの範囲及びｃ’からｄまでの範囲の画素値）は大きくなるように変換する。尚、図５～７において直線１は、変換を行わない場合（ｖ＝ｖ’）を示している。

【００５５】

このように、変換テーブルＴ１～Ｔ３は、閾値（デッドゾーン）及び飽和点を有しており、これらの変換ルールは、閾値及び飽和点を用いた関数の演算式として記述することもできる。図５に示したテーブルＴ１及び図６に示したテーブルＴ２は、１次関数として記述することができ、図７に示したテーブルＴ３は、２次関数として記述することができる。

【００５６】

図４に戻って、合成部１２は、分解部１１により分解されたカートゥーン画像ｕと、変換部１３により変換された新たなテクスチャ画像ｖ’とを合成し、画像Ａ’’－１である復元画像を出力する。

【００５７】

図４に示したＴＶ法高解像化部１０７－２によれば、ＴＶ法による画像処理手法で分離したテクスチャ画像ｖに対し、その画素値を変換して新たなテクスチャ画像ｖ’を生成し、復元画像を生成するようにした。すなわち、画素値の変換に際し、画素値が０に近い第１の領域では、強制的に０に変換してノイズ成分を除去し、画素値が比較的大きい第２の領域では、予め設定された最大値になるように画素値を小さくして精細感を高め、画素値が中位の第３の領域では、画素値が小さい場合は一層小さく、画素値が大きい場合は一層大きくして精細感を高めるようにした。これにより、原画像ｆが保有する周波数成分以外の周波数帯域の信号を用いて復元画像が生成されるから、画像の高精細化を実現することができる。図１２に、ＴＶ法高解像化部１０７－２による復元画像の例を示す。図１１に示す従来のバンドパスフィルタまたはハイパスフィルタを用いた画像処理手法により合成した復元画像と比較すると、図１２の方が高精細であることがわかる。

【００５８】

以上、実施例を挙げて本発明を説明したが、本発明は上記実施例に限定されるものではなく、その技術思想を逸脱しない範囲で種々変形可能である。例えば、図４に示したＴＶ法高解像化部１０７－２の変換部１３が、１次関数で記述できるテーブルＴ１，Ｔ２や２次関数で記述できるテーブルＴ３を用いるようにしたが、これ以外の３次以上の関数である単調増加関数を用いるようにしてもよい。また、三角関数等の部分的に増加する関数を用いるようにしてもよいし、そのうちの増加する部分のみを用いるようにしてもよい。

【図面の簡単な説明】

【００５９】

【図１】本発明の実施の形態による画像符号化装置の構成を示すブロック図である。

【図２】本発明の実施の形態による画像復号化装置の構成を示すブロック図である。

【図３】ＴＶ法高解像化部の第１の構成を示すブロック図である。

【図４】ＴＶ法高解像化部の第２の構成を示すブロック図である。

【図５】変換テーブルＴ１を示す図である。

【図６】変換テーブルＴ２を示す図である。

【図７】変換テーブルＴ３を示す図である。

【図８】ＴＶ法によりノイズが低減する原理を説明するための図である。

【図９】ＴＶ法により、原画像に存在しない高周波成分が生成されることを説明するための図である。

【図１０】ＴＶ法により原画像ｆをカートゥーン画像ｕとテクスチャ画像ｖに分解する処理を説明するための図である。

【図１１】従来のフィルタを用いた手法による復元画像の例である。

【図１２】図４のＴＶ法高解像化部によりカートゥーン画像ｕとテクスチャ画像ｖ’とを合成した復元画像の例である。

【図１３】従来の画像復号化装置を用いた場合の画像の周波数分布の例である。

【図１４】図１の画像復号化装置を用いた場合の画像の周波数分布の例である。

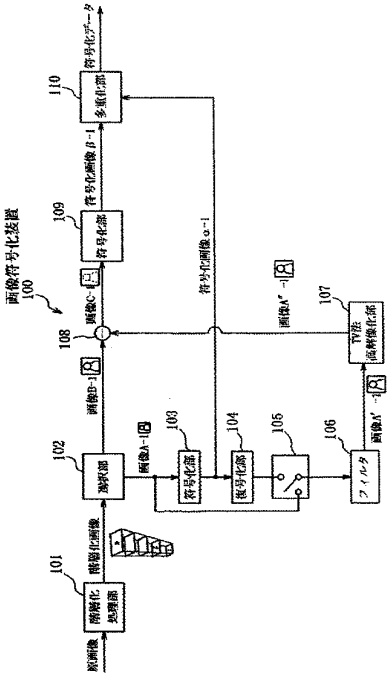
【符号の説明】

【００６０】

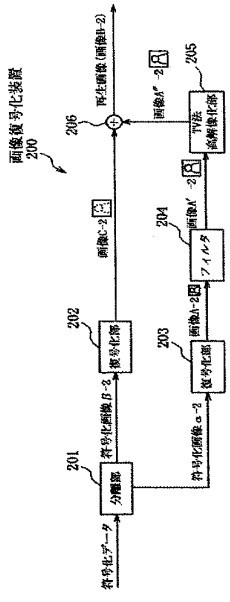
１１　分解部
１２　合成部
１３　変換部
１００　画像符号化装置
１０１　階層化処理部
１０２　選択部
１０３　符号化部

１０４　復号化部
１０５　切り替え部
１０６　フィルタ部
１０７　ＴＶ法高解像化部
１０８　減算部
１０９　符号化部
１１０　多重化部
２００　画像復号化装置
２０１　分離部
２０２　復号化部
２０３　復号化部
２０４　フィルタ部
２０５　ＴＶ法高解像化部
２０６　加算部

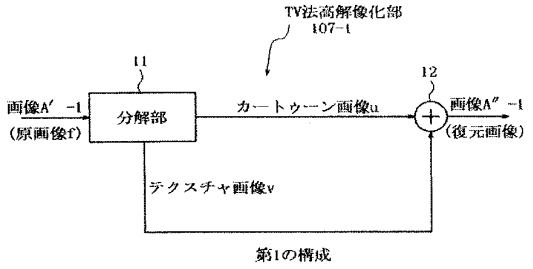
【図１】



【図２】

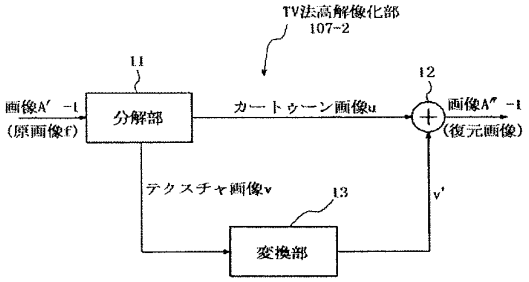


【図３】



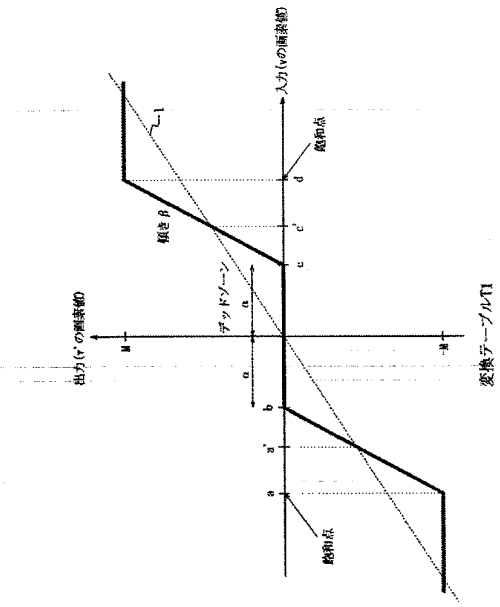
第1の構成

【図４】

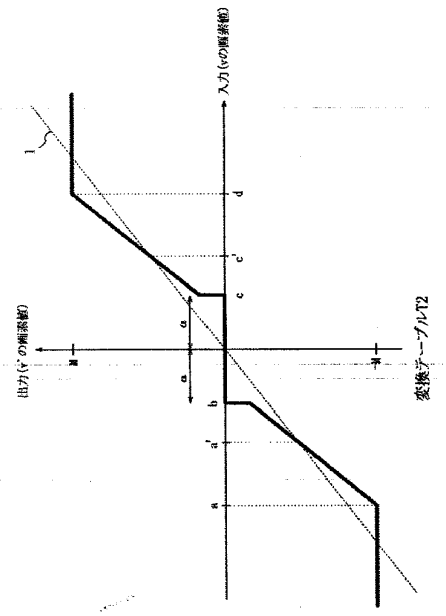


第2の構成

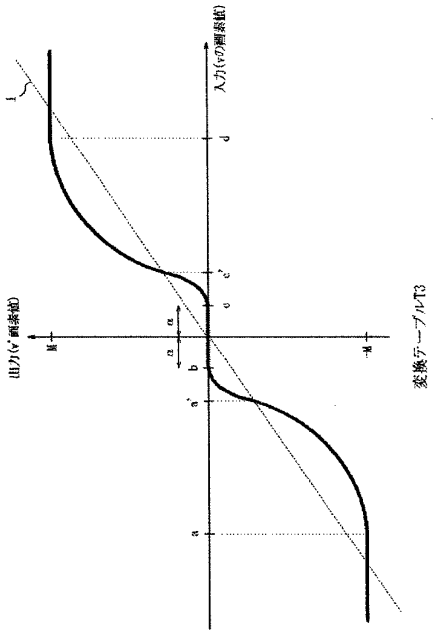
【図５】



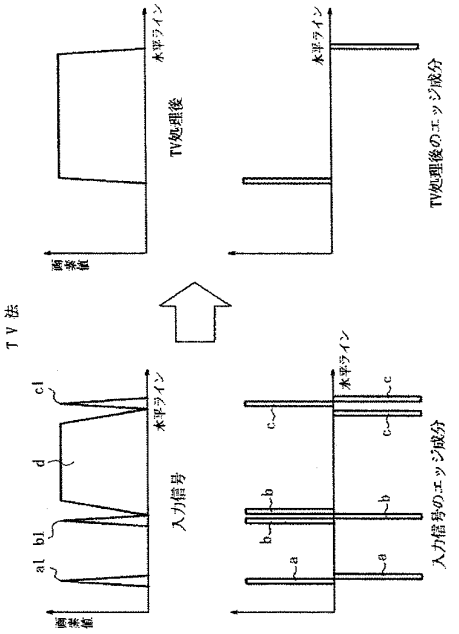
【図６】



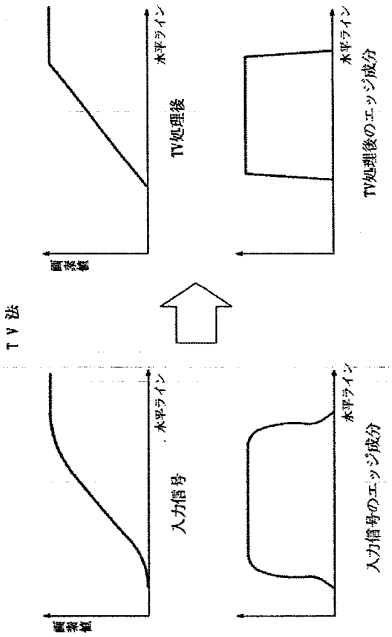
【図７】



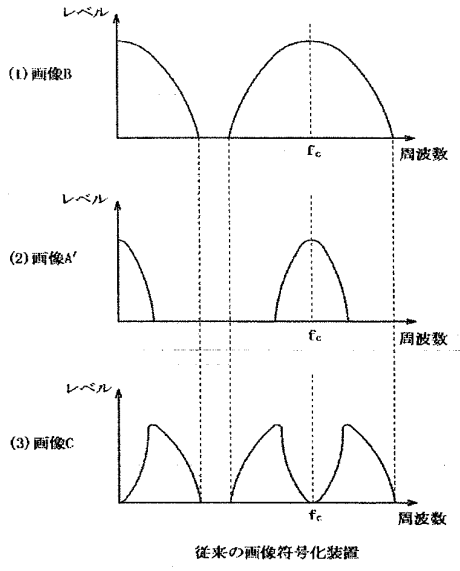
【図８】



【図９】



【図１３】



従来の画像符号化装置

【図１４】

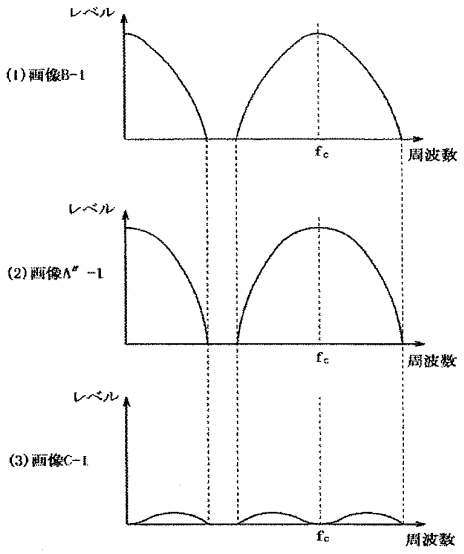


図1の画像符号化装置

【図１０】

(A)



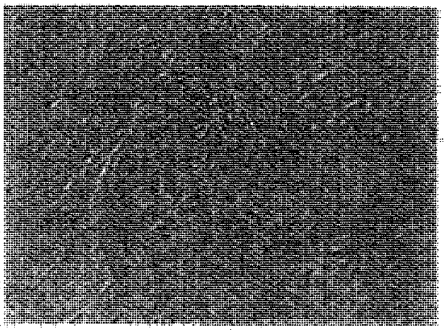
原画像f (x, y)

(B)



カートゥーン画像u (x, y)

(C)



テクスチャ画像v (x, y)

【図１１】



処理前

【図１２】



処理後

フロントページの続き

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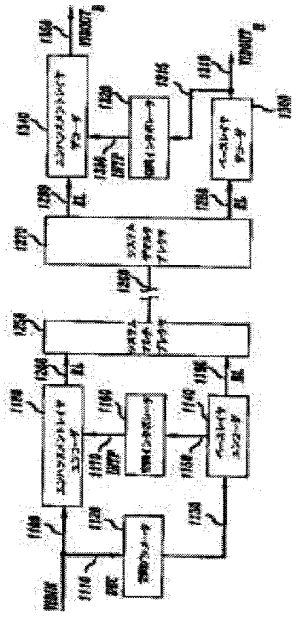
(21)Application number : 06-251625
(22)Date of filing : 21.09.1994

(71)Applicant : AT & T CORP
BELL COMMUN RES INC
(72)Inventor : PURI ATUL
WONG ANDRIA H

(30)Priority
Priority number : 93 124917 Priority date : 21.09.1993 Priority country : US

(54) VIDEO SIGNAL ENCODING DEVICE

(57)Abstract:
PURPOSE: To efficiently encode a video signal by combining prediction acquired from one layer and prediction obtained from the other layer and using the combined prediction for encoding two layers.
CONSTITUTION: A high resolution video signal VIDIN is inputted through an input line 100 and supplied to a space decimeter 1120. A decimated base layer signal is outputted to a line 1130 and supplied to a base layer encoder A140. The encoder 1140 outputs an encoded bit stream BL to a line 1190. The encoder 1140 supplies a base layer video image to a space interpolator 1160. A decoded base layer video signal VIDOTB is supplied to a space interpolator 1320, which generates an up-sampled signal to a line 1330. An enhancement player decoder 1340 outputs a video signal having higher resolution to an output line 1350.



(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号

特開平7－162870

(43)公開日　平成７年(1995)６月23日

(51)Int.Cl.[6]	識別記号	庁内整理番号	ＦＩ		技術表示箇所
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(33)優先権主張国　米国（ＵＳ）

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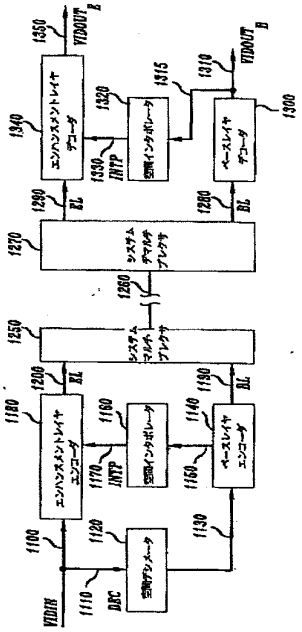
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(54)【発明の名称】　ビデオ信号符号化装置

(57)【要約】

【目的】　ビデオ画像が種々の解像度スケールおよび画像フォーマットで復号化されることを可能にするようなスケーラブルな方式でビデオ信号を効率的に符号化する。

【構成】　一方のレイヤから得られた予測が他方のレイヤから得られた予測と組み合わせられ、この組み合わせられた予測がいずれかのレイヤを符号化するために用いられる。ベースレイヤとエンハンスメントレイヤを用いた本発明の実施例においては、空間的に補間されたベースレイヤが適切な重みの選択によってエンハンスメントレイヤの動き補償済み時間予測と組み合わせられて、エンハンスメントレイヤを符号化するために用いられる予測が生成される。重みは、予測とリファレンスマクロブロックとの間の差の絶対値の総和、あるいは差の２乗の総和の計算に基づいて選択され、最良帯域効率を実現する予測が生成される。



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【特許請求の範囲】

【請求項１】　ビデオ信号が特性解像度を有する状況でビデオ画像の画素に関連する連続ディジタル表現を含むディジタルビデオ信号を受信する手段と、
前記受信されたディジタルビデオ信号に関する前記特性解像度以下の解像度を有する第１の符号化済みバージョンを生成する第１符号化手段と、
前記受信されたディジタルビデオ信号に関する前記特性解像度と等しい解像度を有する第２の符号化済みバージョンを生成する第２符号化手段と、
前記受信されたディジタルビデオ信号の前記第１の符号化済みバージョンから前記ビデオ画像の第１の予測を生成する第１予測生成手段と、
前記受信されたディジタルビデオ信号の前記第２の符号化済みバージョンから前記ビデオ画像の第２の予測を生成する第２予測生成手段と、
前記第１および第２予測を組み合わせて組合せ予測を生成する組合せ手段と、
前記組合せ予測を利用して前記受信されたディジタルビデオ信号の前記第２の符号化済みバージョンを符号化する手段とからなることを特徴とするビデオ信号符号化装置。

【請求項２】　前記第１予測生成手段が、空間予測生成手段を有することを特徴とする請求項１の装置。

【請求項３】　前記第２予測生成手段が、時間予測生成手段を有することを特徴とする請求項２の装置。

【請求項４】　前記組合せ手段が、前記組合せ予測を生成する目的で前記空間予測を重み付けし前記時間予測を重み付けする手段を有することを特徴とする請求項３の装置。

【請求項５】　前記第１符号化手段が、前記受信されたディジタルビデオ信号のインターレースバージョンを符号化する手段を有することを特徴とする請求項１の装置。

【請求項６】　前記第１符号化手段が、前記受信されたディジタルビデオ信号のプログレッシブバージョンを符号化する手段を有することを特徴とする請求項１の装置。

【請求項７】　前記第２符号化手段が、前記受信されたディジタル信号のインターレースバージョンを符号化する手段を有することを特徴とする請求項５または６の装置。

【請求項８】　前記第２符号化手段が、前記受信されたディジタル信号のプログレッシブバージョンを符号化する手段を有することを特徴とする請求項５または６の装置。

【請求項９】　前記第１符号化手段が、ＭＰＥＧ－１符号化標準を用いた符号化手段を有することを特徴とする請求項１の装置。

【請求項１０】　前記第１符号化手段が、Ｈ．２６１符

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号化標準を用いた符号化手段を有することを特徴とする請求項１の装置。

【請求項１１】　前記第１符号化手段が、ＭＰＥＧ－２符号化標準を用いた符号化手段を有することを特徴とする請求項１の装置。

【請求項１２】　前記第２符号化手段が、ＭＰＥＧ－２符号化標準を用いた符号化手段を有することを特徴とする請求項９、１０または１１の装置。

【請求項１３】　複数個の所定の特性のうちの少なくとも１つを有する符号化されていないビデオ信号を生成する手段を有することを特徴とする、請求項１の前記第１および第２の符号化済みバージョンを復号化する装置。

【請求項１４】　前記複数個の所定の特性のうちの少なくとも１つが、解像度スケールであることを特徴とする請求項１の装置。

【請求項１５】　前記複数個の所定の特性のうちの少なくとも１つが、画像フォーマットであることを特徴とする請求項１の装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明はビデオ信号の符号化および復号化に関し、特にビデオ画像が種々の解像度スケールおよび画像フォーマットで復号化されることを可能にするようなスケーラブルな方式でビデオ信号を効率的に符号化する方法に関する。

【０００２】

【従来の技術】ビデオ信号の生成、伝送および再構成の品質を向上するために全世界的な努力が続けられている。なぜなら、ビデオシステムの品質向上に関する非常に大きな商業的重要性が予測されてきているからである。これらの努力には、少なくともその一部においては、画像が、通常ディジタルビットストリームの形態を有する対応する電気的信号に変換される際の解像度を、ビデオ画像を電気信号に変換する際に用いられる空間的および時間的サンプリングレートを増大させることによって増大させることが含まれる。この解像度の増大は、結果として、画像に関するより多くのデータが、与えられた時間間隔内に生成され、処理され、そして伝送されなければならないことを意味している。

【０００３】テレビジョンカメラの分野における画像などのビデオ画像は、所定のレートで掃引され、一連の電気信号に変換される。このそれぞれの電気信号は、一般に画素、ペル、あるいはピクセルとして知られている、画像の所定の領域の特性を表現する。画素は、主としてビデオ信号処理目的で、それぞれが１６×１６の画素アレイよりなるマクロブロックにグルーピングされる。所定の時刻に同時に取得された複数個のマクロブロックは、所定の時刻における画像の性質を表現するスチル画像（すなわちフレーム）に対応するものを構成する。このようにして生成されるビデオ信号の品質を向上させる

ことは、少なくともその一部において、与えられた画像フレームを表現するためにより多くの数のより小さなサイズの画素を用いること、および単位時間当たりにより多くの数の画像フレームを生成することを含んでいる。

【０００４】それぞれのビデオ画像に対するペルの数が増大し、画像が生成されるレートが増大するに連れ、与えられた時間間隔内に生成され、伝送され、受信されて処理されなければならないビデオデータの量が増大する。より低い品質の画像に対して用いられるものと同一のビット数および同一のビットレートを用いてより高い品質のビデオ画像を送信することを試みる種々のビデオ圧縮方式が提案されてきている。動画エキスパートグループフェーズＩ（ＭＰＥＧ－１）標準は、この種の方式の１つに関する特有のシンタクスおよび復号化プロセスを提供する。この標準は、国際標準化機構（ＩＳＯ）委員会草案１１１７２－２である、「動画および関連するオーディオ信号の最大１．５Ｍビット／秒までのディジタルストレージ媒体に対する符号化」（１９９１年１１月）において公にされている。

【０００５】伝送された単一の高解像度ビデオ信号から１つあるいは複数個のより低い解像度の画像が得られることは望ましい。例えば、高品位テレビジョン（ＨＤＴＶ）と標準的なＮＴＳＣテレビジョン受像機に対して同時に伝送されるビデオ信号は、ＨＤＴＶ受像機に対して非常に高い解像度を有する画像を提供し、より低い解像度を有する画像を標準受像機に対して提供しなければならない。同様に、ウインドウ環境を実現しているコンピュータスクリーン上に表示されるビデオ信号から獲得されることになる画像の解像度は、それが表示される特定のウインドウの大きさとともに変化させられなければならない。複数の解像度が望ましい他のアプリケーションには、それぞれのロケーションにおいて相異なったビデオ装置が用いられてビデオ信号が非同期転送モード（ＡＴＭ）ネットワークを介して伝送されるようなビデオ会議システムが含まれる。

【０００６】可変解像度画像が導出されうるビデオ信号を実現する１つの既知の方法は、それぞれが相異なった解像度で再構成されるようにスケーリングされた、独立したビデオシーケンスレプリカの組を同時に伝送することである。この、「サイマルキャスト」として知られている方式は単純ではあるが、複数個の独立したビデオ画像の伝送を実現するためにより大きな帯域を必要とする。サイマルキャストに代わる、より効率的な帯域利用を行なう方法がスケーラブルビデオである。解像度スケーラブルビデオは、ビデオ信号が符号化され、その結果得られるビットシーケンスが、受像機において用いられる特定の信号複合化方式に依存して、そこからある範囲の解像度レベルが導出されうるように分割されるような技法である。

【０００７】解像度スケーラブルビデオ符号化は、空間

ドメインあるいは周波数ドメインのいずれかにおいて実現されうる。空間スケーラビリティにおいては、通常、空間ドメインにおけるベースレイヤとエンハンスメントレイヤとを有する階層符号化が用いられる。この方式においては、レイヤ間のゆるい結合が存在する。すなわち、それぞれのレイヤを符号化するために用いられる符号化アルゴリズムは独立であるが、エンハンスメントレイヤはベースレイヤによって生成された再構成済み画像を用いて符号化される。２つのレイヤに対して用いられる符号化方式は、特定のアップおよびダウンサンプリング方式などのように、それぞれ独立して選択されうる。

【０００８】

【発明が解決しようとする課題】残念なことに、解像度スケーラブルビデオの符号化は、大部分のビデオ標準の拘束条件内では実現され得ない。ＭＰＥＧ－１符号化標準における重要な制限事項は、それ自体が解像度スケーラブルビデオの符号化および復号化を容易にする準備を欠いているということである。

【０００９】

【課題を解決するための手段】可変解像度を有するビデオ画像が、本発明の原理に従って、一方のレイヤから獲得された予測が他方のレイヤから得られた予測と組み合わせられてその組み合わせられた予測がそれら２つのレイヤを符号化するために用いられる、空間的スケーラビリティを用いた新たな２レイヤビデオ符号化技法を用いることによって、帯域を高効率で利用しつつ導きだされる。

【００１０】ベースレイヤおよびエンハンスメントレイヤを用いた本発明の実施例においては、空間的に補間されたベースレイヤが、適切な重みを選択することによって、エンハンスメントレイヤの動き補償済み時間予測とともに組み合わせられてエンハンスメントレイヤを符号化するために用いられる予測が生成される。重みは、差の絶対値の総和、あるいは予測とリファレンスマクロブロックとの間の差の２乗の総和、の計算に基づいて、最良の帯域効率を実現する予測を生成するように選択される。この重み付けプロセスは、空間ー時間重み付けと呼称される。

【００１１】本発明に係る実施例の他の側面においては、ベースレイヤとエンハンスメントレイヤとが、本発明のある種のアプリケーションにおいて必要とされる特定の画像フォーマットを有する場合に空間ー時間重み付けを用いる方法が含まれる。例えば、あるアプリケーションにおいては、ベースレイヤがインターレースフォーマットであることが要求されるが、その一方で別のプログレッシブフォーマットが要求される。よって、ベースーエンハンスメントレイヤ画像フォーマットの種々の組み合わせによって、本発明に係る側面を利用した４つの空間スケーラビリティフォームが存在することになる。これらは、プログレッシブープログレッシブ、プログレ

ッシブ－インターレース、インターレース－プログレッシブ、およびインターレース－インターレースである。

【００１２】本発明は、従来技術に係る解像度スケーラブルビデオ技法に関して実質的な改善を実現する。例えば、帯域効率が上昇する。空間スケーラビリティのそれぞれの形態に対して最適化された重みの組みが選択されうる。複数個の相異なった符号化標準間でのコンパチビリティを実現するようにレイヤが符号化されうる。より堅固かつエラーに関して弾力的な伝送を実現するために複数個のプライオリティを用いてネットワーク場での伝送に関してそれぞれのレイヤに容易にプライオリティをつけることができる。

【００１３】本明細書の発明の概要、図面の説明、実施例、および添付図面は本発明のある実施例を示すものであって、この出願によって成立した特許によって授与される独占権の範囲に関して何らかの制限を与えるものとみなされるべきではない。この独占権の範囲は、本明細書における特許請求の範囲において設定される。

【００１４】

【実施例】図１は、本発明に係る２レイヤエンコーダ／デコーダを簡潔に示したブロック図である。当該エンコーダ／デコーダは、エンハンスメントレイヤエンコーダ１１８０、ベースレイヤエンコーダ１１４０、エンハンスメントレイヤデコーダ１３４０、ベースレイヤデコーダ１３００、その他の素子を有している。エンハンスメントレイヤエンコーダ１１８０、ベースレイヤエンコーダ１１４０、エンハンスメントレイヤデコーダ１３４０、ベースレイヤデコーダ１３００、およびそれらに含まれる機能については、以下に詳細に記述される。高解像度ビデオ信号ＶＩＤＩＮは入力ライン１１００を介して入力され、ライン１１１０によって空間デシメータ１１２０に供給される。この際、高解像度ビデオ信号ＶＩＤＩＮに対しては、空間デシメータ１１２０が画素数をベースレイヤ解像度と呼ばれるより低い解像度に低減する以前にローパスフィルタがかけられる。高解像度ビデオ信号ＶＩＤＩＮは、インターレースあるいはプログレッシブのいずれかでフォーマットされている。当業者には公知ではあるが、本発明のある種の実施例においては、モーションピクチャーエキスパートグループ（ＭＰＥＧ）フェーズ2テストモデル５原案第２版、文書番号Ｄｏｃ．ＭＰＥＧ９３／２２５（１９９３年4月）（ＭＰＥＧ－２）に従ったインターレースビデオ信号に関するフレーム画像符号化を用いることが望ましい。あるいは、ＭＰＥＧ－２に従ったフィールド画像符号化を用いることが望ましい。画素数を低減する操作は、デシメーション（ＤＥＣ）と呼称される。デシメータは当業者には公知であるが、本発明に従う独特のデシメーション手法は以下に詳細に記載される。デシメートされたベースレイヤ信号はライン１１３０上に出力され、ベースレイヤエンコーダ１４０に供給される。ベースレイヤエンコーダ１１４０は、エンコードしたビットストリームＢＬをライン１１９０上に出力する。

【００１５】ベースレイヤエンコーダ１１４０は、局所的にデコードされたベースレイヤビデオ画像を回線１１５０によって空間インタポレータ１１６０に供給する。空間インタポレータ１１６０は、アップサンプリングインタポレーション（ＩＮＴＰ）法を用いてフレーム当たりのペル数を増加させる。インタポレータは当業者には公知ではあるが、本発明に係る独特のアップサンプリングインタポレーション法は以下に詳細に記述される。アップサンプリングされたエンハンスメントレイヤ信号は、ライン１１７０上に出力されてエンハンスメントレイヤエンコーダ１１８０に供給され、エンハンスメントレイヤエンコーダ１１８０はエンコードされたビットストリームＥＬをライン１２００上に出力する。エンハンスメントレイヤエンコーダ１１８０は、入力ライン１１００上の高解像度ビデオ信号入力を符号化する効率を向上させる目的で、ライン１１７０上のアップサンプリングされた信号を予測として利用する。

【００１６】ベースレイヤエンコーダ１１４０およびエンハンスメントレイヤ１１８０の出力におけるエンコードされたビットストリームＢＬおよびＥＬは、チャネル１２６０上での伝送の準備としてマルチプレクサ１２５０において組み合わせられる。あるいは、ビットストリームＢＬおよびＥＬは、２つの個別の独立したチャネルを介して送出される。高解像度ビデオ信号ＶＩＤＩＮのビットストリームＢＬおよびＥＬへの符号化により、より堅固かつエラーに対してより弾力的な伝送を可能にする複数個のプライオリティを用いることによって、ネットワーク上での伝送の優先付けの利用が可能になる。

【００１７】ビットストリームＢＬおよびＥＬが多重化される場合には、チャネル１２６０を介した伝送の後に、デマルチプレクサ１２７０がビットストリームＢＬおよびＥＬを分離し、ライン１２８０および１２９０上にビットストリームＢＬおよびＥＬを出力する（チャネル１２６０に関して伝送エラーが存在しない場合）。

【００１８】ビットストリームＢＬおよびＥＬは、それぞれライン１２８０および１２９０によってベースレイヤデコーダ１３００およびエンハンスメントレイヤデコーダ１３４０に入力される。ベースレイヤデコーダ１３００は、ライン１３１０にデコードされたベースレイヤビデオ信号$ＶＩＤＯＵＴ_B$を出力する。このベースレイヤビデオ信号は、伝送エラーが存在しない場合には、ライン１１５０上のビデオ信号がデコードされたものと正確に同じである。

【００１９】デコードされたベースレイヤビデオ信号$ＶＩＤＯＵＴ_B$は、ライン１３１５を介して空間インタポレータ１３２０に供給される。このインタポレータは、インタポレータ１１６０と同一のものであり、ライン１３３０上にアップサンプリングされた信号を生成する。

伝送エラーが存在しない場合には、ライン１３３０上およびライン１１７０上のアップサンプリング済みビデオ信号は同一である。エンハンスメントレイヤデコーダ１３４０は、ライン１３３０上のアップサンプリングされたビデオ信号をライン１２９０上のエンハンスメントレイヤビットストリームとともに利用し、出力ライン１３５０上にデコードされたより高い解像度を有するビデオ信号ＶＩＤＯＵＴ$_E$を生成する。

【００２０】当業者には公知ではあるが、ある種のアプリケーションにおいては入力ライン１１００上の高解像度ビデオ入力信号ＶＩＤＩＮがプログレッシブフォーマットであることが望ましく、他のアプリケーションにおいてはＶＩＤＩＮがインターレースフォーマットであることが望ましい。よって、ベースレイヤーエンハンスメントレイヤ画像フォーマットに依存する本発明の原理を例示するために、４つのフォーマットの空間スケーラビリティが用いられる。それらの空間スケーラビリティのフォームは、具体的には、プログレッシブープログレッシブ、プログレッシブーインターレース、インターレースープログレッシブおよびインターレースーインターレースと呼称される。空間スケーラビリティのフォームに依存して、前述の空間デシメーション（ＤＥＣ）および空間インタポレーション（ＩＮＴＰ）操作が相異なる。空間スケーラビリティの前述のフォームのそれぞれに対して必要とされるＤＥＣおよびＩＮＴＰ操作、およびそれぞれに関する潜在的なアプリケーションについては以下に議論される。

【００２１】図２および図３は、本発明に係る空間スケーラビリティのプログレッシブープログレッシブおよびプログレッシブーインターレースフォームにおいて必要とされるＤＥＣおよびインタポレーション（ＩＮＴＰ）操作を示す図である。図２に示されているように、ＤＥＣ操作においては、プログレッシブフォーマットの高解像度ビデオ信号がライン２１１０によって水平／垂直デシメータ２１１５に入力される。この際、高解像度ビデオ信号ＳＩＧＩＮ$_D$は、当該高解像度ビデオ信号ＳＩＧＩＮ$_D$がサンプリングされるレートを低減することによって高解像度ビデオ信号ＳＩＧＩＮ$_D$に含まれる画素数を水平および垂直の双方の方向に関して水平／垂直デシメータ２１１５が低減する以前に、濾波される。より低い解像度を有するビデオ信号ＳＩＧＯＵＴ$_D$はライン２１３０上に出力される。ある種のアプリケーションにおいては、水平方向および垂直方向とも１：１未満のサンプリングレート低減が起こらないことが望ましい。水平／垂直サンプラ２１１５が高解像度ビデオ信号ＳＩＧＩＮ$_D$をサンプリングするレートは、２つの整数間の比、例えば２：１、によって表現される。よって、水平方向デシメーションは、水平方向にファクタ２分のサンプリングレートの低減を必要とする。

【００２２】図３に示されているように、ＩＮＴＰ操作においては、プログレッシブフォーマットの低解像度ビデオ信号ＳＩＧＩＮ$_I$がライン３１５０によって、水平／垂直デシメータ２１１５（図２）によって実行されるものと反対の操作を行なう水平／垂直インタポレータ３１５５に入力される。しかしながら、水平／垂直デシメータ２１１５において空間解像度の損失が生ずるため、水平／垂直インタポレータ３１５５は、デシメータ２１１５（図２）への入力２１１０における信号の近似信号をライン３１７０上のＳＩＧＯＵＴ$_I$として出力できるのみである。

【００２３】空間スケーラビリティのプログレッシブープログレッシブフォームの一例は、コモンインターミーディエイトフォーマット（ＣＩＦ）タイプの信号がプログレッシブフレーム当たり水平３５２×垂直２８８画素の解像度でベースレイヤエンコーダ１１４０（図１）に入力され、スーパーコモンインターミーディエイトフォーマット（ＳＣＩＦ）タイプの信号がプログレッシブフレーム当たり水平７０４×垂直５７６画素の解像度でエンハンスメントレイヤエンコーダ１１８０（図１）に入力され、この際、双方の入力信号が毎秒３０フレームというフレームレートを有するような符号化方法である。ＣＩＦおよびＳＣＩＦフォーマットを有する信号は、当業者には公知である。ベースレイヤエンコーダ１１４０（図１）に入力されるＣＩＦ信号は、水平および垂直の双方の方向に関してファクタ２の空間デシメーションを行なうことにより、ＳＣＩＦ入力信号から導出される。ローカルに復号化されたベースレイヤフレームは、水平および垂直の双方の方向に関してファクタ２だけ補間され、エンハンスメントレイヤにおける信号を符号化する際に用いられる予測において利用される。この例においては水平および垂直方向のファクタ２のデシメーションおよびインタポレーションが必要とされているが、当業者には明らかなように、他の整数比も用いられうる。この例においては、モーションピクチャーズエキスパートグループフェーズ１（ＭＰＥＧ－１）あるいはＣＣＩＴＴ勧告Ｈ．２６１のｐｘ６４Ｋｎｉｔ／ｓにおけるオーディオビジュアルサービス用ビデオコーデック（ジュネーブ、１９９０年８月）（Ｈ．２６１）という符号化方法が、本発明の一側面に従う空間スケーラビリティがＭＰＥＧ－１、あるいはＨ．２６１、とＭＰＥＧ－２標準との間のコンパチビリティをどのようにして可能にするかを例示する目的で、ベースレイヤを符号化するために用いられる。さらに、あるアプリケーションにおいては、双方のレイヤにおいてＭＰＥＧ－２符号化を用いることが望ましく、また可能である。例えば、ベースレイヤに対してＭＰＥＧ－２メインプロファイル符号化が用いられ、エンハンスメントレイヤに対してＭＰＥＧ－２ネクストプロファイル空間スケーラブル符号化が用いられる。メインプロファイルおよびネクストプロファイル符号化方法は、当業者には公知である。

【００２４】プログレッシブ－インターレーススケーラビリティの一例は、ノンインターレースフレーム当たり水平３５２×垂直２４０画素の解像度のソースインプットフォーマット（ＳＩＦ）タイプの信号がベースレイヤエンコーダ１１４０（図１）に入力され、インターレースフレーム当たり水平７０４×垂直４８０画素の解像度を有する国際無線通信諮問委員会勧告６０１、標準４：２：０（ＣＣＩＲ－６０１　４：２：０）タイプの信号がエンハンスメントレイヤエンコーダ１１８０（図１）に入力されるような符号化方法である。ベースレイヤエンコーダ１１４０（図１）に入力されるＳＩＦ信号は、ＣＣＩＲ－６０１　４：２：０信号から、偶数フィールドを削除した後、水平方向にファクタ２のデシメーションを行なうことによって導出される。ローカルに復号化されたベースレイヤフレームに対しては、水平および垂直方向にファクタ２のアップサンプリング行われてエンハンスメントレイヤの符号化のために用いられる予測に関して利用される。この例においては、本発明の一側面に従う空間スケーラビリティがＭＰＥＧ－１とＭＰＥＧ－２標準との間のコンパチビリティをどのようにして可能にするかを例示する目的で、ＭＰＥＧ－１符号化方法が前述の例の場合と同様にベースレイヤを符号化するために用いられる。あるアプリケーションにおいては、双方のレイヤにおいてＭＰＥＧ－２符号化を用いることが望ましく、また可能である。例えば、ベースレイヤに対してＭＰＥＧ－２メインプロファイル符号化が用いられ、エンハンスメントレイヤに対してＭＰＥＧ－２ネクストプロファイル空間スケーラブル符号化が用いられる。

【００２５】図４および図５は、空間スケーラビリティのインターレース－プログレッシブフォームに対して必要とされるＤＥＣおよびＩＮＴＰ操作を示している。図４に示されているように、ＤＥＣ操作においては、高解像度ビデオ信号$SIGIN_{12}$がライン４１１０によって水平／垂直デシメータ４１１５に入力され、高解像度ビデオ信号がサンプリングされるレートを低減することにより、水平および垂直方向の画素数が低減される。より低い空間解像度を有するプログレッシブビデオ信号がライン４１０５に出力される。あるアプリケーションにおいては、水平方向および垂直方向ともサンプリングレートが１：１未満に低減されないことが望ましい。水平／垂直デシメータ４１１５によって用いられるサンプリングレートは、例えば２：１のように、２つの整数間の比によって表現される。水平方向デシメーションは、水平方向のサンプリングレートをファクタ２だけ低減することを必要とする。次いで、ライン４１０５上のプログレッシブフレームが、当業者には公知のプログレッシブ－インターレースデシメーション操作を受ける。その後、より低い空間解像度のインターレースフレームが$SIGOUT_{12}$としてライン４１３０上に出力される。

【００２６】図５に示されているように、ＩＮＴＰ操作においては、低解像度インターレースビデオ信号$SIGIN_{12}$がライン５１５０によってインターレース－プログレッシブインタポレータ５１６５に入力される。プログレッシブ低解像度フレームがライン５１４５によってインターレース－プログレッシブインタポレータ５１６５から出力され、水平／垂直デシメータ４１１５（図４）によって実行されるものの逆の操作を実行する水平／垂直インタポレータ５１５５に対する入力として供給される。しかしながら、水平／垂直デシメータ４１１５において空間解像度の損失が生ずるため、水平／垂直インタポレータ５１５５は、水平／垂直デシメータ４１１５（図４）への入力４１１０における信号の近似信号をライン５１７０上の$SIGOUT_{12}$として出力できるのみである。

【００２７】インターレース－プログレッシブスケーラビリティの一例は、ベースレイヤがＣＣＩＲ－６０１　４：２：０解像度のインターレースフレームのメインプロファイル符号化を用い、エンハンスメントレイヤが６０フレーム／秒のプログレッシブ高品位テレビジョン（ＨＤＴＶ）解像度フレームを用いるようなスケーラブル符号化である。ＣＣＩＲ－６０１　４：２：０メインプロファイルおよびＨＤＴＶフォーマット信号は当業者には公知である。このようなインターレース－プログレッシブ空間スケーラビリティは、標準のディジタルＴＶとディジタルプログレッシブＨＤＴＶとのコンパチビリティを実現するために有利に用いられる。この例においては、ＭＰＥＧ－２メインプロファイル符号化がベースレイヤに対して用いられ、ＭＰＥＧ－２ネクストプロファイル空間スケーラブル符号化がエンハンスメントレイヤに対して用いられる。

【００２８】図６および図７は、空間スケーラビリティのインターレース－インターレースフォームに対して必要とされるデシメーションのＤＥＣおよびＩＮＴＰ操作を示している。図６に示されているように、より低い空間解像度を有するインターレース信号を生成するためのインターレース信号のデシメーションに関しては、その第１段階はインターレース－プログレッシブインタポレーション操作を含んでいる。この例に関して入力信号$SIGIN_{03}$が３０フレーム／秒のインターレース信号であることを仮定すると、これはそれぞれのフィールドが１フレームの半分のラインを有する６０フィールド／秒のインターレースビデオとみなすことができる。インターレース－プログレッシブインタポレータ６１６５は、ライン６１１０上の６０フィールド／秒インターレースビデオ信号入力から、ライン６１０５上に同数のラインを有するインターレースフレームが６０フレーム／秒で出力されるように、プログレッシブフレームを生成する。インターレース－プログレッシブインタポレーションに引き続いて、信号は水平／垂直デシメータ６１１５

においてデシメートされ、デシメートされた信号がＳＩＧＯＵＴ$_{03}$としてライン６１３０上に出力される。元の入力信号の半分の水平および垂直解像度を有する低解像度インターレース信号が希望される場合には、水平方向に関して２：１のデシメーションファクタ、垂直方向に関して４：１のデシメーションファクタがそれぞれ用いられる。

【００２９】図７は、本発明に係る空間スケーラビリティのインターレース－インターレースフォームにおいて用いられるＩＮＴＰ操作を示している。この例においても、３０フレーム／秒の低解像度インターレース信号ＳＩＧＩＮ$_{13}$は６０フィールド／秒信号とみなされる。第１段階は、それがライン７１５０上の入力信号ＳＩＧＩＮ$_{13}$に関するインターレース－プログレッシブインタポレーション操作を含むという観点で図６を参照して記述されたデシメーション操作と同一であり、ライン７１７５上に６０フレーム／秒のプログレッシブビデオ出力を生成する。次の段階においては、偶数フィールドによって生成されたプログレッシブフレームがスイッチ７１８５を通過した後にライン７１９５上で利用可能になり、垂直インタポレータ／ラインセレクタ７２３５によって垂直方向に１：２で補間されて再度サンプリングされる。奇数フィールドによって生成されたプログレッシブフレームはスイッチ７１８５を追加した後にライン７２０５上で利用可能になり、この段階では再サンプリングされない。次いで、スイッチ７２５５がライン７２０５および７２４５上の信号を交互に選択する。最終段階においては、スイッチ７２５５の出力がライン７１４５によって１：２水平インタポレータ７１５５に供給される。

【００３０】ここで、より説明を理解しやすくするために、ＤＥＣおよびＩＮＴＰ操作において用いられるインターレース－プログレッシブインタポレーション操作についてより詳細に記述する。ＤＥＣおよびＩＮＴＰにおいて用いられるインターレース－プログレッシブインタポレーション操作は、インターレース－インターレースフォームに関するものと明らかに異なっている。なぜなら、ＩＮＴＰ操作はＭＰＥＧ－２標準によって規定されているが、ＤＥＣ操作は標準外であり、より複雑であるからである。

【００３１】図８は、空間スケーラビリティのインターレース－インターレースフォームにおいて用いられるインターレース－プログレッシブインタポレーション操作の詳細を示した図である。図８においては、ラインＡ、Ｃ、Ｅ、Ｇ．．．は奇数フィールドに属しており、ラインＢ’、Ｄ’、Ｆ’、Ｈ’．．．はフィルタを適用することによって生成されたものである。

【００３２】図９は、本発明の一側面に従う空間スケーラビリティのプログレッシブ－プログレッシブおよびインターレース－プログレッシブフォームに関する重み付け空間－時間予測の背後に存在する原理を示している。

図９においては、ラインＢ、Ｄ、Ｆ、Ｈ．．．は偶数フィールドに属しており、ラインＡ’、Ｃ’、Ｅ’、Ｈ’．．．はインターレース－プログレッシブインタポレーションフィルタを適用することによって生成されたものである。インターレース－プログレッシブインタポレーションフィルタの出力は、デインターレースされつつあるフィールドからの寄与と同一フレーム内の相異なった偶奇を有するフィールドからの寄与の２つの寄与からなる。双方の寄与は、図８および図９の矢印によって示されているように、生成されるべきデインターレースされるラインを中心として隣接しているラインサンプルに重み付けファクタを適用することによって生成される。よってこのフィルタ操作は、垂直方向および時間軸方向の解像度を保持するという妥協を維持する。

【００３３】インターレース－インターレーススケーラビリティの一例は、ベースレイヤエンコーダ１１４０（図１）がＣＣＩＲ－６０１　４：２：０解像度インターレースフレームを符号化し、エンハンスメントレイヤエンコーダ１１８０（図１）がＨＤＴＶ解像度インターレースフレームを符号化するスケーラブル符号化法である。このようなインターレース－インターレース空間スケーラビリティは、標準ディジタルＴＶとコンパチブルなディジタルインターレースＨＤＴＶを実現するために有効に用いられうる。

【００３４】図１０は、本発明の一側面に従う空間スケーラビリティのプログレッシブ－インターレースおよびインターレース－インターレースフォームに関する重み付け空間－時間予測の背後に存在する原理を示している。プログレッシブフォーマットビデオ信号に関して、図１０は、空間予測に対して適用される重み付け空間－時間予測操作が、ベースレイヤからローカルに復号化された画像をアップサンプリングしてエンハンスメントレイヤにおける動き補償時間予測と組み合わせることによって得られることを示している。重みコードＷは、それぞれのブロックの全てのラインに対して適用される空間重みであるｗを単に表現している。重み付け空間－時間予測は、空間予測ブロックにｗという重み付けを行なってそれらを１－ｗというファクタによって重み付けを行なった時間予測ブロックに加算することによって得られる。

【００３５】以下に示される表１および表２は、プログレッシブ－プログレッシブおよびインターレース－プログレッシブスケーラビリティに関する空間重みファクタを示しているが、これらは例示目的であって本発明を制限するものではない。例示されている重みファクタ以外にも、純粋に時間的な予測（すなわち、空間重みファクタが０）もそれぞれの場合において用いられうる。

【００３６】以下の表１は、プログレッシブ－プログレッシブおよびインターレース－プログレッシブスケーラ

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ビリティに関する２重みコードの組の例である。

【表１】

w
1
1/2

【００３７】以下の表２は、プログレッシブ－プログレッシブおよびインターレース－プログレッシブスケーラビリティに関する４重みコードの組の例である。

【表２】

w
1
3/4
1/2
1/4

【００３８】表３および表４は、ベースレイヤが奇数および偶数フィールドをそれぞれ符号化するプログレッシブ－インターレーススケーラビリティに係る空間重みを示しているが、それらは例示目的であって本発明を制限するものではない。例示された重み以外にも、純粋に時間的な予測（すなわち、空間重みファクタが（０、０））も用いられうる。

【００３９】以下の表３は、ベースレイヤが奇数フィールドを符号化するプログレッシブ－インターレーススケーラビリティに対する４重みコードの組の例を示している。

【表３】

w1	w2
1	0
1/2	0
1	1/2
1/2	1/2

【００４０】以下の表４は、ベースレイヤが偶数フィールドを符号化するプログレッシブ－インターレーススケーラビリティに対する４重みコードの組の例を示している。

【表４】

w1	w2
0	1
0	1/2
1/2	1
1/2	1/2

【００４１】表５および表６は、ベースレイヤが奇数および偶数フィールドをそれぞれ符号化するプログレッシブ－インターレーススケーラビリティに係る空間重みを示しているが、それらは例示目的であって本発明を制限するものではない。例示された重み以外にも、純粋に時

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間的な予測（すなわち、空間重みファクタが（０、０））も用いられうる。

【００４２】以下の表５は、ベースレイヤが奇数フィールドを符号化するプログレッシブ－インターレーススケーラビリティに対する４重みコードの組の例を示している。

【表５】

w1	w2
1	1/4
3/4	0
3/4	1/2
1/2	1/4

【００４３】以下の表６は、ベースレイヤが偶数フィールドを符号化するプログレッシブ－インターレーススケーラビリティに対する４重みコードの組の例を示しているが、例示目的のみであって本発明を制限するものではない。

【表６】

w1	w2
1/4	1
0	3/4
1/2	3/4
1/4	1/2

【００４４】表７および表８は、ベースレイヤが奇数および偶数フィールドをそれぞれ符号化するインターレース－インターレーススケーラビリティに係る空間重みを示しているが、それらは例示目的であって本発明を制限するものではない。例示された重み以外にも、純粋に時間的な予測（すなわち、空間重みファクタが（０、０））も用いられうる。

【００４５】以下の表７は、インターレース－インターレーススケーラビリティに対する２重みコードの組の例を示している。

【表７】

w1	w2
1	1
1/2	1/2

【００４６】以下の表８は、インターレース－インターレーススケーラビリティに対する４重みコードの組の例を示している。

【表８】

15

w1	w2
1	1
3/4	3/4
1/2	1/2
1/4	1/2

【００４７】図１２は、図１に示された実施例において用いられているベースレイヤエンコーダおよびエンハンスメントレイヤエンコーダのブロック図である。高解像度ビデオ信号は入力ライン１２１００で入力される。空間デシメータ１２１１０は、図１に関して既に記述されているようにフレーム当たりのペル数を低減し、ライン１２１２０上にベースエンコーダ１２２０１へのベースレイヤ信号を出力する。ベースレイヤエンコーダ１２２０１は、一般にＩ、Ｂ、およびＰ画像を符号化する公知のＭＰＥＧ－１画像装置を利用する。フレームリオーガナイザ１２１３０は、符号化の準備のために当業者には公知の方法で入力フレームの再配置を行ない、その結果をライン１２１４０および１２１５０上に出力する。

【００４８】動き推定器１２１７０は、ライン１２１５０上の入力フレームを調べてそれを直前の１つあるいは２つの符号化済みフレームと比較する。入力フレームがタイプＩあるいはＰである場合には、直前の１つのフレームが用いられる。タイプＢである場合には、直前の２つの符号化済みフレームが用いられる。動き推定器１２１７０は、動きベクトルを、動き補償器１２１８０によって用いられるようにライン１２１７５上に、可変／固定長エンコーダ１２３１０によって用いられるようにライン１２１８５上に、それぞれ出力する。動き補償器１２１８０は、動きベクトルｍｖと直前に符号化されたフレーム内のペルとを用いて（ＰおよびＢタイプフレームに関して）動き補償済み予測をライン１２２３０上に出力し、それはさらにライン１２２４０および１２２５０に伝達される。Ｉタイプフレームに関しては、動き補償器１２１８０はゼロペル値を出力する。

【００４９】加算器１２１６０は、ライン１２１４０上の入力フレームと（ＰおよびＢタイプに関する）ライン１２２５０上の予測フレームとの間の再を計算する。その結果はライン１２２１５上に現れ、変換器１２２７０によって変換され、量子化器１２２９０によって通常は整数値に量子化される。量子化された変換係数は、ライン１２３００上に出力されて可変／固定長エンコーダ１２３１０へ、およびライン１２３０５によって逆量子化器１２３８０へ、それぞれ伝達される。

【００５０】逆量子化器１２３８０は、量子化された変換係数を元のフルレンジに変換し、その結果をライン１２３９０を介して逆離散コサイン変換器１２４００に伝達する。逆離散コサイン変換器１２４００は、ペル予測誤差値をライン１２４１０上に出力する。加算器１２４２０は、ライン１２４１０上の予測誤差値をライン１２

２４０上の予測値に加算してライン１２４３０および１２４４０上に符号化されたベースレイヤペルを出力する。

【００５１】ＩおよびＰタイプフレームに関しては、スイッチ１２２２５はライン１２４３０からの符号化されたペルをライン１２２０５を介して直後画像ストア１２２０６に伝達する。同時に、直後画像ストア１２２０６内のフレームがライン１２１９５を介して直前画像ストア１２１９０に伝達される。Ｂタイプフレームに関しては、スイッチ１２２２５は何ら動作をなさず、画像ストア１２１９０および１２２０６の内容は不変のまま保たれる。画像ストア１２１９０および１２２０６の内容は、ライン１２２１０および１２２２０を介してそれぞれ動き推定器１２１７０および動き補償器１２１８０に要求に応じて伝達される。

【００５２】量子化器１２２９０および逆量子化器１２３８０によって用いられる量子化器ステップサイズＱＳは、ライン１２３５０上のバッファフル表示に依存して量子化アダプタ１２３６０によって適応計算される。量子化器ステップサイズＱＳは、ライン１２３７０によって量子化器１２２９０へ、ライン１２３７５によって逆量子化器１２３８０へ、それぞれ伝達される。量子化器ステップサイズＱＳは、さらにライン１２３６５を介して可変／固定長エンコーダ１２３１０へ伝達される。可変／固定長エンコーダ１２３１０は、ライン１２３００上の量子化された変換係数入力、ライン１２１８５上の動きベクトルｍｖ入力、およびライン１２３６５上の量子化器ステップサイズＱＳを、ライン１２３２０上に出力されてライン１２３４０によってシステムマルチプレクサ１２３４５に対して伝達されるまでの間のテンポラリストレージとしてのバッファ１２３３０へ供給されるビットストリームに符号化する。符号化されたベースレイヤフレームは、前述されているようにライン１２４４０を介してインタポレータ１２４５０に伝達され、そこでアップサンプリングされてライン１２４６０を介してエンハンスメントレイヤエンコーダ１２２０１に伝達される。

【００５３】エンハンスメントレイヤエンコーダ１２２０２においては、フレームオーガナイザ１２４７０が高解像度ビデオフレームをベースレイヤのオーダーに一致するように再配置し、再配置されたフレームをライン１２４８０に出力する。加算器１２４９０は、ライン１２４８０上の符号化されることになる入力画像とライン１２４６０上の空間ー時間予測画像との間の差異を計算する。予測誤差はライン１２５００上に出力され、変換器１２５１０によって変換され、量子化器１２５３０によって量子化されてライン１２５４０を介して可変／固定長エンコーダ１２５５０に伝達される。エンハンスメントレイヤエンコーダ１２２０１によって用いられる量子化器ステップサイズＱＳ$_E$は、ライン１２５９０上で受

信されたバッファ１２５７０のバッファフル表示に依存して量子化アダプタ１２６００によって計算される。量子化器ステップサイズＱＳEは、ライン１２６０５を介して量子化器１２５３０に、ライン１２６１０を介して逆量子化器１２７４０に、そしてライン１２６１５を介して可変／固定長エンコーダ１２５５０に、それぞれ伝達される。動き推定器１２６４０はライン１２４８５上のエンハンスメントレイヤ入力フレームを調べ、符号化される画像タイプに依存してそれをライン１２６３０上の直前の１つの復号化されたエンハンスメントレイヤフレームかライン１２６３０および１２６８０上の２つの直前の復号化されたエンハンスメントレイヤフレームと比較する。動き推定器１２６４０は動きベクトルmvEを、動き補償器１２６５５によって用いられるようにライン１２６５０上に、可変／固定長エンコーダ１２５５０によって用いられるようにライン１２６４５上に、それぞれ出力する。動き補償器１２６５５は、動きベクトルmvEを、ライン１２７００上に出力されて重み付け器１２７１０に伝達される動き補償済み時間予測を計算するために用いる。

【００５４】空間的に補間された対応するベースレイヤ復号化済みフレームがライン１２４６０上で利用可能であり、ライン１２６９０によって重み付け器１２７１０に入力される。ベースレイヤインタポレータ１２４５０の出力における空間予測フレームは、空間－時間重みアナライザ１２６８５の入力ライン１２６６５に対しても供給される。動き補償器１２６５５の出力における時間予測フレームは、時間－空間重みアナライザ１２６８５のもう一方の入力ライン１２６７５に対しても供給される。フレームオーガナイザ１２４７０からの入力フレームは、空間－時間重みアナライザ１２６８５の第３の入力ライン１２７０５に供給される。空間－時間重みアナライザ１２６８５は、空間スケーラビリティのタイプに依存して重みテーブルをまず選択し、次いで用いられるべき最良の重みあるいは重みの組を示すあらかじめストアされたテーブルに対する指数を計算する。この操作は、画像当たり一回あるいはそれ以上実行されうる。通常、ＭＰＥＧ様の符号化環境が用いられる場合には、空間－時間重みは、マクロブロック対マクロブロックという関係に基づいて適用される。マクロブロックに関する選択された重みに対する指数はライン１２７２５上に現れ、可変／固定長エンコーダ１２５５０においてビットストリームの一部として符号化される。重み付け器１２７１０は、ライン１２６９０および１２７００上の２つの予測入力の重み付け平均を計算し、その結果をライン１２７２０および１２７３０を介してそれぞれ加算器１２４９０および加算器１２７８０に供給する。

【００５５】次のエンハンスメントレイヤフレームの動き補償に関して必要とされるローカルに復号化されたエンハンスメントレイヤビデオは、いくつかの相違点を除いてベースレイヤにおけるものと同様に計算される。詳細に述べれば、量子化された変換係数が、逆量子化器１２７４０によってフルレンジに変換され、逆変換器１２７６０によって予測誤差ペル値に変換され、加算器１２７８０によって動き補償済み予測に加算され、次フレームストア１２６２０に伝達される。次フレームストア１２６２０の内容は、同時に直前フレームストア１２６６０に対してもコピーされうる。次フレームがＰ画像である場合には直前フレームストアの内容が必要とされ、Ｂ画像である場合には双方のフレームストアの内容が動き補償に関して必要とされる。可変エンコーダ１２５５０は、ライン１２５４０上の量子化された変換係数入力、ライン１２６１５上の量子化器ステップサイズＱＳE、ライン１２６４５上の動きベクトルmvE、およびライン１２７２５上の重み指数を、ライン１２５６０上に出力されるビットストリームに符号化する。ライン１２５６０上のビットストリームは、それがライン１２５８０を介してシステムマルチプレクサ１２３４５に伝達されるまでのテンポラリストレージとして機能するバッファ１２５７０に伝達される。

【００５６】本発明に係るこの実施例においては、上述されているベースおよびエンハンスメントレイヤエンコーダを例示する目的で単純なエンコーダが用いられている。しかしながら、ベースレイヤエンコーダはＭＰＥＧ－１すなわちＨ．２６１エンコーダもしくはＭＰＥＧ－２メインプロファイルエンコーダであることが望ましい。エンハンスメントレイヤエンコーダは、以下に詳細に議論される重み付け器１２７１０および空間－時間アナライザ１２６８５を除いてＭＰＥＧ－２メインプロファイルエンコーダと同様のＭＰＥＧ－２ネクストプロファイル空間スケーラビリティエンコーダであることが仮定されている。

【００５７】図１３は、図１の符号化システムに対応する、ベースレイヤデコーダ１３００１およびエンハンスメントレイヤデコーダ１３００２からなる２レイヤデコーダを示している。ベースレイヤデコーダ１３００１は、一般にＩ、Ｂ、およびＰ画像よりなる公知のＭＰＥＧ－１画像符号化装置を用いている。受信されたビットストリームは、システムデマルチプレクサから、ライン１３３４０を介して、それがライン１３３２０を介して可変／固定長デコーダ１３３１０へ伝達されるまでのテンポラリストレージとして機能するバッファ１３３３０へ伝達される。可変／固定長デコーダ１３３１０は量子化された変換係数を復号化し、それらをライン１３３００上へ出力する。量子化器ステップサイズＱＳDはライン１３３７０上へ出力される。動きベクトルmvDはライン１３３６０および１３１７５上に出力される。動き補償器１３１８０は、ライン１３１７５上の動きベクトルmvDと、Ｐ画像に関してはライン１３２１０上の直前に復号化されたフレームからのペルとを、Ｂ画像に関

してはライン１３２１０および１３２２０上の直前に復号化されたフレームからのペルとを、ライン１３２４０上に出力される動き補償済み予測を計算するために利用する。Ｉタイプフレームに関しては、動き補償器１３１８０はゼロペル値を出力する。

【００５８】量子化器ステップサイズQS_Dは、可変／固定長デコーダ１３３１０からライン１３３７０を介して逆量子化器１３３８０に伝達される。量子化された変換係数は、ライン１３３００を介して逆量子化器１３３８０に伝達される。逆量子化器１３３８０は、量子化された変換係数をフルレンジに変換し、その結果をライン１３３９０を介して、ライン１３４１０上にペル予測誤差値を出力する逆変換器に伝達する。加算器１３４２０は、ライン１３４１０上の予測誤差値とライン１３２４０上の予測値とを加算して、ライン１３４３０、１３１４０および１３４４０上に復号化されたベースレイヤペルを形成する。ＩおよびＰタイプ画像に関しては、スイッチ１３４３５はライン１３４３０上の復号化されたペル入力をライン１３２０５を介して直後画像ストア１３２００に伝達する。同時に、直後画像ストア１３２００内のフレームは、ライン１３１９５を介して直前画像ストア１３１９０に伝達される。Ｂタイプフレームに関しては、スイッチ１３４３５は何も動作をなさず、画像ストア１３９０および１３２００の内容は不変のままである。画像ストア１３１９０および１３２００の内容は、本明細書に記載されているように必要に応じて利用されるように、それぞれライン１３２１０および１３２２０を介して動き推定器１３１７０および動き補償器１３１８０に伝達される。フレームオーガナイザ１３１３０は、当業者には公知の方法によってライン１３１２５上に表示する準備としてライン１３１４０上の復号化されたベースレイヤ出力フレームを再び順序付けする。復号化されたベースレイヤフレームは、既に記述されているように、ライン１３４４０を介してインタポレータ１３４５０に伝達され、アップサンプリングされてライン１３４６０を介してエンハンスメントレイヤデコーダ１３００２に伝達される。

【００５９】エンハンスメントレイヤビットストリームは、システムデマルチプレクサ１３００５からライン１３５８０を介して、ライン１３５６０を介して可変／固定長デコーダ１３５５０へ伝達されるまでのテンポラリストレージとしてのバッファ１３５７０に伝達される。可変／固定長デコーダ１３５５０は、量子化された変換係数を復号化してライン１３５４０へ、量子化器ステップサイズQS_{DE}をライン１３６１０へ、動きベクトルmv_{DE}をライン１３６４５および１３６５０へ、および重み指数をライン１３７２５および１３６９５へ、それぞれ出力する。量子化器ステップサイズQS_{DE}はライン１３６１０から逆量子化器１３７４０へ伝達される。逆量子化器１３７４０は、ライン１３５４０上の量子化された変換係数をフルレンジに変換し、その結果を逆変換器１３７６０へライン１３７５０を介して伝達する。逆変換器１３７６０は、ペル予測誤差値を欄１３７７０へ出力する。

【００６０】動き補償器１３６５５は、ライン１３６５０上のエンハンスメントレイヤ動きベクトルmv_{DE}およびライン１３６３０および１３６８０上の直前に復号化されたエンハンスメントレイヤフレームからのペルを用いて、ライン１３７００上に出力されて重み付け器１３７１０に伝達される、動き補償済み予測を計算する。復号化されたベースレイヤフレームはインタポレータ１３４５０内でアップサンプリングされてライン１３４６０を介して重み付け器１３７１０の他の入力に供給される。重み付け器１３７１０は、ライン１３４６０および１３７００上の２つの予測の重み付け平均を計算し、その結果をライン１３７２０を介して加算器１３７８０に供給する。予測の計算に用いられる重み付けは、符号化プロセスにおいて用いられたものと同一である。重みは、ライン１３６９５から供給される、表から値を探すためも重み指数を用いて重み付け器１３７１０において獲得される。加算器１３７８０の出力は、ライン１３４８０および１３７９０に伝達される。復号化されたフレームはライン１３７９０上に出力される。Ｂ画像ではない場合には、出力はスイッチ１３８１０を介してライン１３８１５に伝達され、直後画像ストア１３６２０にストアされ、同時にその内容は直前画像ストア１３６６０にもストアされる。画像ストア１３６６０および１３６２０の内容は、以降のフレームの動き補償済み予測に関して用いられる。フレームリオーガナイザ１３４７０はライン１３４８０上の高解像度ビデオフレームをベースレイヤの順序に一致するように再構成し、その出力は表示されるためにライン１３１３５上に現れる。

【００６１】本発明に係るこの実施例においては、上述されているベースおよびエンハンスメントレイヤエンコーダを例示する目的で単純なエンコーダが用いられている。しかしながら、ベースレイヤエンコーダはＭＰＥＧ－１すなわちＨ．２６１エンコーダもしくはＭＰＥＧ－２メインプロファイルエンコーダであることが望ましい。エンハンスメントレイヤエンコーダは、以下に詳細に議論される重み付け器１３７１０を除いてＭＰＥＧ－２メインプロファイルエンコーダと同様のＭＰＥＧ－２ネクストプロファイル空間スケーラビリティエンコーダであることが仮定されている。

【００６２】図１４は、図１２において用いられている空間－時間アナライザの詳細を示した図である。空間－時間アナライザ１４０００は、ライン１４６９０上のベースレイヤ信号とライン１４７００上のエンハンスメントレイヤ時間予測信号の補間によって得られた空間予測信号を受け取る。ライン１４６９０上の信号はライン１４８８０上にも現れ、ライン１４７００上の信号はライ

ン１４８９０上にも現れて、空間－時間重み付け器１４９２０への２つの入力を構成する。第３の入力は、ライン１４９１０上の重みＷ０である。重みルックアップテーブル１４８７０の第１のエントリは、その内容がライン１４９０５上で利用可能となる。このプロセスは、それぞれ入力ライン１４８８１および１４８９１においてライン１４６９０および１４７００上の信号を受信する空間－時間重み付け器１４９２１に関して反復される。この際、その内容がライン１４９０５上で利用可能な重みルックアップテーブル１４８７０内の次のエントリである重みＷ１が、ライン１４９１１によって供給される。このプロセスは、全ての空間－時間重み付け器に関して反復される。重み付け器の個数は、重みテーブルから選択する際に利用可能なエントリの個数に依存する。空間－時間重み付け済み予測画像ブロックはライン１４９３０、１４９３１、．．．、１４９３４において利用可能となり、加算器１４９５０、１４９５１、．．．、１４９５４においてライン１４９４０、１４９４１、．．．、１４９４４から得られる元の画像ブロックから減算され、その結果得られる予測誤差ブロックがライン１４９６０、１４９６１、．．．、１４９６４上で利用可能となって、空間－時間予測当たり画像ブロックあたりの単一歪度を計算するための入力を構成する。１４９７０、１４９７１、．．．、１４９７４において計算されたそれぞれの歪度は２乗和あるいは絶対値の総和であって、ライン１４９８０、１４９８１、．．．、１４９８４へ出力されてコンパレータ１４９９０への入力を構成する。コンパレータ１４９９０は全ての値を比較して画像ブロック当たりの最小値に対応する指数をライン１４６９５上へ出力する。ＭＰＥＧ－１タイプの符号化が用いられる場合には、画像ブロックはマクロブロックと等価である。相異なった状況においては、画像ブロックはフレームあるいはフィールド全体と同じ大きさを有しうる。

【００６３】重みルックアップテーブル１４８７０は、種々の空間スケーラビリティの具体的なフォーム（すなわち、プログレッシブープログレッシブ、インターレースーインターレース、インターレースープログレッシブおよびプログレッシブーインターレース）に対する個別の重みテーブルを有しており、選択された空間スケーラビリティのフォームに依存して対応する重みテーブルが選択される。

【００６４】図１５は、図１２、図１３および図１４において用いられている空間－時間重み付け器の詳細を示した図である。空間－時間重み付け器１５０００は、ライン１５６９０上のベースレイヤ信号とライン１５７００上のエンハンスメントレイヤ時間予測信号との補間によって得られた空間予測信号を受け取る。ライン１５６９５上の指数入力が供給されて重みテーブル１５８７０へのアドレスが生成され、その結果得られた重みがライン１５８２５によって、その他方の入力としてライン１５６９０上の空間予測信号を受け取る乗算器１５８２０に供給される。さらに、重みはライン１５８４５によって加算器１５８６５へ供給される。加算器１５８６５の他方の入力は「１」に固定されており、その結果得られる重み補信号はライン１５８３５によって乗算器１５８３０へ供給される。ライン１５７００上の時間予測信号が乗算器１５８３０のもう一方の入力を構成している。乗算器１５８２０および１５８３０の出力は、それぞれライン１５８４０および１５８５０上に現れ、加算器１５８６０への入力を構成している。加算器１５８６０の出力は空間－時間重み付け済み予測信号であり、ライン１５８７５上に現れる。

【００６５】以上に説明されているように、本発明は、単一のビデオソースから種々の解像度を有するビデオ画像を導出する技法およびその装置を提供する。以上の説明は、本発明の一実施例に関するもので，この技術分野の当業者であれば、本発明の種々の変形例が考え得るが、それらはいずれも本発明の技術的範囲に包含される。

【００６６】

【発明の効果】以上述べたごとく、本発明によれば、単一のビデオソースから種々の解像度を有するビデオ画像を導出する技法およびその装置が提供される。

【００６７】

【略号の説明】

ＢＦ－バッファ
ＣＯＭＰ－コンパレータ
ＤＥＣ－デシメーション
ＩＮＴＰ－インタポレーション
ＭＣ－動き補償器
ＭＥ－動き推定器
ｍｖ－動きベクトル
ＯＲＧ－オーガナイザ
Ｑ－量子化器
ＩＱ－逆量子化器
ＱＡ－量子化器アダプタ
Ｔ－変換（例えば離散コサイン変換［ＤＣＴ］）
ＩＴ－逆変換
ＶＦＥ－可変／固定長エンコーダ
ＶＦＤ－可変／固定長デコーダ
ＳＴＡ－空間－時間アナライザ
ＰＳ－直前画像ストア
ＮＳ－直後画像ストア
ＳＷ－スイッチ
ＷＴ－重み付け器

【図面の簡単な説明】

【図１】本発明を利用した２レイヤエンコーダ／デコーダの実施例を簡潔に示すブロック図である。

【図２】空間スケーラビリティのプログレッシブープロ

グレッシブおよびプログレッシブーインターレースフォームにおいて用いられるデシメーション操作（ＤＥＣ）を示すブロック図である。

【図３】空間スケーラビリティのプログレッシブープログレッシブおよびプログレッシブーインターレースフォームにおいて用いられるインタポレーション（補間）操作（ＩＮＴＰ）を示すブロック図である。

【図４】空間スケーラビリティのインターレースープログレッシブフォームにおいて用いられるデシメーション操作（ＤＥＣ）を示すブロック図である。

【図５】空間スケーラビリティのインターレースープログレッシブフォームにおいて用いられるインタポレーション操作（ＩＮＴＰ）を示すブロック図である。

【図６】空間スケーラビリティのインターレースーインターレースフォームにおいて用いられるデシメーション操作（ＤＥＣ）を示すブロック図である。

【図７】空間スケーラビリティのインターレースーインターレースフォームにおいて用いられるインタポレーション操作（ＩＮＴＰ）を示すブロック図である。

【図８】空間スケーラビリティのインターレースーインターレースフォームにおいて用いられるインターレースープログレッシブインタポレーションの詳細を示す図である。

【図９】空間スケーラビリティのインターレースープログレッシブフォームにおいて用いられるインターレースープログレッシブインタポレーションの詳細を示す図である。

【図１０】本発明の一側面に従う空間スケーラビリティのプログレッシブープログレッシブおよびインターレースープログレッシブフォームに対する重み付け空間ー時間予測の背後に存在する原理を示す図である。

【図１１】本発明の一側面に従う空間スケーラビリティのプログレッシブーインターレースおよびインターレースーインターレースフォームに対する重み付け空間ー時間予測の背後に存在する原理を示す図である。

【図１２】図１に示された本発明の実施例において用いられるベースレイヤエンコーダおよびエンハンスメントレイヤエンコーダのブロック図である。

【図１３】図１に示された実施例に対応する２レイヤデコーダを示す図である。

【図１４】本発明に従う空間ー時間重み付け器を簡潔に示すブロック図である。

【図１５】本発明に従う空間ー時間アナライザを簡潔に示すブロック図である。

【符号の説明】

１１２０　空間デシメータ
１１４０　ベースレイヤエンコーダ
１１６０　空間インタポレータ
１１８０　エンハンスメントレイヤエンコーダ
１２５０　システムマルチプレクサ

１２７０　システムデマルチプレクサ
１３００　ベースレイヤデコーダ
１３２０　空間インタポレータ
１３４０　エンハンスメントレイヤデコーダ
２１１５　水平／垂直デシメータ
３１１５　水平／垂直インタポレータ
４１１５　水平／垂直デシメータ
４１２５　プログレッシブーインターレースデシメータ
５１５５　水平／垂直インタポレータ
５１６５　インターレースープログレッシブインタポレータ
６１１５　水平／垂直デシメータ
６１６５　インターレースープログレッシブインタポレータ
７１５５　水平インタポレータ
７１６５　インターレースープログレッシブインタポレータ
７１８５　スイッチ
７２３５　垂直インタポレータ／ラインセレクタ
７２５５　スイッチ
１２１１０　デシメータ
１２１３０　オーガナイザ
１２１６０　加算器
１２１７０　動き推定器
１２１８０　動き補償器
１２１９０　直前画像ストア
１２２００　直後画像ストア
１２２０１　ベースレイヤエンコーダ
１２２０２　エンハンスメントレイヤエンコーダ
１２２２５　スイッチ
１２２７０　変換器
１２２９０　量子化器
１２３１０　可変／固定長エンコーダ
１２３３０　バッファ
１２３６０　量子化アダプタ
１２３８０　逆量子化器
１２４００　逆変換器
１２４２０　加算器
１２４５０　インタポレータ
１２４７０　オーガナイザ
１２４９０　加算器
１２５１０　変換器
１２５３０　量子化器
１２５５０　可変／固定長エンコーダ
１２５７０　バッファ
１２６００　量子化アダプタ
１２６２０　直後画像ストア
１２６４０　動き推定器
１２６５５　動き補償器
１２６６０　直前画像ストア

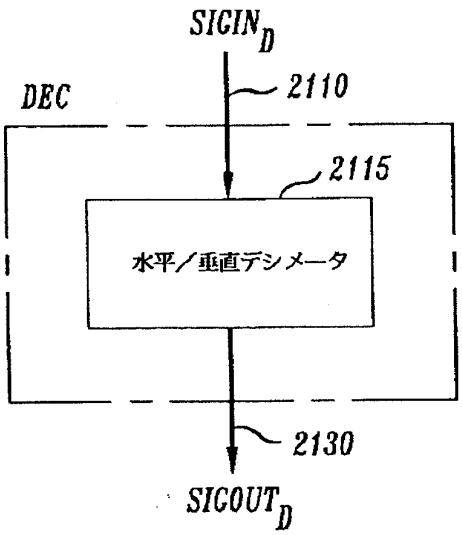
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１２６８５　空間ー時間アナライザ
１２７１０　重み付け器
１２７４０　逆量子化器
１２７６０　逆変換器
１２７８０　加算器
１２８００　スイッチ
１３００１　ベースレイヤデコーダ
１３００２　エンハンスメントレイヤデコーダ
１３００５　システムデマルチプレクサ
１３１３０　オーガナイザ
１３１８０　動き補償器
１３１９０　直前画像ストア
１３２００　直後画像ストア
１３３１０　可変／固定長デコーダ
１３３３０　バッファ
１３３８０　逆量子化器
１２４００　逆変換器
１３４２０　加算器
１３４３５　スイッチ
１３４５０　インタポレータ

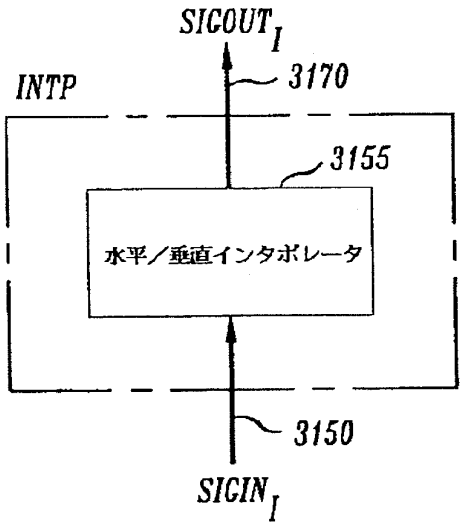
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＊１３４７０　オーガナイザ
１３５５０　可変／固定長デコーダ
１３５７０　バッファ
１３６２０　直後画像ストア
１３６５５　動き補償器
１３６６０　直前画像ストア
１３７１０　重み付け器
１３７４０　逆量子化器
１３７６０　逆変換器
１３７８０　加算器
１３８１０　スイッチ
１４８７０　重みルックアップテーブル
１４９２０、１４９２１、１４９２４　重み付け器
１４９５０、１４９５１、１４９５４　加算器
１４９７０、１４９７１、１４９７４　２乗和あるいは絶対値総和計算器
１４９９０　コンパレータ
１５８２０、１５８３０　乗算器
１５８６０、１５８６５　加算器
＊１５８７０　重みルックアップテーブル

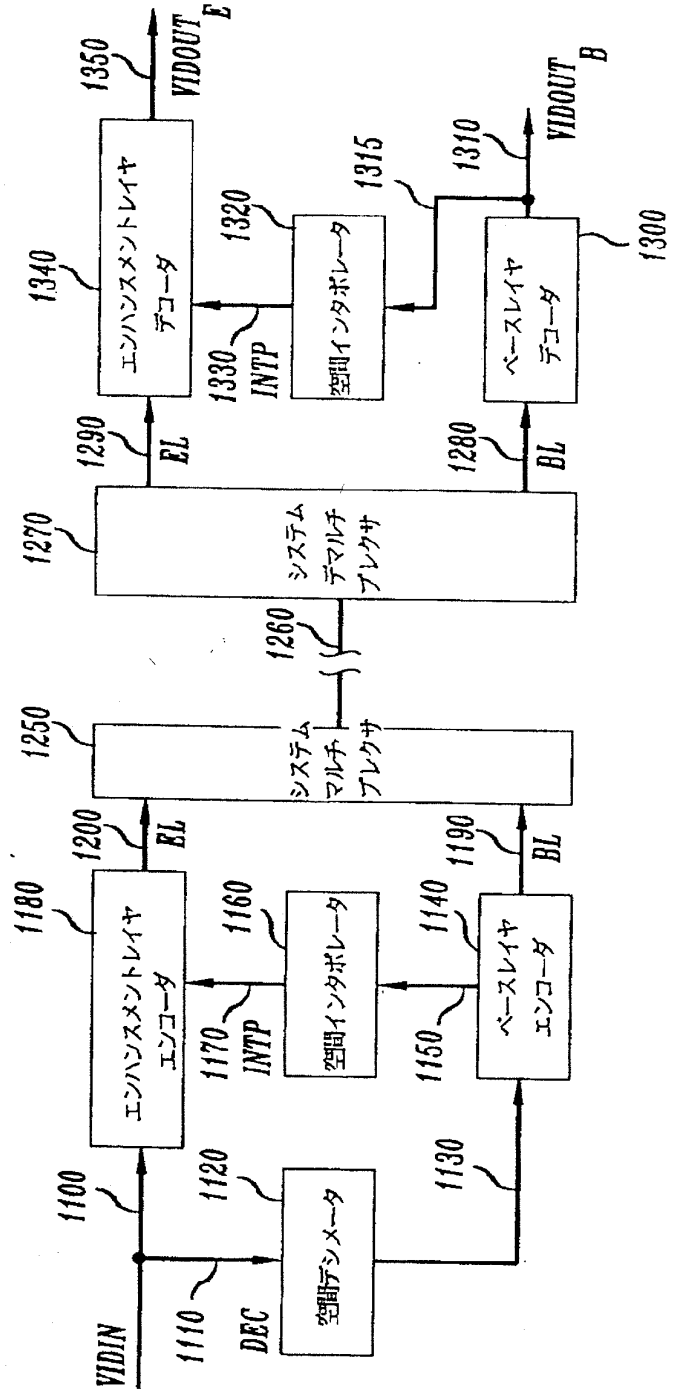
【図２】



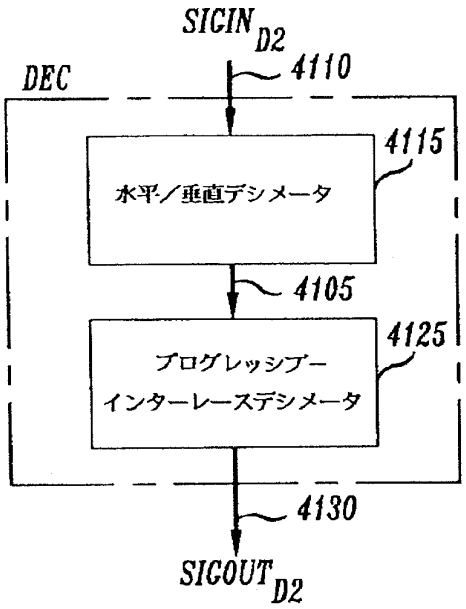
【図３】



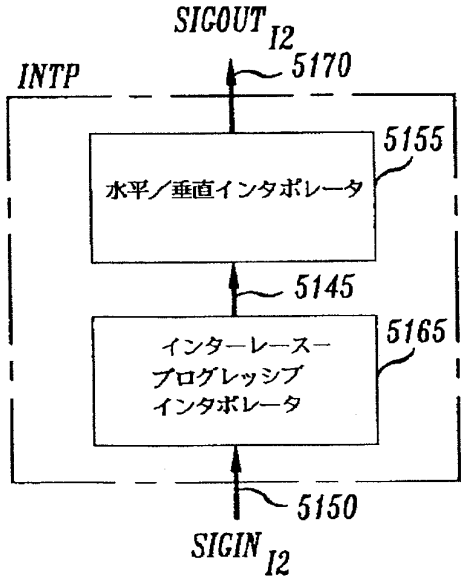
【図１】


VIDIN
1110
DEC
1100
空間デシメータ
1120
1130
エンハンスメントレイヤ エンコーダ
1180
1170
INTP
空間インタポレータ
1160
1150
ベースレイヤ エンコーダ
1140
1200
EL
1190
BL
システム マルチ プレクサ
1250
1260
システム デマルチ プレクサ
1270
1290
EL
1280
BL
エンハンスメントレイヤ デコーダ
1340
1330
INTP
空間インタポレータ
1320
1315
ベースレイヤ デコーダ
1300
1310
VIDOUT B
1350
VIDOUT E

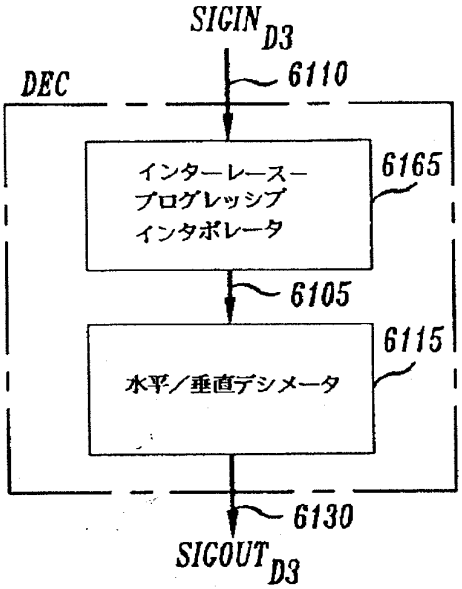
【図４】


SICIN D2
4110
DEC
4115
水平／垂直デシメータ
4105
4125
プログレッシブ－
インターレースデシメータ
4130
SICOUT D2

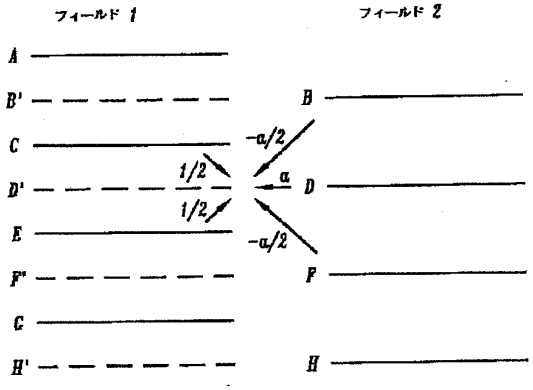
【図５】


SICOUT I2
5170
INTP
5155
水平／垂直インタポレータ
5145
5165
インターレース－
プログレッシブ
インタポレータ
5150
SIGIN I2

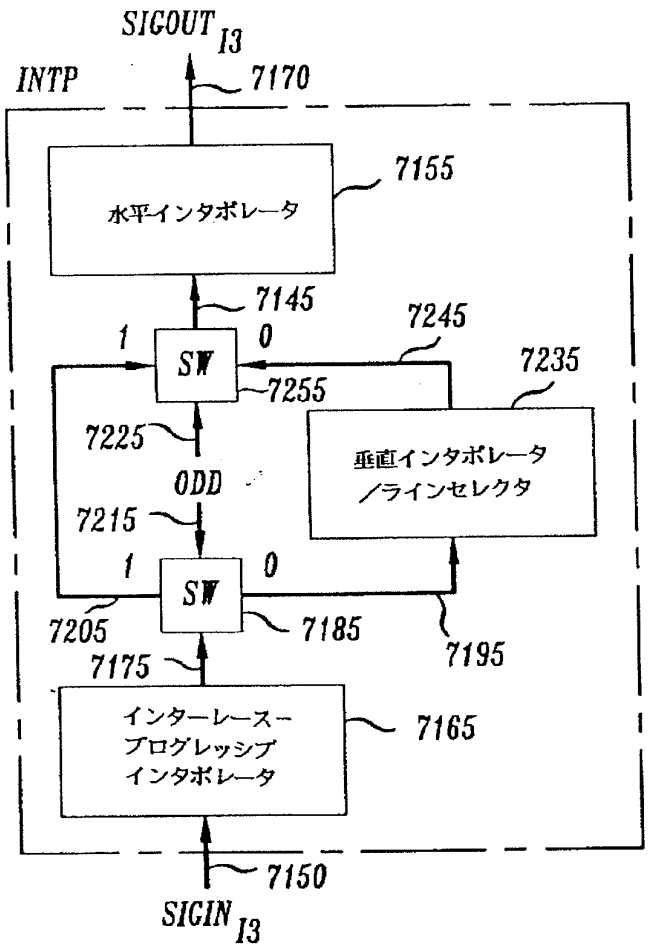
【図６】


SICIN D3
6110
DEC
6165
インターレース－
プログレッシブ
インタポレータ
6105
6115
水平／垂直デシメータ
6130
SICOUT D3

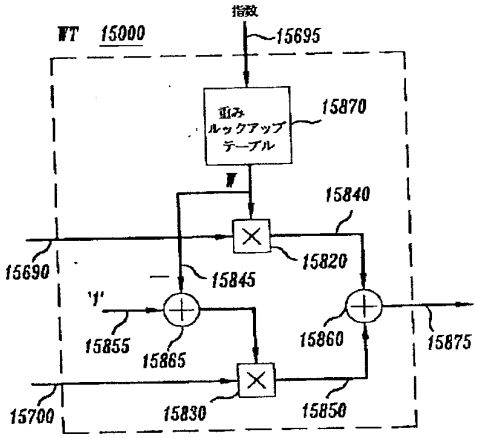
【図８】


フィールド 1
フィールド 2
A
B'
B
C
-α/2
1/2
α
D'
D
1/2
E
-α/2
F'
F
G
H'
H

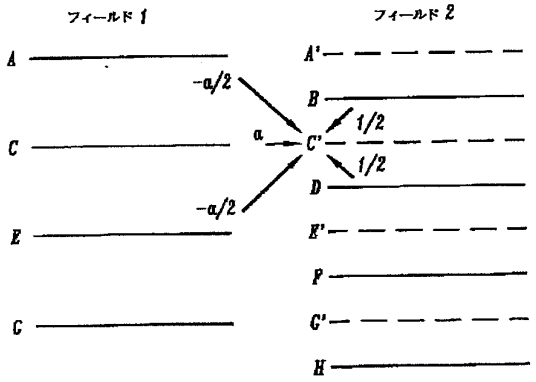
【図７】


SIGOUT I3
INTP
7170
水平インタポレータ
7155
7145
1
SW
0
7245
7255
7235
7225
垂直インタポレータ
／ラインセレクタ
ODD
7215
1
SW
0
7205
7185
7195
7175
インターレース－
プログレッシブ
インタポレータ
7165
7150
SIGIN I3

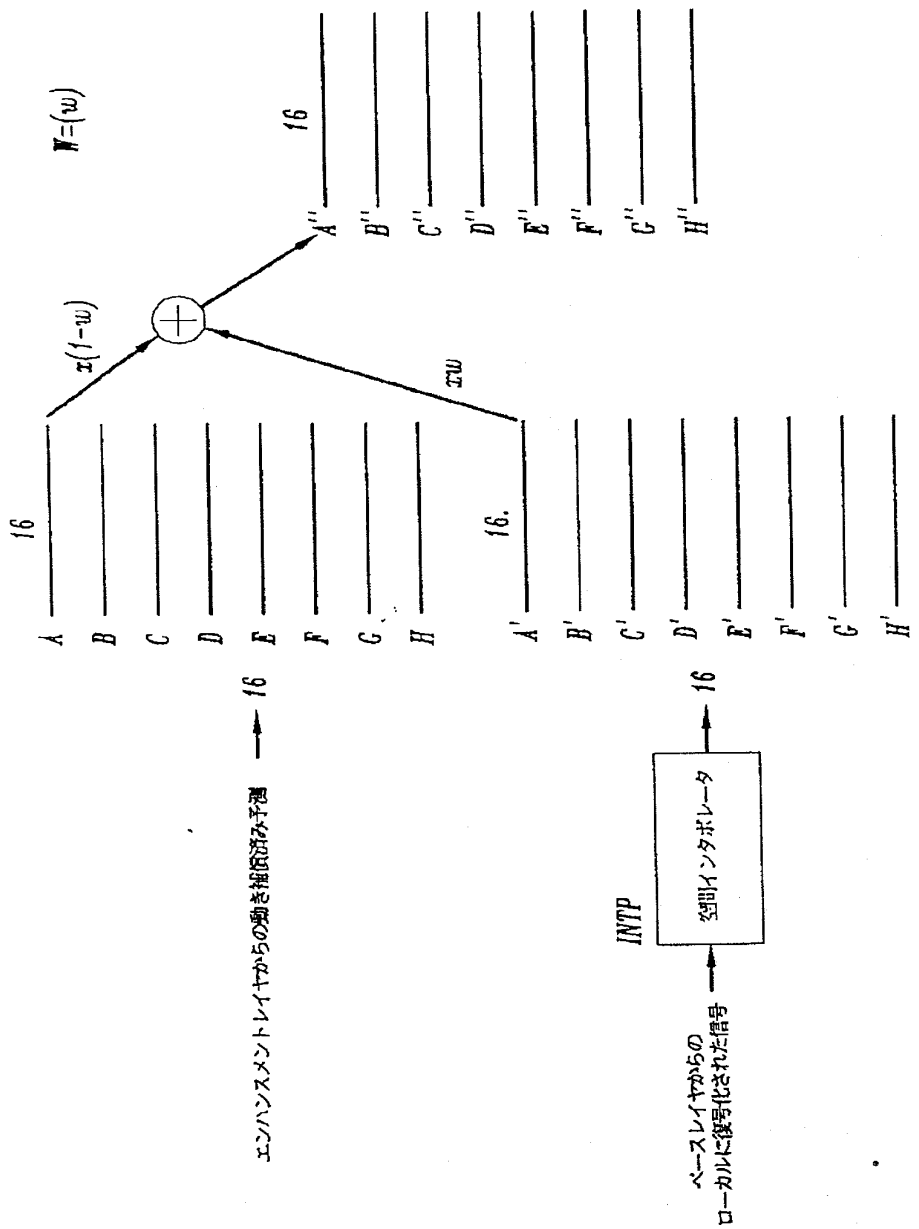
【図１５】


指数
WT 15000
15695
重み
ルックアップ
テーブル
15870
W
15840
15690
15820
15845
'1'
15855
15865
15860
15875
15700
15830
15850

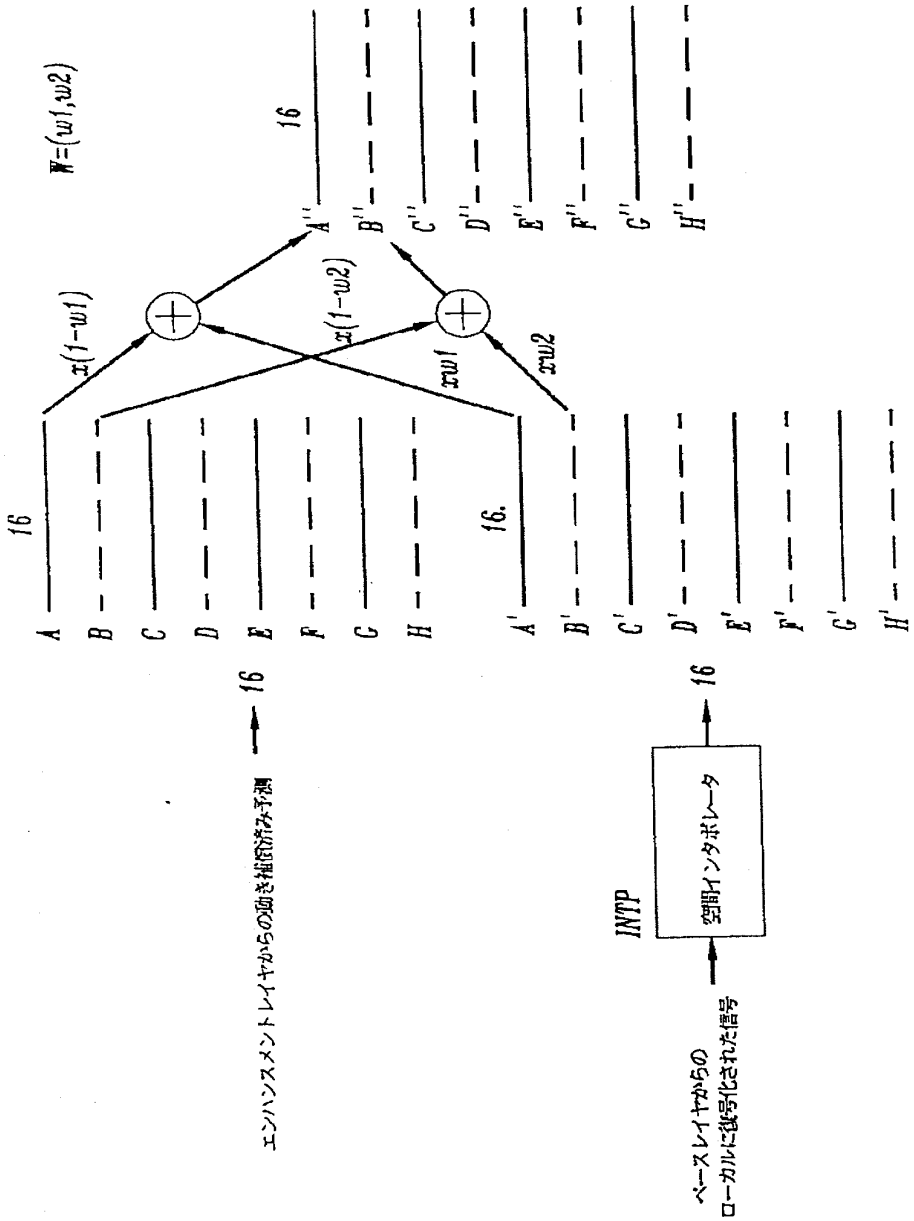
【図９】


フィールド 1
フィールド 2
A
A'
-α/2
B
1/2
C
α
C'
1/2
D
-α/2
E
E'
F
G
G'
H

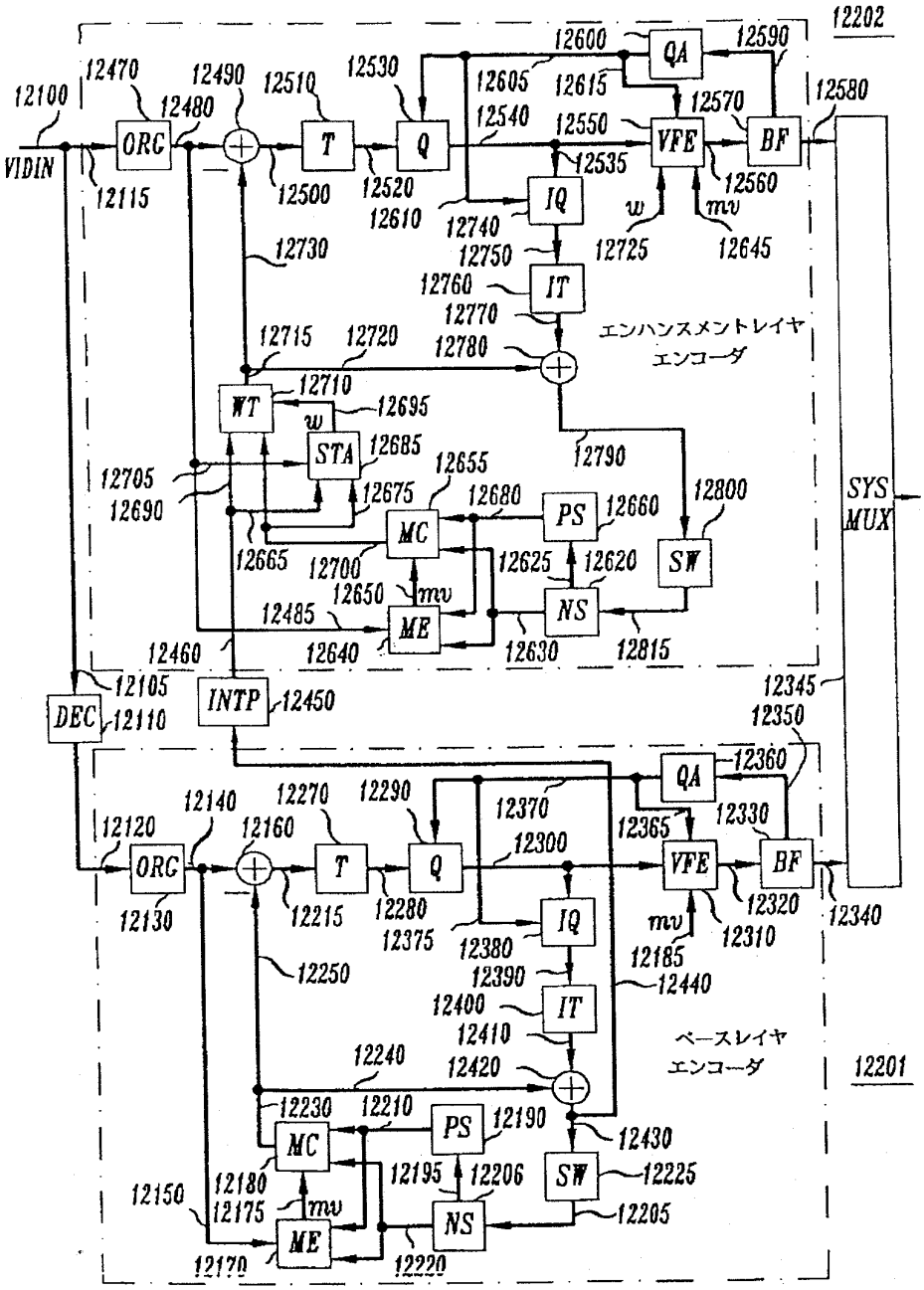
【図１０】


W=(w)
16
A''
B''
C''
D''
E''
F''
G''
H''
x(1-w)
xw
16
A
B
C
D
E
F
G
H
16.
A'
B'
C'
D'
E'
F'
G'
H'
エンハンスメントレイヤからの動き補償済み予測
16
INTP
空間インタポレータ
16
ベースレイヤからの
ローカルに復号化された信号

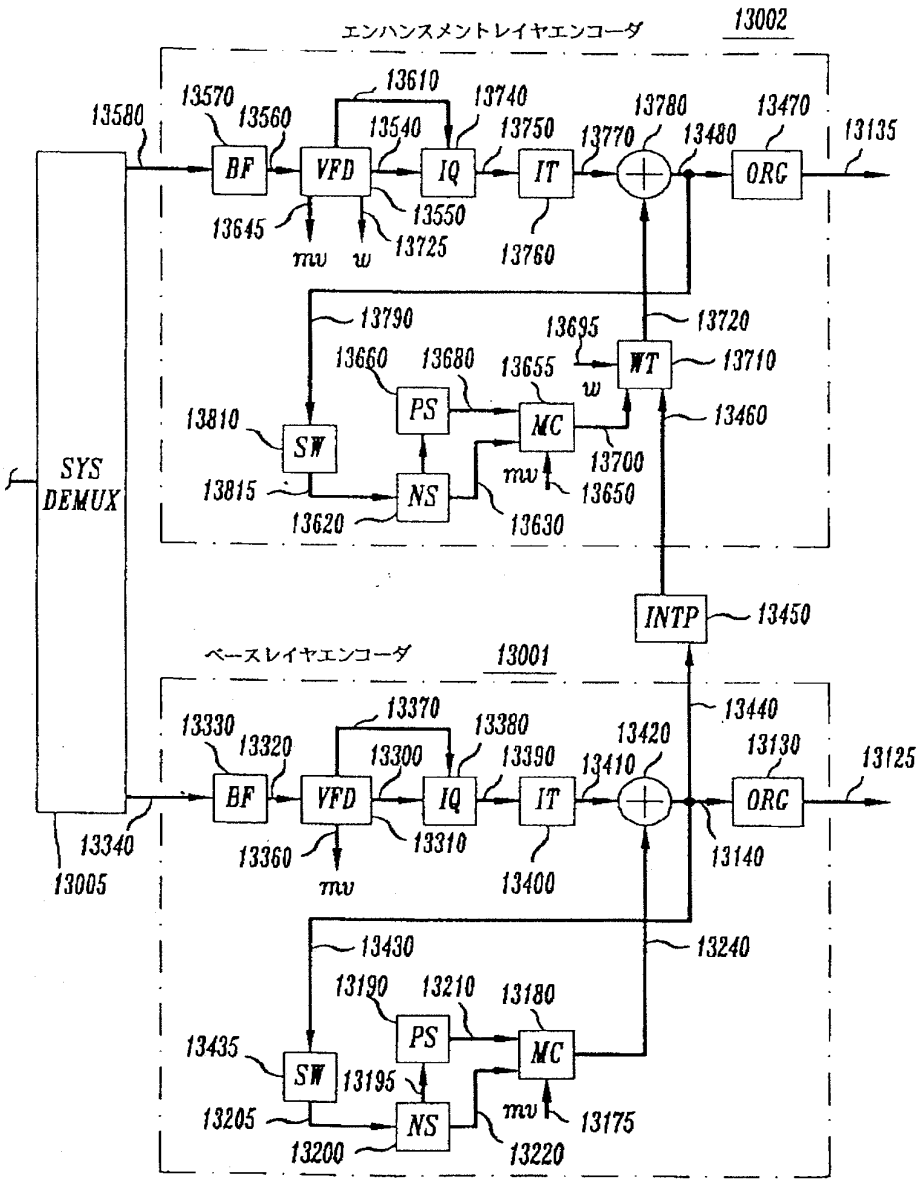
【図１１】


W=(w1,w2)
16
16
16
16
x(1-w1)
x(1-w2)
xw1
xw2
A
B
C
D
E
F
G
H
A'
B'
C'
D'
E'
F'
G'
H'
A''
B''
C''
D''
E''
F''
G''
H''
エンハンスメントレイヤからの動き補償済み予測
INTP
空間インタポレータ
ベースレイヤからの
ローカルに復号化された信号

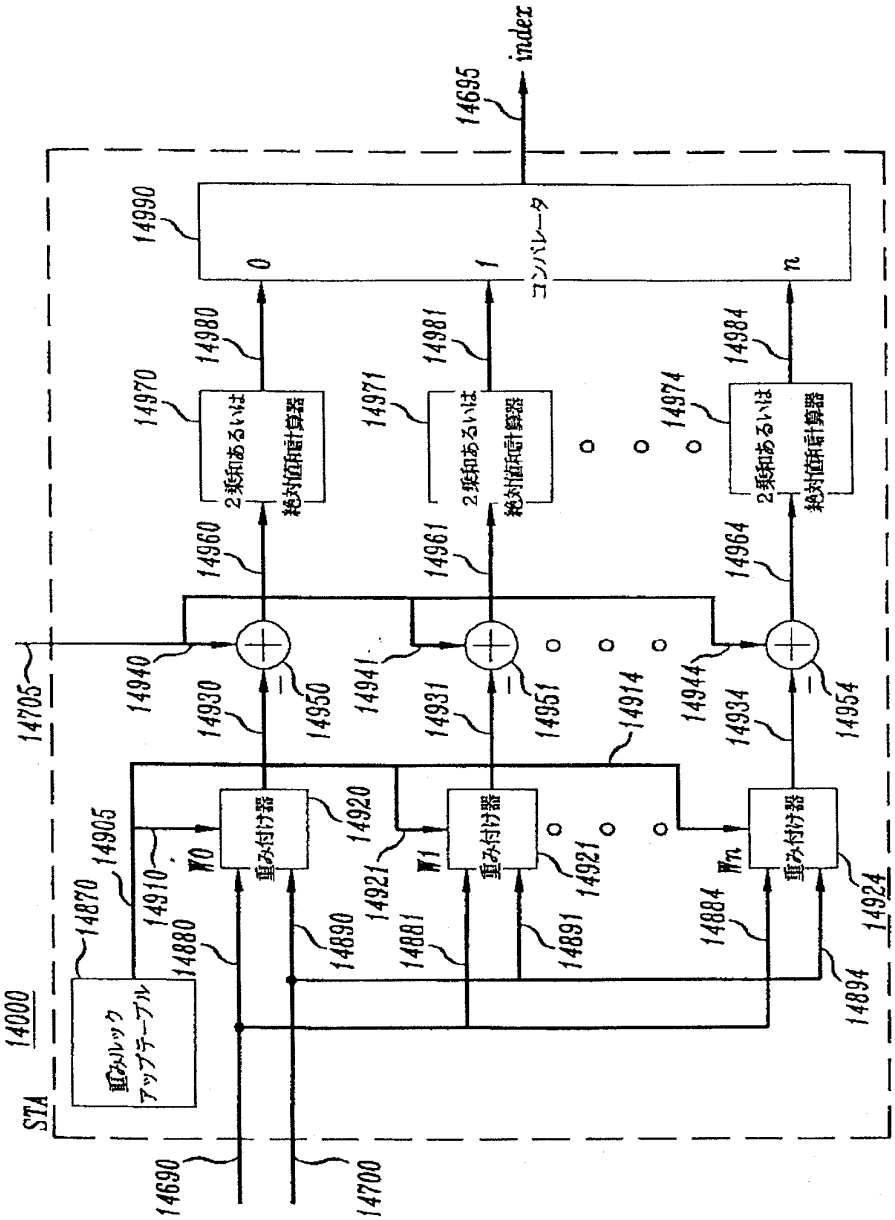
【図１２】


12202
12600
QA
12590
12470
12490
12510
12530
12605
12615
12570
12580
12100
12480
12540
12550
VFE
BF
VIDIN
ORC
T
Q
12535
12560
12115
12500
12520
12610
IQ
w
mv
12740
12725
12645
12730
12750
IT
12760
12770
エンハンスメントレイヤ
エンコーダ
12715
12720
12780
12710
WT
12695
w
STA
12685
12655
12790
12705
12675
12680
PS
12660
12800
SYS
MUX
12690
MC
SW
12665
12700
12625
12620
12650
mv
NS
12485
ME
12460
12640
12630
12815
12105
12345
DEC
12110
INTP
12450
12350
QA
12360
12140
12270
12290
12370
12365
12330
12120
12160
12300
VFE
BF
ORC
T
Q
12320
12340
12130
12215
12280
12375
IQ
mv
12310
12380
12185
12250
12390
12440
12400
IT
12410
ベースレイヤ
エンコーダ
12240
12420
12201
12230
12210
PS
12190
12430
MC
12180
12195
12206
SW
12225
12150
12175
mv
NS
12205
ME
12170
12220

【図１３】


エンハンスメントレイヤエンコーダ
13002
13580
13570
13560
13610
13740
13540
13750
13780
13770
13480
13470
13135
BF
VFD
IQ
IT
ORC
13645
mv
w
13550
13725
13760
13790
13695
13720
13660
13680
13655
WT
13710
w
PS
MC
13460
13810
SW
13700
SYS
DEMUX
13815
NS
mv
13650
13620
13630
INTP
13450
ベースレイヤエンコーダ
13001
13330
13320
13370
13380
13420
13440
13130
13125
13300
13390
13410
BF
VFD
IQ
IT
ORC
13340
13360
mv
13310
13400
13140
13005
13430
13240
13190
13210
13180
PS
MC
13435
SW
13195
13205
NS
mv
13175
13200
13220

【図１４】



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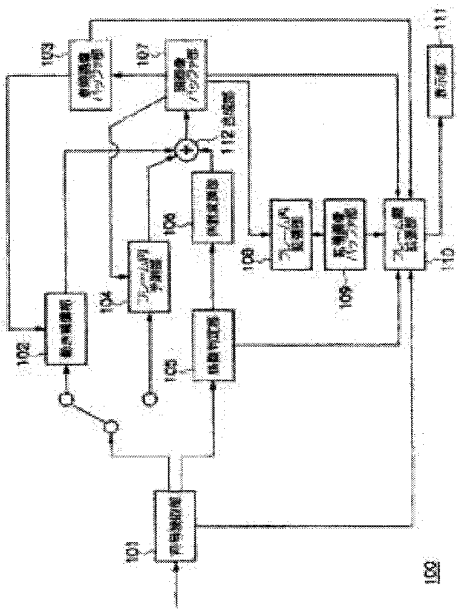
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(54) IMAGE PROCESSOR AND IMAGE PROCESSING METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To reduce the processing quantity of inter-frame processing by super-resolution processing and to perform the processing at a higher speed.

SOLUTION: An image processor according to the present invention includes a decoded image forming means of receiving compressed and encoded image data of a compressed and encoded input image and forming a decoded image based upon the compressed and encoded image data; an in-frame expansion processing means of forming an expanded image whose frames are expanded in resolution based upon image data of the decoded image formed by the decoded image forming means; a coefficient decision means of deciding availability of inter-frame expansion processing for a decoded image sequence based upon the size of coefficient data of orthogonal conversion of the input image included in the compressed and encoded image data; and an inter-frame expansion processing means of performing inter-frame expansion processing based upon expanded image information which is expanded in resolution by the in-frame expanding means when the coefficient decision means decides that the inter-frame expansion processing is effective.



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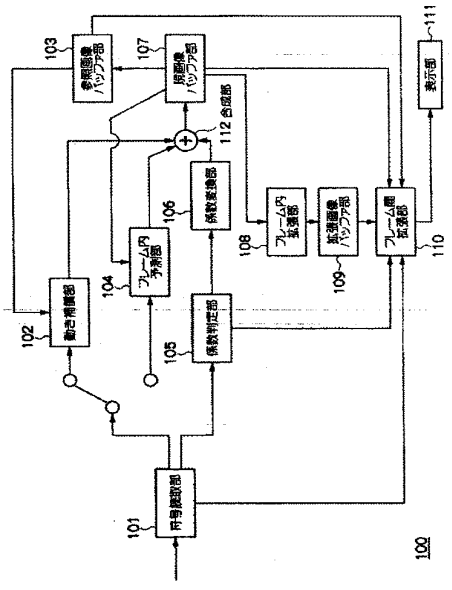
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(54)【発明の名称】画像処理装置及び画像処理方法

(57)【要約】
【課題】超解像処理によるフレーム間処理の処理量を軽減すると共に、より高速に行なうことができるようにする。
【解決手段】本発明の画像処理装置は、圧縮符号化された入力画像の圧縮符号化画像データを取り込み、圧縮符号化画像データに基づいて復号画像を形成する復号画像形成手段と、復号画像形成手段により形成された復号画像の画像データに基づいて、各フレームの解像度を拡張した拡張画像を形成するフレーム内拡張処理手段と、圧縮符号化画像データに含まれている入力画像の直交変換の係数データの大きさに基づいて、復号画像列に対するフレーム間拡張処理の有効性を判定する係数判定手段と、係数判定手段によりフレーム間拡張処理が有効であると判定した場合、フレーム内拡張手段により解像度が拡張された拡張画像情報に基づいてフレーム間拡張処理を行なうフレーム間拡張処理手段とを備えることを特徴とする。
【選択図】　図１



【特許請求の範囲】
【請求項１】
圧縮符号化された入力画像の圧縮符号化画像データを取り込み、上記圧縮符号化画像データに基づいて復号画像を形成する復号画像形成手段と、
上記復号画像形成手段により形成された上記復号画像の画像データに基づいて、各フレームの解像度を拡張した拡張画像を形成するフレーム内拡張処理手段と、
上記圧縮符号化画像データに含まれている上記入力画像の直交変換の係数データの大きさに基づいて、上記復号画像列に対するフレーム間拡張処理の有効性を判定する係数判定手段と、
上記係数判定手段によりフレーム間拡張処理が有効であると判定した場合、上記フレーム内拡張手段により解像度が拡張された拡張画像情報に基づいてフレーム間拡張処理を行なうフレーム間拡張処理手段と
を備えることを特徴とする画像処理装置。
【請求項２】
上記フレーム間拡張処理手段は、上記圧縮符号化画像データに含まれている動きベクトルを、フレーム間拡張のための動きベクトルとして使用することを特徴とする請求項１に記載の画像処理装置。
【請求項３】
復号画像形成手段が、圧縮符号化された入力画像の圧縮符号化画像データを取り込み、上記圧縮符号化画像データに基づいて復号画像を形成する復号画像形成工程と、
フレーム内拡張処理手段が、上記復号画像形成手段により形成された上記復号画像の画像データに基づいて、各フレームの解像度を拡張した拡張画像を形成するフレーム内拡張処理工程と、
係数判定手段が、上記圧縮符号化画像データに含まれている上記入力画像の直交変換の係数データの大きさに基づいて、上記復号画像列に対するフレーム間拡張処理の有効性を判定する係数判定工程と、
フレーム間拡張処理手段が、上記係数判定手段によりフレーム間拡張処理が有効であると判定した場合、上記フレーム内拡張手段により解像度が拡張された拡張画像情報に基づいてフレーム間拡張処理を行なうフレーム間拡張処理工程と
を備えることを特徴とする画像処理方法。

【発明の詳細な説明】
【技術分野】
【０００１】
本発明は、画像処理装置及び画像処理方法に関し、例えば、ＭＰＥＧの標準化技術により圧縮符号化処理された入力画像よりも解像度を高くして高解像度画像を出力する超解像処理機能を有する画像処理装置及び画像処理方法に適用し得る。
【背景技術】
【０００２】
従来、ＭＰＥＧの標準化技術により圧縮符号化された画像の圧縮符号化データ（以下、ＭＰＥＧデータともいう）の復号画像列に対して超解像処理によるフレーム間処理を行なうためには、現処理対象画像と参照画像との間で動き探索を行ない、動きベクトルの検出とその有効性を判定する必要がある。
【０００３】
ここで、超解像処理とは、入力画像の解像度よりも高い解像度の画像を出力する処理をいい、複数枚の低解像度画像と画像間の推定動き量とに基づいて入力画像を高解像度画像に拡張している。この動き量の推定をするためには、動き探索をすることと、それにより得られた動きベクトルの有効性を判定することが必要となる。
【０００４】
特許文献１は、監視用カメラが撮影した画像データを高精細画像データにして記憶する

映像記録システムについて記載されており、その具体的な内容は、カメラ映像データをＭＰＥＧの標準化技術で圧縮符号化するＭＰＥＧ処理部がマクロブロックと動きベクトルとフレームデータ（Ｉフレーム又はＰフレーム）を超解像処理部に与え、超解像処理部がこれらのデータに基づいて超解像処理を行なうことで高精細画像データを出力し、記憶させる。

【０００５】

【特許文献１】特開２００５－１５０８０８号公報

【発明の開示】

【発明が解決しようとする課題】

【０００６】

しかしながら、上述したように、復号されたＭＰＥＧデータの復号画像列に対して、超解像処理によるフレーム間処理を行なうためには、処理負荷の大きい動き探索処理を行なうことが必要であった。また、超解像処理によるフレーム間処理を行なうか否かを判定するためには、動きベクトルに基づく所定の判定処理が必要であった。従って、超解像処理のフレーム間処理を行なうためには、多大な処理量が必要であるため、この処理量を軽減することが望まれている。

【０００７】

そのため、超解像処理によるフレーム間処理の処理量を軽減すると共に、より高速に行なうことができる画像処理装置及び画像処理方法が求められている。

【課題を解決するための手段】

【０００８】

かかる課題を解決するために、第１の本発明の画像処理装置は、（１）圧縮符号化された入力画像の圧縮符号化画像データを取り込み、圧縮符号化画像データに基づいて復号画像を形成する復号画像形成手段と、（２）復号画像形成手段により形成された復号画像の画像データに基づいて、各フレームの解像度を拡張した拡張画像を形成するフレーム内拡張処理手段と、（３）圧縮符号化画像データに含まれている入力画像の直交変換の係数データの大きさに基づいて、復号画像列に対するフレーム間拡張処理の有効性を判定する係数判定手段と、（４）係数判定手段によりフレーム間拡張処理が有効であると判定した場合、フレーム内拡張手段により解像度が拡張された拡張画像情報に基づいてフレーム間拡張処理を行なうフレーム間拡張処理手段とを備えることを特徴とする。

【０００９】

第２の本発明の画像処理方法は、（１）復号画像形成手段が、圧縮符号化された入力画像の圧縮符号化画像データを取り込み、圧縮符号化画像データに基づいて復号画像を形成する復号画像形成工程と、（２）フレーム内拡張処理手段が、復号画像形成手段により形成された復号画像の画像データに基づいて、各フレームの解像度を拡張した拡張画像を形成するフレーム内拡張処理工程と、（３）係数判定手段が、圧縮符号化画像データに含まれている入力画像の直交変換の係数データの大きさに基づいて、復号画像列に対するフレーム間拡張処理の有効性を判定する係数判定工程と、（４）フレーム間拡張処理手段が、係数判定手段によりフレーム間拡張処理が有効であると判定した場合、フレーム内拡張手段により解像度が拡張された拡張画像情報に基づいてフレーム間拡張処理を行なうフレーム間拡張処理工程とを備えることを特徴とする。

【発明の効果】

【００１０】

本発明の画像処理装置及び画像処理方法によれば、超解像処理によるフレーム間処理の処理量を軽減すると共に、より高速に行なうことができる。

【発明を実施するための最良の形態】

【００１１】

（Ａ）第１の実施形態

以下、本発明の画像処理装置及び画像処理方法の第１の実施形態を図面を参照しながら説明する。

【００１２】
第１の実施形態は、ＭＰＥＧの標準化技術により圧縮符号化された圧縮符号化データ（ＭＰＥＧデータ）を取り込み、その復号データに対して超解像処理を行ない、高解像度画像を出力表示する画像装置に、本発明の画像処理装置及び画像処理方法を適用した場合を説明する。
【００１３】
（Ａ－１）第１の実施形態の構成
図１は、第１の実施形態の画像装置の内部構成を示すブロック図である。図１に示すように、第１の実施形態の画像装置は、符号読取部１０１、動き補償部１０２、参照画像バッファ部１０３、フレーム内予測部１０４、係数判定部１０５、係数変換部１０６、現画像バッファ部１０７、フレーム内拡張部１０８、拡張画像バッファ部１０９、フレーム間拡張部１１０、表示部１１１、合成部１１２、を少なくとも有して構成される。
【００１４】
符号読取部１０１は、図示しない送信側からＭＰＥＧの標準化技術により圧縮符号化された画像のＭＰＥＧデータを受け取り、そのＭＰＥＧデータから予測データ及び係数データを読み取るものである。
【００１５】
このとき、符号読取部１０１は、ＭＰＥＧデータがイントラ予測符号化されたものである場合、読み取った予測データをフレーム内予測部１０４に与え、又ＭＰＥＧデータがインター予測符号化されたものである場合、読み取った予測データを動き補償部１０２及びフレーム間拡張部１１０に与えるものある。
【００１６】
また、符号読取部１０１は、ＭＰＥＧデータがインター予測符号化されたものである場合、読み取った各インターブロックの係数データを係数判定部１０５に与えるものである。
【００１７】
動き補償部１０２は、符号読取部１０１からの予測データ（インター予測符号データ）に基づいて動き補償をするものである。すなわち、動き補償部１０２は、符号読取部１０１から予測データ（インター予測符号化データ）を受け取ると、参照画像バッファ部１０３から参照画像データを受け取り、参照画像データに予測データ（インター予測符号化データ）を加算することで新しい再生画像データを形成し、その再生画像データを合成部１１２に与えるものである。
【００１８】
参照画像バッファ部１０３は、過去の再生画像（参照画像）データを蓄積するものであり、動き補償部１０２及びフレーム間拡張部１１０と接続し、適宜参照画像データを動き補償部１０２及びフレーム間拡張部１１０に与えるものである。
【００１９】
フレーム内予測部１０４は、符号読取部１０１から予測データ（イントラ予測符号化データ）を受け取ると、現画像バッファ部１０７から現画像データを受け取り、当該現画像データのフレーム内予測を行なうものである。
【００２０】
係数判定手段１０５は、予め閾値が設定されており、符号読取部１０１からインターブロックの係数データを受け取ると、各インターブロックの係数データの絶対値を求め、その各インターブロックの係数データの絶対値と閾値とを比較し、すべてのインターブロックの係数データの絶対値が閾値より小さければ有効とする判定結果をフレーム間拡張部１１０に与え、そうでなければ無効とする判定結果をフレーム間拡張部１１０に与えるものである。また、係数判定手段１０５は、符号読取部１０１から受け取った各インターブロックの係数データを係数変換部１０６に与える。
【００２１】
係数変換部１０６は、係数判定部１０５から各インターブロックの係数データを受け取

ると、受け取った各インターブロックの係数データに対して逆変換処理を行ない、その逆変換により得たデータを合成部１１２に与えるものである。

【００２２】

合成部１１２は、動き補償部１０２、フレーム内予測部１０４及び係数変換部１０６と接続しており、動き補償部１０２、フレーム内予測部１０４及び係数変換部１０６から与えられたデータを合成して再生画像データを形成するものであり、形成した再生画像データを現画像データとして現画像バッファ部１０７に与えるものである。

【００２３】

現画像バッファ部１０７は、現画像データを蓄積するものであり、フレーム内拡張部１０８及びフレーム間拡張部１１０に接続し、適宜現画像データをフレーム内拡張部１０８及びフレーム間拡張部１１０に与えるものである。また、現画像バッファ部１０７は、合成部１１２により合成された現画像データを受け取るたびに、蓄積していた現画像データを参照画像バッファ部１０３に与えて参照画像データとして蓄積させるものである。

【００２４】

フレーム内拡張部１０８は、現画像バッファ部１０７から現画像データを受け取り、受け取った現画像データに対して超解像処理による所定のフレーム内処理を行ないフレーム内の解像度を拡張した拡張画像データを形成し、その拡張画像を拡張画像バッファ部１０９に与えるものである。なお、フレーム内拡張部１０８が現画像データに対して行なうフレーム内処理の方法は、既存の超解像処理によるフレーム内処理を適用することができるから、ここでの詳細な説明は省略する。

【００２５】

拡張画像バッファ部１０９は、フレーム内拡張部１０８からの拡張画像データを蓄積するものであり、蓄積している拡張画像データをフレーム間拡張部１１０に与えるものである。

【００２６】

フレーム間拡張部１１０は、解像度が拡張された現画像データと１フレーム前の参照画像データとに基づいて超解像処理による所定のフレーム間処理を行なうものであり、係数判定部１０５による判定結果が有効であるときは超解像処理によるフレーム間処理を行なうものとし、係数判定部１０５による判定結果が無効であるときは超解像処理によるフレーム間処理を行なわないものとする。

【００２７】

つまり、係数判定部１０５の判定結果が有効である場合、フレーム間拡張部１１０は、拡張画像バッファ部１０９から解像度が拡張された１フレーム前の参照画像データと解像度が拡張された現画像データとを受け取り、また符号読取部１０１から予測データを受け取り、ＭＰＥＧデータの動きベクトルを超解像処理のフレーム間拡張の動きベクトルとして、超解像処理を行なう。

【００２８】

表示部１１１は、フレーム間拡張部１１０から与えられた画像を受け取り、その画像を出力表示するものである。

【００２９】

（Ａ－２）第１の実施形態の動作

次に、第１の実施形態の画像装置２０における画像処理動作を図１を用いて説明する。

【００３０】

まず、ＭＰＥＧデータが符号読取部１０１に与えられると、符号読取部１０１により係数データ及び予測データが読み取られる。

【００３１】

符号読取部１０１において、ＭＰＥＧデータがイントラ予測符号化データであるときには、予測データはフレーム内予測部１０４に与えられ、ＭＰＥＧデータがインター予測符号化データであるときには、予測データは動き補償部１０２及びフレーム間拡張部１１０に与えられる。

【００３２】
イントラ予測符号化データである場合、符号読取部１０１に読み取られた予測データは、フレーム内予測部１０４に与えられ、フレーム内予測部１０４により通常のイントラ予測符号化に対する復号処理が行なわれ復号画像データとする。
【００３３】
そして、フレーム内予測部１０４により復号された復号画像データは合成部１１２を介して合成されて、再生された再生画像データが現画像バッファ部１０７に蓄積される。
【００３４】
また、インター予測符号化データである場合、符号読取部１０１に読み取られた予測データは、動き補償部１０２に与えられ、動き補償部１０２により参照画像データに加算され復号画像データが形成され、再生された再生画像データが現画像バッファ部１０７に蓄積される。
【００３５】
現画像バッファ部１０７に蓄積された復号画像データは、フレーム内拡張部１０８に与えられ、フレーム内拡張部１０８により超解像処理のフレーム内拡張処理が行なわれる。そして、フレーム内拡張部１０８により拡張された復号画像データは拡張画像として拡張画像バッファ部１０９に蓄積される。
【００３６】
インター予測符号化データの場合、符号読取部１０１により読み取られた各インターブロックの係数データは、係数判定部１０５に与えられ、係数判定部１０５により絶対値化される。
【００３７】
そして、各インターブロックの係数データの絶対値は係数判定部１０５により閾値と比較され、インターブロックの係数データの絶対値がすべて閾値より小さいとき、有効とする判定結果が係数判定部１０５からフレーム間拡張部１１０に与えられる。一方、そうでないとき、無効とする判定結果が係数判定部１０５からフレーム間拡張部１１０に与えられる。
【００３８】
係数判定部１０５からの判定結果がフレーム間拡張部１１０に与えられると、フレーム間拡張部１１０は係数判定部１０５からの判定結果に応じて超解像処理のフレーム間拡張処理をするか否かを判断する。
【００３９】
すなわち、判定結果が有効ならば、フレーム間拡張部１１０は、拡張画像バッファ部１０９から１フレーム前の拡張された復号画像データと現在の拡張された復号画像データを受け取り、また符号読取部１０１から予測データを受け取りＭＰＥＧデータの動きベクトルを超解像処理のフレーム間拡張の動きベクトルとして使用し超解像処理を行なう。そして、フレーム間拡張部１１０によりフレーム間拡張処理がなされた画像データは、表示部１１１に与えられて出力表示される。
【００４０】
一方、判定結果が無効ならば、フレーム間拡張部１１０は、拡張画像バッファ部１０９から１フレーム前の拡張された復号画像データを受け取り、超解像処理のフレーム間拡張を行なわず、その復号画像データを表示位置１１１に画像データを与え、出力表示させる。
【００４１】
（Ａ－３）第１の実施形態の効果
以上のように、第１の実施形態によれば、動き探索を行なわずに超解像処理のフレーム間処理を行なうことができるため、処理量の軽減が期待できる。さらに超解像処理における各動きベクトルの有効性の判定を残差信号を各画素について判定するかわりに符号化周波数係数の絶対値で判定するため、高速化を期待することができるのである。
【００４２】

（Ｂ）他の実施形態

上述した第１の実施形態で説明した機能は、ＣＰＵ等のハードウェアの実行によるソフトウェア処理により実現することができる。また、ハードウェアとして実現してもよい。

【００４３】

上述した第１の実施形態において、係数判定部１０５は、係数データの絶対値を取り、係数データの絶対値と閾値の比較により判定することとしたが、係数データの大きさに基づいて判定することができれば、係数データの２乗値に基づいて判定してもよいし、これ以外の演算結果に基づいて判定してもよい。

【図面の簡単な説明】

【００４４】

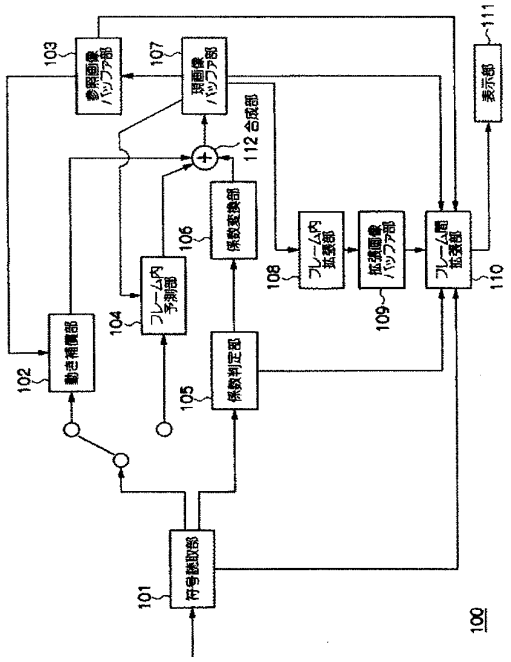
【図１】第１の実施形態の画像装置の内部構成を示すブロック図である。

【符号の説明】

【００４５】

１００…画像装置、１０１…符号読取部、１０２…動き補償部、１０３…参照画像バッファ部、１０４…フレーム内予測部、１０５…係数判定部、１０６…係数変換部、１０７…現画像バッファ部、１０８…フレーム内拡張部、１０９…拡張画像バッファ部、１１０…フレーム間拡張部、１１１…表示部、１１２…合成部。

【図１】



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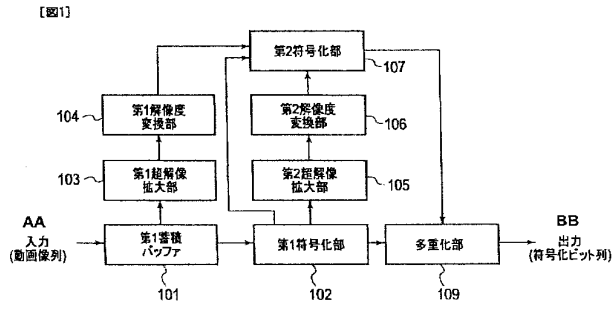
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(54) **Title**: DYNAMIC IMAGE ENCODER, DYNAMIC IMAGE ENCODING METHOD, DYNAMIC IMAGE ENCODING PROGRAM, DYNAMIC IMAGE DECODER, DYNAMIC IMAGE DECODING METHOD, DYNAMIC IMAGE DECODING PROGRAM, DYNAMIC IMAGE RE-ENCODER, DYNAMIC IMAGE RE-ENCODING METHOD, DYNAMIC IMAGE RE-ENCODING PROGRAM

(54) 発明の名称: 動画像符号化装置、動画像符号化方法、動画像符号化プログラム、動画像復号装置、動画像復号方法、動画像復号プログラム、動画像再符号化装置、動画像再符号化方法、動画像再符号化プログラム



101 FIRST STORAGE BUFFER
102 FIRST ENCODER
103 FIRST SUPER-RESOLUTION IMAGE ENLARGEMENT UNIT
104 FIRST RESOLUTION CONVERTER
105 SECOND SUPER-RESOLUTION IMAGE ENLARGEMENT UNIT
106 SECOND RESOLUTION CONVERTER
107 SECOND ENCODER
109 MULTIPLEXER
AA INPUT (DYNAMIC IMAGE SEQUENCE)
BB OUTPUT (ENCODED BIT STREAM)

(57) **Abstract**: A first super-resolution image enlargement unit (103) includes frequency component information in the spatial direction and the temporal direction which could not be adequately displayed at the standard resolution although latently included in the input dynamic image by applying a super-resolution enlargement process to an input dynamic image having standard resolution. A first resolution converter (104) returns the signal which has undergone super-resolution image enlargement to the standard resolution. A second encoder (107) encodes the signal which has undergone super-resolution enlargement and which was returned to the standard resolution. A first encoder (102) encodes the input dynamic image having the standard resolution. A multiplexer (109) multiplexes the encoded bit stream from the first encoder (102) and the encoded bit stream from the second encoder (107). The second encoder (107) may use the locally decoded signal at the first encoder (102) or a processed version of that signal as the reference signal.

(57) 要約:

[続葉有]

DESCRIPTION

MOVING PICTURE ENCODING SYSTEM, MOVING PICTURE ENCODING METHOD, MOVING PICTURE ENCODING PROGRAM, MOVING PICTURE DECODING SYSTEM, MOVING PICTURE DECODING METHOD, MOVING PICTURE DECODING PROGRAM, MOVING PICTURE REENCODING SYSTEM, MOVING PICTURE REENCODING METHOD, AND MOVING PICTURE REENCODING PROGRAM

Technical Field

[0001]

The present invention relates to a moving picture encoding system, a moving picture encoding method, a moving picture encoding program, a moving picture decoding system, a moving picture decoding method, a moving picture decoding program, a moving picture reencoding system, a moving picture reencoding method, and a moving picture reencoding program adapted to work on moving picture sequences to implement processes such as those for super-resolution enlargement.

Background Art

[0002]

As conventional techniques to attain a spatial resolution scalability of pictures, there have been those implementing, in a hierarchical encoding system with two layers being a base layer and an enhancement layer, for instance, processing signals of pictures input with the same spatial resolution as the enhancement layer, for a decimation into a spatial resolution of the base layer, followed by an encoding at the base layer, making a prediction using a correlation between those signals decoded along with the base layer encoding and spatially interpolated as signals having the same spatial resolution as the enhancement layer and those signals of pictures input with the same spatial resolution as the enhancement layer, encoding signals of errors in the prediction, and having a combination of encoded bit streams obtained there and bit streams obtained by the base layer encoding, multiplexed and transmitted to a decoding system, the

multiplexed combination of encoded bit streams being decoded in reverse at the decoding system. (Refer to Patent Literature 1.)

Citation List

Patent Literature

[0003] PTL 1: Japanese Patent Application Laying-Open Publication No. 7-162870

Summary of the Invention

Technical Problem

[0004]

By the way, there are techniques for moving picture encoding services such as represented by MPEG-1, -2, and -4/AVC/ SVC specified to standardize under the ISO/IEC SC29WG11, including use of decoded pictures obtained by a local decoding as reference pictures for estimation of motions to create data on motion vectors, and use of data on motion vectors created by compensation of motions, to create such predictive pictures as having nearest image qualities to target pictures as encoding targets, followed by determining difference data between predictive pictures and target pictures, and implementing on the difference data a process for a prescribed encoding to attain a high efficient encoding making use of high correlations in the temporal direction. It is thus possible to have predictive pictures improved in image quality, and enhanced in correlation to target pictures, affording to expect more enhanced encoding efficiencies. However, failures to allot a sufficient code rate would cause deficiencies such as deficient precision of data on motion vectors or deficient attainment of the quality of images of locally decoded reference pictures, degrading image qualities of predictive pictures, resulting in reduced encoding efficiencies.

[0005]

Moreover, there are techniques for hierarchical encoding services on moving pictures represented by among others the above-noted Patent Literature 1and MPEG-4 SVC, which also include predictive pictures or predictive blocks created from reference pictures of a layer lower than the layer in which a current encoding is made, for use in combination with target pictures or target blocks of the current layer to make an inter-layer prediction in between, aiming at still enhanced encoding efficiencies making use of high correlations between different spatial

resolutions. However, like techniques making use of high correlations in the temporal direction, also those making use of high correlations between layers are subject to the problem that failures to allot a sufficient code rate would degrade image qualities of predictive pictures or predictive blocks, resulting in reduced encoding efficiencies.

[0006]

Further, they involve implementing a process for a prescribed resolution conversion on moving pictures input as encoding targets with a spatial resolution (referred herein to as a base or standard resolution), creating moving pictures with a resolution (referred herein to as a low resolution) lower than the standard resolution of the input moving pictures, to make a hierarchical encoding on moving pictures between two or more layers making use of high correlations between layers. However, in such the hierarchical encoding, even if the encoding process implemented was reversible, input moving pictures would undergo a band limitation to information on their spatial frequency components in the spatial direction that can be represented by the standard resolution, in addition to the implementation of a hierarchical encoding including a process to be implemented on the input moving pictures for such an encoding that involves decoded pictures obtained through a local decoding in course of hierarchical encoding, or by decoding bit streams encoded by way of hierarchical encoding, with image qualities nearest to those of input moving pictures under given encoding conditions, thus affording to make use of correlations between associated layers to estimate new information on spatial frequency components, while failing to encode and transmit more information on spatial frequency components than the information on spatial frequency components that can be represented by the standard resolution, as a problem.

[0007]

It therefore is an object of the present invention to provide a moving picture encoding system, a moving picture encoding method, and a moving picture encoding program adapted to encode and transmit more information on spatial frequency components than information on spatial frequency components that can be represented by a resolution of input moving pictures. It also is an object of the present invention to provide a moving picture decoding system, a moving picture decoding method, and a moving picture decoding program adapted to acquire and decode sequences of encoded bits created by a moving picture encoding system, a moving

picture encoding method, or a moving picture encoding program according to the present invention. It also is an object of the present invention to provide a moving picture reencoding system, a moving picture reencoding method, and a moving picture reencoding program adapted for a decoding followed by a re-encoding and a transmission.

Solution to Problem

[0008]

To solve the problems described, according to the present invention, there is a moving picture encoding system comprising, as illustrated in Fig. 9 for instance, a first encoder configured to work on a subsequence of a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution, a first super-resolution enlarger configured to work on the subsequence of the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution, a first resolution converter configured to work on the set of super-resolution enlarged pictures to implement a process for a first resolution conversion to create a set of super-resolution enlarged and converted pictures with the standard resolution, and a second encoder configured to have the set of super-resolution enlarged and converted pictures from the first resolution converter as a set of encoding target pictures to implement a second combination of processes for a prediction and an encoding to create a second sequence of encoded bits.

[0009]

Here, as illustrated in Fig. 7 for instance, it may well have the second encoder configured to have the set of decoded pictures from the first encoder as a set of reference pictures to implement the second combination of processes for the prediction and the encoding to create the second sequence of encoded bits.

[0010]

Further, as illustrated in Fig. 1 and 8 for instance, it may well comprise a second super-resolution enlarger configured to acquire the set of decoded pictures with the standard resolution from the first encoder to implement thereon a process for a second super-resolution

enlargement to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution, and a second resolution converter configured to work on the set of super-resolution enlarged decoded pictures to implement a process for a second resolution conversion to create a set of super-resolution enlarged and converted decoded pictures with the standard resolution, the second encoder being configured to have the set of super-resolution enlarged and converted decoded pictures from the second resolution converter as a set of reference pictures to implement the second combination of processes for the prediction and the encoding to create the second sequence of encoded bits.

[0011]

Further, as illustrated at (a) in Fig. 4 for instance, it may well have the first super-resolution enlarger comprising a positioner configured to work in a processing for super-resolution enlargement, on a combination of a base picture constituting a base therein and one or more observation pictures to be based on, to make a positioning to pixel positions of a desirable high resolution, for an interval-unequal sampling to create nonhomogeneous high resolution pictures, an interpolator configured to work on nonhomogeneous high resolution pictures created at the positioner, to implement a process for a prescribed nonhomogeneous interpolation to create interpolated pictures with a desirable high resolution, an estimated picture creator configured to acquire interpolated pictures created at the interpolator, to implement thereon a process for a prescribed reconstruction to create estimated pictures with a desirable resolution, and a repetition determiner configured to acquire a nonhomogeneous high resolution picture from the positioner and a nonhomogeneous estimated picture from the estimated picture creator, for employment of the acquired pictures to follow a prescribed determination method to determine whether or not a repetition of the processing for super-resolution enlargement is necessary, and work depending on a result thereof, to operate as the repetition is necessary, to provide the interpolator with information for a control to continue the processing, and operate as the repetition is unnecessary, to provide the estimated picture creator with information for a control to output a set of estimated pictures with a high resolution after super-resolution enlargement.

[0012]

Further, as illustrated in Fig. 1 or such for instance, it may well comprise a multiplexer configured to operate complying with a prescribed syntax structure to multiplex the first sequence of encoded bits from the first encoder, the second sequence of encoded bits from the second encoder, and information on encoding parameters of respective types used in the encoding at the first encoder and the encoding at the second encoder.

[0013]

Further, as illustrated in Fig. 10 for instance, it may well comprise a first accumulation buffer configured to work in a course before the first encoder and the first super-resolution enlarger, to accumulate subsequences of the sequence of moving pictures with the standard resolution, a second accumulation buffer configured to work in a course between the first encoder and the second encoder, to accumulate sets of decoded pictures from the first encoder, an accumulation controller configured to work for detections of buffer accumulation amounts at the first accumulation buffer, the second accumulation buffer, the first encoder, and the second encoder, to control the buffer accumulation amounts , and a code rate controller configured to work on bases of the detections of buffer accumulation amounts at the accumulation controller, to control code rates at the first encoder and the second encoder.

[0014]

Further, according to the present invention, there is a moving picture encoding system comprising, as illustrated in Fig. 13 for instance, a first encoder configured to work on a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution, a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution, a second super-resolution enlarger configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a second super-resolution enlargement to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution, a third resolution converter configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a third resolution conversion to create a set of resolution converted enlarged decoded

pictures with a resolution higher than the standard resolution, and a third encoder configured to have the set of super-resolution enlarged pictures from the first super-resolution enlarger as a set of encoding target pictures, employing the set of super-resolution enlarged decoded pictures from the second super-resolution enlarger and the set of resolution converted enlarged decoded pictures from the third resolution converter as sets of reference pictures, to implement thereon a third combination of processes for a prediction and an encoding to create a third sequence of encoded bits.

[0015]

Further, according to the present invention, there is a moving picture encoding system comprising, as illustrated in Fig. 16 for instance, a first encoder configured to work on a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution, a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution, a third resolution converter configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a third resolution conversion to create a set of resolution converted enlarged decoded pictures with a resolution higher than the standard resolution, and a third encoder configured to have the set of super-resolution enlarged pictures from the first super-resolution enlarger as a set of encoding target pictures, employing the set of resolution converted enlarged decoded pictures from the third resolution converter as a set of reference pictures, to implement thereon a third combination of processes for a prediction and an encoding to create a third sequence of encoded bits.

[0016]

Further, according to the present invention, there is a moving picture encoding system comprising, as illustrated in Fig. 17 for instance, a first encoder configured to work on a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution, a first super-resolution enlarger configured to

work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution, a second super-resolution enlarger configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a second super-resolution enlargement to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution, and a third encoder configured to have the set of super-resolution enlarged pictures from the first super-resolution enlarger as a set of encoding target pictures, employing the set of super-resolution enlarged decoded pictures from the second super-resolution enlarger as a set of reference pictures, to implement thereon a third combination of processes for a prediction and an encoding to create a third sequence of encoded bits.

[0017]

Further, according to the present invention, there is a moving picture encoding system comprising, as illustrated in Fig. 19 for instance, a first encoder configured to work on a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution, a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution, a first resolution converter configured to work on the set of super-resolution enlarged pictures to implement a process for a first resolution conversion to create a set of super-resolution enlarged and converted pictures with the standard resolution, a second super-resolution enlarger configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a second super-resolution enlargement to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution, a second resolution converter configured to work on the set of super-resolution enlarged decoded pictures from the second super-resolution enlarger to implement a process for a second resolution conversion to create a set of super-resolution enlarged and converted decoded pictures with the standard resolution, a second encoder configured to have the set of super-resolution enlarged and converted pictures from the first

resolution converter as a set of encoding target pictures, employing the set of decoded pictures from the first encoder and the set of super-resolution enlarged and converted decoded pictures with the standard resolution from the second resolution converter as sets of reference pictures, to implement thereon a second combination of processes for a prediction and an encoding to create a second sequence of encoded bits, a third resolution converter configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a third resolution conversion to create a set of resolution converted enlarged decoded pictures with a resolution higher than the standard resolution, and a third encoder configured to have the set of super-resolution enlarged pictures from the first super-resolution enlarger as a set of encoding target pictures, employing the set of super-resolution enlarged decoded pictures from the second super-resolution enlarger and the set of resolution converted enlarged decoded pictures from the third resolution converter as sets of reference pictures, to implement thereon a third combination of processes for a prediction and an encoding to create a third sequence of encoded bits.

[0018]

Further, according to the present invention, there is a moving picture encoding method comprising a step of implementing a first combination of processes for an encoding and a decoding on a sequence of moving pictures with a standard resolution, creating a first sequence of encoded bits and a set of decoded pictures with the standard resolution, a step of implementing a process for a first super-resolution enlargement on the sequence of moving pictures with the standard resolution, creating a set of super-resolution enlarged pictures with a resolution higher than the standard resolution, a step of implementing a process for a first resolution conversion on the set of super-resolution enlarged pictures, creating a set of super-resolution enlarged and converted pictures with the standard resolution, and a step of having the set of super-resolution enlarged and converted pictures as a set of encoding target pictures, implementing thereon a second combination of processes for a prediction and an encoding, creating a second sequence of encoded bits.

[0019]

Further, according to the present invention, there is a moving picture encoding program configured to have a computer execute a step of implementing a first combination of processes for an encoding and a decoding on a sequence of moving pictures with a standard

resolution, creating a first sequence of encoded bits and a set of decoded pictures with the standard resolution, a step of implementing a process for a first super-resolution enlargement on the sequence of moving pictures with the standard resolution, creating a set of super-resolution enlarged pictures with a resolution higher than the standard resolution, a step of implementing a process for a first resolution conversion on the set of super-resolution enlarged pictures, creating a set of super-resolution enlarged and converted pictures with the standard resolution, and a step of having the set of super-resolution enlarged and converted pictures as a set of encoding target pictures, implementing thereon a second combination of processes for a prediction and an encoding, creating a second sequence of encoded bits.

[0020]

Further, according to the present invention, there is a moving picture decoding system comprising, as illustrated in Fig. 26 for instance, a demultiplexer configured to work on a sequence of input encoded bits to implement a process for a prescribed demultiplexing to output sequences of encoded bits with a standard resolution, a first decoder configured to acquire a sequence of encoded bits obtained with the standard resolution at the demultiplexer to implement thereon a process for a prescribed decoding to create a sequence of decoded pictures with the standard resolution, a first super-resolution enlarger configured to acquire the sequence of decoded pictures created with the standard resolution at the first decoder to implement thereon a process for a prescribed super-resolution enlargement to create a sequence of super-resolution enlarged decoded pictures, a first resolution converter configured to acquire the sequence of super-resolution enlarged decoded pictures created at the first super-resolution enlarger to implement thereon a process for a prescribed resolution conversion to create a sequence of super-resolution decoded pictures with the standard resolution, and a second decoder configured to acquire a sequence of encoded bits obtained with an extension of the standard resolution at the demultiplexer, the sequence of decoded pictures created with the standard resolution at the first decoder, and the sequence of super-resolution decoded pictures created with the standard resolution at the first resolution converter, to implement thereon processes including a prescribed second decoding being a decoding with an extension of the standard resolution, to create a sequence of super-resolution pictures decoded with the standard resolution.

[0021]

Here, the moving picture decoding system may well comprise, as illustrated in Fig. 23 for instance, a second resolution converter configured to acquire the sequence of decoded pictures with the standard resolution from the decoder to implement thereon a process for a prescribed resolution conversion to create a sequence of enlarged decoded pictures with a high resolution as a resolution higher than the standard resolution, and a third decoder configured to acquire a sequence of encoded bits obtained with an extension of the high resolution at the demultiplexer, the sequence of super-resolution enlarged decoded pictures created at the super-resolution enlarger, and the sequence of enlarged decoded pictures with the high resolution from the second resolution converter, to implement thereon a combination of processes for a prescribed prediction and a prescribed decoding, to create a sequence of super-resolution enlarged pictures as decoded.

[0022]

Further, according to the present invention, there is a moving picture reencoding system comprising, as illustrated in Fig. 27 for instance, a demultiplexer configured to work on a sequence of input encoded bits to implement a process for a prescribed demultiplexing to output sequences of encoded bits with a standard resolution, a decoder configured to acquire a sequence of encoded bits obtained with the standard resolution at the demultiplexer to implement thereon a process for a prescribed decoding to create a sequence of decoded pictures with the standard resolution, a first super-resolution enlarger configured to acquire the sequence of decoded pictures created with the standard resolution at the decoder to implement thereon a process for a prescribed super-resolution enlargement to create a sequence of super-resolution enlarged decoded pictures, a first resolution converter configured to acquire the sequence of super-resolution enlarged decoded pictures created at the first super-resolution enlarger to implement thereon a process for a prescribed resolution conversion to create a sequence of super-resolution decoded pictures with the standard resolution, a second decoder configured to acquire a sequence of encoded bits obtained with an extension of the standard resolution at the demultiplexer, the sequence of decoded pictures created with the standard resolution at the above-noted decoder, and the sequence of super-resolution decoded pictures created with the standard resolution at the first resolution converter, to implement thereon a process for a

prescribed second decoding being a decoding with an extension of the standard resolution, to create a sequence of super-resolution pictures decoded with the standard resolution, a reencoder configured to acquire from the above-noted decoder information on coefficients of orthogonal transform in a course of decoding thereof, and from the second decoder information on coefficients of orthogonal transform in an extension layer of the standard resolution in a course of decoding thereof, to make a synthesis of respective information on coefficients of orthogonal transform and implement thereon a process for a prescribed entropy encoding to create a sequence of encoded bits as reencoded, and a multiplexer configured to acquire the sequence of encoded bits reencoded at the reencoder, to implement thereon a process for a multiplexing complying with a prescribed syntax structure, inserting encoding information inclusive of identification information for identification of information on encoding modes and parameters of respective types used, to create a sequence of encoded bits as multiplexed.

[0023]

Here, the moving picture reencoding system may well have the reencoder configured to acquire the sequence of decoded pictures with the standard resolution from the above-noted decoder, the sequence of super-resolution decoded pictures with the standard resolution from the first resolution converter, and the sequence of super-resolution pictures with the standard resolution from the second decoder, to implement thereon a process for a prescribed encoding to create a sequence of encoded bits as reencoded.

[0024]

Further, according to the present invention, there is a moving picture decoding method comprising a step of implementing a process for a prescribed demultiplexing on a sequence of input encoded bits, outputting sequences of encoded bits with a standard resolution, a step of acquiring a sequence of encoded bits obtained with the standard resolution through the process for the prescribed demultiplexing, implementing thereon a process for a prescribed decoding, creating a sequence of decoded pictures with the standard resolution, a step of acquiring the sequence of decoded pictures created with the standard resolution through the process for the above-noted prescribed decoding, implementing thereon a process for a prescribed super-resolution enlargement, creating a sequence of super-resolution enlarged decoded pictures, a step of acquiring the sequence of super-resolution enlarged decoded pictures created through

the process for the prescribed super-resolution enlargement, implementing thereon a process for a prescribed resolution conversion, creating a sequence of super-resolution decoded pictures with the standard resolution, and a step of acquiring a sequence of encoded bits obtained with an extension of the standard resolution through the process for the prescribed demultiplexing, the sequence of decoded pictures created with the standard resolution through the process for the above-noted prescribed decoding, and the sequence of super-resolution decoded pictures created with the standard resolution through the process for the prescribed resolution conversion, implementing thereon processes including a prescribed second decoding being a decoding with an extension of the standard resolution, creating a sequence of super-resolution pictures decoded with the standard resolution.

[0025]

Here, the moving picture decoding method may well comprise a step of acquiring the sequence of decoded pictures created with the standard resolution through the process for the above-noted prescribed decoding, implementing thereon a process for a prescribed resolution conversion, creating a sequence of enlarged decoded pictures with a high resolution as a resolution higher than the standard resolution, and a step of acquiring a sequence of encoded bits obtained with an extension of the high resolution through the process for the prescribed demultiplexing, the sequence of super-resolution enlarged decoded pictures created through the process for the prescribed super-resolution enlargement, and the sequence of enlarged decoded pictures created with the high resolution through the process for the prescribed resolution conversion, implementing thereon a combination of processes for a prescribed prediction and a prescribed decoding, creating a sequence of super-resolution enlarged pictures as decoded.

[0026]

Further, according to the present invention, there is a moving picture reencoding method comprising a step of implementing a process for a prescribed demultiplexing on a sequence of input encoded bits, a step of acquiring a sequence of encoded bits obtained with a standard resolution through the process for the prescribed demultiplexing, implementing thereon a process for a prescribed decoding, creating a sequence of decoded pictures with the standard resolution, a step of acquiring the sequence of decoded pictures created with the standard

resolution through the process for the above-noted prescribed decoding, implementing thereon a process for a prescribed super-resolution enlargement, creating a sequence of super-resolution enlarged decoded pictures, a step of acquiring the sequence of super-resolution enlarged decoded pictures created through the process for the prescribed super-resolution enlargement, implementing thereon a process for a prescribed resolution conversion, creating a sequence of super-resolution decoded pictures with the standard resolution, a step of acquiring a sequence of encoded bits obtained with an extension of the standard resolution through the process for the prescribed demultiplexing, the sequence of decoded pictures created with the standard resolution through the process for the above-noted prescribed decoding, and the sequence of super-resolution decoded pictures created with the standard resolution through the process for the prescribed resolution conversion, implementing thereon a process for a prescribed second decoding being a decoding with an extension of the standard resolution, creating a sequence of super-resolution pictures decoded with the standard resolution, a step of acquiring information on coefficients of orthogonal transform in a course of decoding in the process for the above-noted prescribed decoding, and information on coefficients of orthogonal transform in an extension layer of the standard resolution in a course of decoding in the process for the prescribed second decoding being a decoding with an extension of the standard resolution, making a synthesis of respective information on coefficients of orthogonal transform, implementing thereon a process for a prescribed entropy encoding, creating a sequence of encoded bits as reencoded, and a step of acquiring the sequence of encoded bits as reencoded, implementing thereon a process for a multiplexing complying with a prescribed syntax structure, inserting encoding information inclusive of identification information for identification of information on encoding modes and parameters of respective types used, creating a sequence of encoded bits as multiplexed.

[0027]

Further, according to the present invention, there is a moving picture decoding program configured to have a computer execute a step of implementing a process for a prescribed demultiplexing on a sequence of input encoded bits, outputting sequences of encoded bits with a standard resolution, a step of acquiring a sequence of encoded bits obtained with the standard resolution through the process for the prescribed demultiplexing, implementing thereon

a process for a prescribed decoding, creating a sequence of decoded pictures with the standard resolution, a step of acquiring the sequence of decoded pictures created with the standard resolution through the process for the above-noted prescribed decoding, implementing thereon a process for a prescribed super-resolution enlargement, creating a sequence of super-resolution enlarged decoded pictures, a step of acquiring the sequence of super-resolution enlarged decoded pictures created through the process for the prescribed super-resolution enlargement, implementing thereon a process for a prescribed resolution conversion, creating a sequence of super-resolution decoded pictures with the standard resolution, and a step of acquiring a sequence of encoded bits obtained with an extension of the standard resolution through the process for the prescribed demultiplexing, the sequence of decoded pictures created with the standard resolution through the process for the above-noted prescribed decoding, and the sequence of super-resolution decoded pictures created with the standard resolution through the process for the prescribed resolution conversion, implementing thereon processes including a prescribed second decoding being a decoding with an extension of the standard resolution, creating a sequence of super-resolution pictures decoded with the standard resolution.

[0028]

Further, according to the present invention, there is a moving picture reencoding program configured to have a computer execute a step of implementing a process for a prescribed demultiplexing on a sequence of input encoded bits, a step of acquiring a sequence of encoded bits obtained with a standard resolution through the process for the prescribed demultiplexing, implementing thereon a process for a prescribed decoding, creating a sequence of decoded pictures with the standard resolution, a step of acquiring the sequence of decoded pictures created with the standard resolution through the process for the above-noted prescribed decoding, implementing thereon a process for a prescribed super-resolution enlargement, creating a sequence of super-resolution enlarged decoded pictures, a step of acquiring the sequence of super-resolution enlarged decoded pictures created through the process for the prescribed super-resolution enlargement, implementing thereon a process for a prescribed resolution conversion, creating a sequence of super-resolution decoded pictures with the standard resolution, a step of acquiring a sequence of encoded bits obtained with an extension of the standard resolution through the process for the prescribed demultiplexing, the sequence of

decoded pictures created with the standard resolution through the process for the above-noted prescribed decoding, and the sequence of super-resolution decoded pictures created with the standard resolution through the process for the prescribed resolution conversion, implementing thereon a process for a prescribed second decoding being a decoding with an extension of the standard resolution, creating a sequence of super-resolution pictures decoded with the standard resolution, a step of acquiring information on coefficients of orthogonal transform in a course of decoding in the process for the above-noted prescribed decoding, and information on coefficients of orthogonal transform in an extension layer of the standard resolution in a course of decoding in the process for the prescribed second decoding being a decoding with an extension of the standard resolution, making a synthesis of respective information on coefficients of orthogonal transform, implementing thereon a process for a prescribed entropy encoding, creating a sequence of encoded bits as reencoded, and a step of acquiring the sequence of encoded bits as reencoded, implementing thereon a process for a multiplexing complying with a prescribed syntax structure, inserting encoding information inclusive of identification information for identification of information on encoding modes and parameters of respective types used, creating a sequence of encoded bits as multiplexed.

Advantageous Effects of the Invention

[0029]

According to the present invention, there are systems such as a moving picture encoding system, having a first encoder working for services to encode moving pictures input with a standard resolution, in combination with a first super-resolution enlarger working on moving pictures input with the standard resolution, implementing a process for a super-resolution enlargement including information on frequency components in the spatial direction and the temporal direction that has been potentially contained in the input moving pictures but unable to express to a sufficient degree by the standard resolution, followed by implementing processes such as for a prescribed resolution conversion at a first resolution converter, thus permitting a second encoder to make an encoding of moving pictures based on an increased amount of information relative to an information amount of moving pictures input with the standard resolution, as a resultant effect. At the second encoder, as reference signals for the encoding there may be use of, among others, decoded signals as decoded at the first

encoder or as additionally processed through processes such as for a second super-resolution enlargement and a second resolution conversion.

[0030]

Moreover, according to the present invention, there are systems such as a moving picture encoding system, having a first encoder working for services to encode moving pictures input with a standard resolution, in combination with a first super-resolution enlarger working on moving pictures input with the standard resolution, implementing a process for a super-resolution enlargement including information on frequency components in the spatial direction and the temporal direction that has been potentially contained in the input moving pictures but unable to express to a sufficient degree by the standard resolution, followed by an encoding of thus obtained signals at a third encoder, permitting the third encoder to make an encoding of moving pictures based on an increased amount of information relative to an information amount of moving pictures input with the standard resolution, as a resultant effect. At the third encoder, as reference signals for the encoding there may be use of decoded signals as decoded at the first encoder and processed through processes such as for a second super-resolution enlargement or a third resolution conversion to enhance the resolution up to the same resolution as first super-resolution enlarged signals. Still more, according to the present invention, there are systems such as a moving picture decoding system, adapted to input thus encoded moving pictures to decode, and yet more, according to the present invention, there are systems such as a moving picture reencoding system,. adapted to input thus encoded moving pictures to decode and reencode.

Brief Description of Drawings

[0031]

[Fig. 1] Fig. 1 is a block diagram showing an example of basic configuration of a moving picture encoding system according to a first embodiment of the present invention.

[Fig. 2] Fig. 2 is a flowchart of actions of the moving picture encoding system according to the first embodiment.

[Fig. 3] Fig. 3 is a diagram of data format illustrating an example of structure of a multiplexed bit sequence created at a multiplexer 109 in the first embodiment.

[Fig. 4] Fig. 4 is a combination of a block diagram showing an example of detailed configuration of a first super-resolution enlarger 103 in the first embodiment, and conceptual diagrams illustrating an example of process for a prescribed super-resolution enlargement to be implemented at the first super-resolution enlarger 103.

[Fig. 5] Fig. 5 is a flowchart of actions of the first super-resolution enlarger 103 in the first embodiment.

[Fig. 6] Fig. 6 is a combination of a block diagram showing an example of detailed structure of a first resolution converter 104 in the first embodiment, and conceptual diagrams illustrating an example of process for a prescribed resolution conversion to be implemented at the first resolution converter 104.

[Fig. 7] Fig. 7 is a block diagram showing an example of configuration of a moving picture encoding system according to a second embodiment.

[Fig. 8] Fig. 8 is a block diagram showing another example of configuration of the moving picture encoding system according to the second embodiment.

[Fig. 9] Fig. 9 is a block diagram showing still another example of configuration of the moving picture encoding system according to the second embodiment.

[Fig. 10] Fig. 10 is a block diagram showing an example of configuration of a moving picture encoding system according to a third embodiment.

[Fig. 11] Fig. 11 is a block diagram showing an example of configuration of a first encoder 403 in the third embodiment.

[Fig. 12] Fig. 12 is a block diagram showing an example of configuration of a first decoder 404 in the third embodiment.

[Fig. 13] Fig. 13 is a block diagram showing an example of configuration of a moving picture encoding system according to a fourth embodiment.

[Fig. 14] Fig. 14 is a flowchart of exemplary actions of the moving picture encoding system according to the fourth embodiment.

[Fig. 15] Fig. 15 is a diagram of data format illustrating an example of structure of a multiplexed bit sequence created at a multiplexer 109 in the fourth embodiment.

[Fig. 16] Fig. 16 is a block diagram showing an example of configuration of a moving picture encoding system according to a fifth embodiment.

[Fig. 17] Fig. 17 is a block diagram showing another example of configuration of the moving picture encoding system according to the fifth embodiment.

[Fig. 18] Fig. 18 is a block diagram showing an example of configuration of a moving picture encoding system according to a sixth embodiment.

[Fig. 19] Fig. 19 is a block diagram showing an example of configuration of a moving picture encoding system according to a seventh embodiment.

[Fig. 20] Fig. 20 is a flowchart of exemplary actions of the moving picture encoding system according to the seventh embodiment.

[Fig. 21] Fig. 21 is a diagram of data format illustrating an example of structure of a multiplexed bit sequence created at a multiplexer 109 in the seventh embodiment.

[Fig. 22] Fig. 22 is a block diagram showing an example of configuration of a moving picture encoding system according to an eighth embodiment.

[Fig. 23] Fig. 23 is a block diagram showing an example of configuration of a moving picture decoding system according to a ninth embodiment.

[Fig. 24] Fig. 24 is a flowchart of exemplary actions of the moving picture decoding system according to the ninth embodiment.

[Fig. 25] Fig. 25 is a flowchart showing an example of operational procedure of a process for a decoding at a standard resolution at a step S602 in Fig. 24.

[Fig. 26] Fig. 26 is a block diagram showing an example of configuration of a moving picture decoding system according to a tenth embodiment.

[Fig. 27] Fig. 27 is a block diagram showing an example of configuration of a moving picture reencoding system according to an eleventh embodiment.

[Fig. 28] Fig. 28 is a flowchart of exemplary actions of the moving picture reencoding system according to the eleventh embodiment.

Description of Embodiments

[0032]

(First Embodiment)

Fig. 1 is a block diagram showing an example of configuration of a moving picture encoding system according to a first embodiment of the present invention.

[0033]

Referring to Fig. 1, the moving picture encoding system according to the first embodiment includes a first accumulation buffer 101, a first encoder 102, a first super-resolution enlarger 103, a first resolution converter 104, a second super-resolution enlarger 105, a second resolution converter 106, a second encoder 107, and a multiplexer 109.

[0034]

The first accumulation buffer 101 is configured for functions to work on moving pictures input as an input, to accumulate two or more pictures as necessary to implement later-described processes for a prescribed pre-super-resolution encoding and a first super-resolution enlargement, and supply the first encoder 102, the first super-resolution enlarger 103, and the like with pictures they require.

[0035]

The first encoder 102 is configured for functions to acquire from the first accumulation buffer 101 a set of pictures with a standard resolution required for a process for a prescribed encoding, and work on pictures acquired with the standard resolution to implement the process for the prescribed encoding (referred herein to as a process for a pre-super-resolution encoding), to create a first sequence of encoded bits, to supply the first sequence of encoded bits thus created to the multiplexer 109. The first encoder 102 is configured for functions to implement a process for a prescribed decoding, to supply decoded pictures to the second super-resolution enlarger 105 and the second encoder 107. The first encoder 102 may well be configured for functions to temporarily store decoded pictures. There may be a configuration to implement the process for the prescribed decoding as a decoding process on the first sequence of encoded bits as created to create decoded pictures. There may be configuration for use of a process for a local decoding constituting part of the process for the prescribed encoding to employ results of the local decoding to create pictures decoded therefrom.

[0036]

The first super-resolution enlarger 103 is configured for functions to acquire from the first accumulation buffer 101 two or more pictures with the standard resolution, as necessary for a process for a prescribed super-resolution enlargement, and work on pictures acquired with the standard resolution to implement the process for the prescribed super-resolution enlargement, to

create super-resolution enlarged pictures with a resolution higher than the standard resolution, and supply thus created super-resolution enlarged pictures to the first resolution converter 104. There may be configuration with a function to have a ratio of enlargement set up upon implementation of the process for the prescribed super-resolution enlargement as preset information on a prescribed enlargement ratio, or as acquired information on enlargement ratio such as set up by an external user, and work on the basis of acquired information on enlargement ratio to establish an enlargement ratio to implement the process for the prescribed super-resolution enlargement. More preferably, to provide information on the prescribed enlargement ratio to a decoding system end, there should be use of a configuration to implement an ushown process for a prescribed entropy encoding, to create a bit sequence of information on enlargement ratio, to supply to the multiplexer 109, to transmit to that end. In this regard, there should be use of similar configuration for the second super-resolution enlarger 105 also. The first super-resolution enlarger 103 and the second super-resolution enlarger 105 have their configurations and actions, of which detailed examples will be described with reference to Fig. 4.

[0037]

The first resolution converter 104 is configured for functions to acquire super-resolution enlarged pictures from the first super-resolution enlarger 103, and work on acquired super-resolution enlarged pictures to implement a process for a prescribed resolution conversion to create, from the super-resolution enlarged pictures having a resolution higher than the standard resolution, a set of pictures (as a set of super-resolution enlarged and converted pictures) such as having the standard resolution for instance, to supply to the second encoder 107.

[0038]

The second super-resolution enlarger 105 is configured for functions to acquire from the first encoder 102 two or more decoded pictures with the standard resolution, as necessary for a process for a prescribed super-resolution enlargement, and work on pictures acquired with the standard resolution to implement the process for the prescribed super-resolution enlargement, to create super-resolution enlarged decoded pictures with a resolution higher than the standard resolution, and supply thus created super-resolution enlarged decoded pictures to the second

resolution converter 106. Like the first super-resolution enlarger 103, there may be configuration with a function to have a ratio of enlargement set up upon implementation of the process for the prescribed super-resolution enlargement as preset information on a prescribed enlargement ratio, or as acquired information on enlargement ratio such as set up by an external user, and work on the basis of acquired information on enlargement ratio to establish an enlargement ratio to implement the process for the prescribed super-resolution enlargement. It is noted that the resolution after enlargement at the second super-resolution enlarger 105 may be equal to or different from the resolution after enlargement at the first super-resolution enlarger 103.

[0039]

The second resolution converter 106 is configured for functions to acquire super-resolution enlarged decoded pictures from the second super-resolution enlarger 105, and work on acquired super-resolution enlarged decoded pictures to implement a process for a prescribed resolution conversion to create, from the super-resolution enlarged decoded pictures having a resolution higher than the standard resolution, a set of super-resolution decoded pictures (as a set of super-resolution enlarged and converted decoded pictures) such as having the standard resolution for instance, to supply to the second encoder 107. There may be configuration with a function to have a ratio of resolution conversion set up upon implementation of the process for the prescribed resolution conversion as preset information on a prescribed resolution conversion ratio, or as acquired information on resolution conversion ratio such as set up by an external user, and work on the basis of acquired information on resolution conversion ratio to establish a resolution conversion ratio to implement the process for the prescribed resolution conversion. More preferably, to provide information on the resolution conversion ratio, there should be use of a configuration to implement an ushown process for a prescribed entropy encoding, to create a bit sequence of information on resolution conversion ratio, to supply to the multiplexer 109.

[0040]

The second encoder 107 is configured for functions to have super-resolution enlarged and converted signals of input pictures with the standard resolution from the first resolution converter 104 as encoding target pictures, decoded pictures from the first encoder 102 as first

reference pictures, and super-resolution enlarged and converted signals of decoded pictures with the standard resolution from the second resolution converter 106 as second reference pictures, and implement thereon a combination of processes for a prescribed prediction and a second encoding, to create a second sequence of encoded bits, and supply the multiplexer 109 with the second sequence of encoded bits thus created.

[0041]

For a reference picture to be used in a process for the prescribed prediction at the second encoder 107, there may be a configuration to employ either a first reference picture obtained from a decoded picture or a second reference picture obtained from a super-resolution enlarged and converted decoded picture, to create a predictive picture, and subtract the predictive picture from a target picture, to create a data on a difference in between.

[0042]

There may be a configuration involved to create a difference data from a target picture, using neither first reference picture nor second reference picture.

[0043]

For control to make a selection of reference picture for each picture or for each set of a prescribed number of pictures, the second encoder 107 may be configured to create a set of data on the selection of reference picture to identify a first reference picture or a second reference picture whichever is used, and implement thereon a process for a prescribed entropy encoding using an unshown entropy encoder to create a sequence of encoded bits of data on the reference picture selection, to supply to the multiplexer 109. There are sequences of encoded bits of data on reference picture selection, multiplexed as a bit sequence 310 of data on encoding parameters constituting part of a multiplexed bit sequence 300, as will be described later on. There may be use of combination of target pictures each respectively divided with no spaces left into regions of a prescribed area and first and second reference pictures likewise divided with no spaces left into regions of a prescribed area, to operate for each commensurate region to identify a first reference picture or a second reference picture whichever is selective to create a predictive picture, and subtract the predictive picture from a target picture, to create a data on a difference in between. There may be operations made for each region of a prescribed area to have data for identification of which reference picture has been used, as data on reference picture selection,

and implement thereon a process for a prescribed entropy encoding using an unshown entropy encoder, to create, and supply to the multiplexer 109, a resultant sequence of encoded bits of data on reference picture selection. There may well be regions of a prescribed area shaped as regions of a prescribed rectangular form, or as regions of an arbitrary form conforming to a prescribed domain division.

[0044]

The second encoder 107 may be configured for combination of a set of operations to subtract a first reference picture as a predictive picture from an encoding target picture, to obtain a data on a difference in between as a first difference data, and implement thereon a process for a prescribed second encoding to create a first sequence of bits encoded by the second encoding, a set of operations to subtract a second reference picture as a predictive picture from the encoding target picture, to obtain a data on a difference in between as a second difference data, and implement thereon the process for the prescribed second encoding to create a second sequence of bits encoded by the second encoding, and a set of operations to create a data on difference simply from the encoding target picture, using neither first reference picture nor second reference picture, to use as a third difference data, and implement thereon the process for the prescribed second encoding to create a third sequence of bits encoded by the second encoding, to provide the multiplexer 109 with thus created first to third sequences of bits encoded by second encoding. There are data on methods for selection of respective types of reference pictures and data on encoding methods as described, which may be collected as data on reference picture selection modes and as data on encoding modes for the second encoding, respectively, and processed by implementing thereon a process for a prescribed entropy encoding using an unshown entropy encoder, to supply to the multiplexer 109.

[0045]

The second encoder 107 may be configured to execute an encoding in the CGS (Coarse Grain Scalability) layer under MPEG-4 SVC for instance, and work for sequences of moving pictures equal in spatial resolution to the spatial resolution of sequences of moving pictures having a standard resolution at the first encoder 102, to operate complying with a prescribed syntax structure meeting the restraining conditions to facilitate a conversion from SVC to AVC in terms of the AVC rewriting by the JVT (Joint Video Team) being a joint group

of MPEG and ITU-T, to make the second encoding for creation of second encoded bit sequences. This configuration permits the second encoder 107 to create second encoded bit sequences, as sequences of such encoded bits that afford to make the conversion from the encoding format of SVC that is a hierarchical encoding to the encoding format of AVC that is a single layer encoding, without the need of making such a reencoding that involves a combination of complete decoding and encoding.

[0046]

The multiplexer 109 is configured for functions to acquire from the first encoder 102 a first sequence of encoded bits and from the second encoder 107 a second sequence of encoded bits, and operate complying with a prescribed syntax structure to implement a process of multiplexing the first sequence of encoded bits, the second sequence of encoded bits, and sequences of encoded bits of associated data covering sets of data on encoding parameters of respective types used in encoding processes, involving data on motion vectors and data on quantizing parameters, encompassing data on the above-noted reference picture selection and the like, as well as sets of data on encoding modes or such, as they are each respectively processed through an unshown entropy encoder, while inserting identification data for their identification, to create a sequence of bits multiplexed as illustrated in Fig. 3 that will be described later on. The multiplexer 109 may well be configured for functions to additionally acquire data on modes of reference picture selection and data on reference picture selection as prepared at the second encoder 107 in the form of sequences of encoded bits encoded through an unshown entropy encoder, and implement thereon a process for a multiplexing to create a sequence of bits multiplexed as described above.

[0047]

According to the present embodiment, there is a system including the foregoing configurations and adapted to work on input moving pictures, to implement a process for a prescribed super-resolution enlargement and a process for a prescribed resolution conversion, creating super-resolution enlarge and converted signals of moving pictures input with a standard resolution, to make use of them allowing for a moving picture encoding based on an increased amount of information relative to an information amount of input moving pictures. It is noted that between the first super-resolution enlarger 103 and the second super-resolution enlarger 105,

the enlargement ratios applied may not be always equal to each other. Likewise, between the first resolution converter 104 and the second resolution converter 106, the resolution conversion ratios applied may not be always equal to each other. However, for configuration in Fig. 1, there should be resolution conversion ratios established for the first resolution converter 104 and the second resolution converter 106 to have a spatial resolution after their processes for resolution conversion, equalized to the standard resolution.

[0048]

Description is now made of actions of the moving picture encoding system according to the first embodiment shown in Fig. 1, with reference to a flowchart of Fig. 2.

[0049]

First, the first accumulation buffer 101 stores therein input moving pictures, as necessary in number of pictures for the first super-resolution enlarger 103 to implement a process for a first super-resolution enlargement (step S201).

[0050]

The first super-resolution enlarger 103 acquires from the first accumulation buffer 101 two or more pictures, as necessary for a process for a prescribed super-resolution enlargement, and implements thereon the process for the prescribed super-resolution enlargement (step S202), whereby it creates super-resolution enlarged pictures with a resolution higher than a standard resolution that input moving pictures have as a spatial resolution thereof, to supply to the first resolution converter 104. For the first super-resolution enlarger 103, specific configurations as well as contents of the process for super-resolution enlargement will be described later on.

[0051]

After that, the first resolution converter 104 acquires super-resolution enlarged pictures from the first super-resolution enlarger 103, and implements thereon a process for a prescribed resolution conversion (step S203), whereby it creates super-resolution enlarged and converted signals of pictures input with the standard resolution, and supplies the second encoder 107 with thus created super-resolution enlarged and converted signals of pictures input with the standard resolution.

[0052]

After that, the second encoder 107 acquires super-resolution enlarged and converted signals of input pictures with the standard resolution from the first resolution converter 104, storing them in a prescribed buffer for temporary accumulation (step S204).

[0053]

On the other hand, the first encoder 102 acquires from the first accumulation buffer 101 a sequence of moving pictures with the standard resolution as necessary for implementation of a process for a prescribed pre-super-resolution encoding, and implements thereon a process for an encoding and a decoding at the standard resolution (step S205), whereby it creates a first sequence of encoded bits with the standard resolution as a result of the encoding process, and a set of decoded pictures with the standard resolution as a result of the decoding. After that, the first encoder 102 works to supply the first sequence of encoded bits thus created to the multiplexer 109, and further to supply the set of decoded pictures thus created to the second super-resolution enlarger 105 and the second encoder 107.

[0054]

After that, the second encoder 107 acquires the set of decoded pictures from the first encoder 102, storing in a prescribed buffer for temporary accumulation (step S206).

[0055]

After that, the second super-resolution enlarger 105 works like the first super-resolution enlarger 103, to acquire the set of decoded pictures from the first encoder 102, and implement thereon a process for a prescribed super-resolution enlargement (step S207), whereby it creates a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution, to supply to the second resolution converter 106.

[0056]

After that, the second resolution converter 106 acquires the set of super-resolution enlarged decoded pictures from the second super-resolution enlarger 105, and implements thereon a process for a prescribed resolution conversion (step S208), whereby it creates super-resolution enlarged and converted signals of decoded pictures with the standard resolution, to supply to the second encoder 107.

[0057]

After that, the second encoder 107 acquires super-resolution enlarged and converted signals of decoded pictures with the standard resolution from the second resolution converter 106, storing them in a prescribed buffer for temporary accumulation (step S209).

[0058]

The combination of processes associated with steps S202 to S204 and the combination of processes associated with steps S205 to S209 may be implemented in parallel, or in series with either ahead in execution.

[0059]

With the combinations of processes at steps S202 to S209 completed, the second encoder 107 has a set of encoding target pictures in the form of super-resolution enlarged and converted signals of input pictures as they are input pictures having undergone the first combination of super-resolution enlargement and resolution conversion through the first super-resolution enlarger 103 and the first resolution converter 104, a set of first reference pictures in the form of decoded pictures as they are input pictures having been simply encoded and decoded at the first encoder 102, and a set of second reference pictures in the form of super-resolution enlarged and converted signals of decoded pictures as they are those decoded pictures having undergone the second combination of super-resolution enlargement and resolution conversion through the second super-resolution enlarger 105 and the second resolution converter 106, and implements thereon a process for a prescribed second prediction (step S210), whereby the second encoder 107 creates a set of difference data at the standard resolution. After that, the second encoder 107 works on the set of difference data thus created to implement a second encoding process as a process for a prescribed second encoding (step S211), whereby it creates a second sequence of encoded bits, to supply to the multiplexer 109.

[0060]

After that, the multiplexer 109 acquires a first sequence of encoded bits from the first encoder 102 and a second sequence of encoded bits from the second encoder 107. Then, complying with a prescribed syntax structure, it implements a process of multiplexing the first sequence of encoded bits, the second sequence of encoded bits, and sequences of encoded bits of associated data covering sets of data on encoding parameters used in encoding processes, involving data on motion vectors, data on quantizing parameters, and data on reference picture

selection, as they area each respectively processed through an unshown entropy encoder, while inserting identification data for identification of a set of subsequent sequences of encoded bits and the like (step S212), to create a sequence of multiplexed bits. The present embodiment involves a series of actions to be complete through the foregoing steps.

[0061]

According to the present invention, there is a moving picture encoding system operable through execution of such the steps to create sequences of encoded bits as necessary.

[0062]

Fig. 3 illustrates an example of multiplexed bit sequence 300 to be output from the multiplexer 109.

[0063]

As illustrated in Fig. 3, the multiplexed bit sequence 300 is comprised of multiplexed information including a bit sequence 310 of data on encoding parameters, a first sequence 320 of encoded bits from the first encoder 102, and a second sequence 330 of encoded bits from the second encoder 107.

[0064]

The bit sequence 310 of data on encoding parameters has sequences of encoded bits stored therein to define data on encoding parameters of respective types that among others the first encoder 103 and the second encoder 107 have employed in their encoding processes, involving data on motion vectors, data on quantizing parameters, data on associated encoding modes, and data on the above-noted selection of reference pictures and reference picture selection modes, and a bit sequence 311 of identification data inserted to identify the first sequence of encoded bits 320 and the second sequence of encoded bits 330 as multiplexed in the multiplexed bit sequence 300. Such the configuration of multiplexed bit sequence 300 is a simple example, and there may be another example of configuration to have those data required over an entirety of encoding and stored in a bit sequence 310 of data on encoding parameters, those data employed at the first encoder 102 as inherent information to the first encoder 102 and stored in a first sequence of encoded bits 320, and those data employed at the second encoder 107 as inherent information to the second encoder 107 and stored in a second sequence of encoded bits 330.

[0065]

There have been operations described as being parallel processes according to the present embodiment, while those processed in parallel may well be consecutively processed in a configuration operable according to the present embodiment.

[0066]

According to the present embodiment, there may well be operations to keep the first super-resolution enlarger 103 and the first resolution converter 104 from working, to supply pictures input with the standard resolution and stored in the first accumulation buffer 101, as super-resolution enlarged and converted signals of input pictures with the standard resolution, to the second encoder 107, to implement thereon a process for a prescribed second encoding at the second encoder 107 in a configuration operable according to the present embodiment.

[0067]

Like this, the provision of a first super-resolution enlarger 103 and a second super-resolution enlarger 105 combined with the provision of a first resolution converter 104 and a second resolution converter 106 affords for services on super-resolution enlarged pictures that are defined with the same standard resolution as input pictures but have information on spatial and temporal frequency components increased by a process for a first super-resolution enlargement, to implement a process for a first resolution conversion that limits the frequency band within a range of desirable frequency components, to create super-resolution enlarged and converted signals of input pictures with the standard resolution.

[0068]

Thus created super-resolution enlarged and converted signals of input pictures with the standard resolution afford for services on the super-resolution enlarged pictures created with greater amounts of information on frequency components than input moving pictures have, to take in therefrom information on frequency components within a band of frequencies up to an uppermost one that can be expressed by spatial frequencies on the standard resolution, into the super-resolution enlarged and converted signals of input pictures with the standard resolution, thus permitting information amounts of frequency components that input moving pictures have to be extended, to implement a process for a moving picture encoding to create a first sequence of encoded bits with the standard resolution and a second sequence of encoded bits with the

standard resolution, allowing for a moving picture encoding to be implemented on bases of information amounts greater than information amounts that input moving pictures have.

[0069]

Further, it is afforded to provide services on moving pictures input with the standard resolution, to implement a combination of processes for prescribed encoding and decoding to create decoded pictures with the standard resolution. Still more, it is afforded to provide services on the decoded pictures with the standard resolution, to implement a process for a prescribed second super-resolution enlargement, creating super-resolution enlarged decoded pictures with a resolution higher than the standard resolution, having increased information on spatial and temporal frequency components, and implement a process for a prescribed second resolution conversion on thus created super-resolution enlarged decoded pictures, creating super-resolution enlarged and converted signals of decoded pictures with the standard resolution. Yet more, it is afforded to have thus created super-resolution enlarged and converted signals of decoded pictures with the standard resolution, as reference pictures, and employ them together with super-resolution enlarged and converted signals of input pictures with the standard resolution, to implement a process for a prescribed prediction in between, followed by implementing a process for a prescribed second encoding, to create a second sequence of encoded bits. It is thus permitted to utilize super-resolution enlarged and converted signals of decoded pictures with the standard resolution, as reference pictures, in combination with super-resolution enlarged and converted signals of input pictures with the standard resolution, to make a hierarchical encoding in between making use of correlations of spatial resolution between identical resolutions, allowing for a moving picture encoding based on greater amounts of information than input moving pictures have.

[0070]

It also is possible for the second encoder 107 to work upon creation of a predictive picture, on one hand to have a first reference picture in the form of a decoded picture as it is an input picture having been simply encoded and decoded at the first encoder 102, and on the other hand to have a second reference picture in the form of a set of super-resolution enlarged and converted signals of a picture as decoded as it represents that decoded picture which has been processed for second super-resolution enlargement and resolution conversion through the

second super-resolution enlarger 105 and the second resolution converter 106, to use the first reference picture or the second reference picture, whichever is selective to create the predictive picture, to implement thereon a process for an encoding, permitting a hierarchical encoding to be made by utilization of a correlation of spatial resolution between the decoded picture and a set of super-resolution enlarged and converted signals of the input picture with the standard resolution or by utilization of a correlation of spatial resolution between the set of super-resolution enlarged and converted decoded signals and the set of super-resolution enlarged and converted signals of the input picture with the standard resolution, whichever is requested, thus allowing for different multiplexed bit sequences to be created to supply to, accumulate at, and /or transmit to a decoding system end.

[0071]

Also, it is possible to work along creation of predictive pictures, to control selection of reference picture for each picture or for each set of a prescribed number of pictures, permitting an adaptive creation of predictive picture in accordance with the image quality of decoded picture, resulting in an enhanced encoding efficiency.

[0072]

Moreover, it is possible to provide a configuration for services to create a data of reference picture selection for identifying a first reference picture or a second reference picture whichever is used, to supply to the multiplexer 109, to multiplex into a multiplexed bit sequence 300, allowing for a facilitated identification of a reference picture used in the encoding.

[0073]

Moreover, it is possible to provide a target picture divided with no spaces left into regions each having a prescribed area, and combination of a first reference picture and a second reference picture likewise divided into regions each having a prescribed area, and identify the first reference picture or the second reference picture whichever is selective for a respective region to create a predictive picture, thereby permitting an adaptive creation of predictive picture in accordance with the image quality of decoded picture, resulting in an enhanced encoding efficiency.

[0074]

Further, it is possible to work on moving pictures input with the standard resolution, to implement a process for prescribed encoding and decoding to create a first sequence of encoded bits, and implement a process for second encoding to create a second sequence of encoded bits, and to operate complying with a prescribed syntax structure, to implement a process of multiplexing the sequences of encoded bits, together with sequences of encoded bits of data on encoding parameters used in the encoding processes, involving data on motion vectors, data on quantizing parameters, data on reference picture selection, and data on encoding modes, while inserting data else such as identification data for identification of a set of subsequent sequences of encoded bits, as necessary to create a sequence of multiplexed bits. The sequence of multiplexed bits thus created is configured as a single sequence of encoded bits including both of a result of encoding on inherent input moving pictures and a result of encoding on a set of errors in a prediction using information on frequency components as enlarged in super-resolution pictures having undergone a process for super-resolution enlargement combined with a process for resolution conversion, and is adaptive for services such as transmitting to an unshown external accumulator before recording in a prescribed recording medium, or delivering through a network using an unshown external communication system, thereby permitting a moving picture encoding system according to the present embodiment to operate on moving pictures with heavy amounts of information, allowing for efficient encoding, accumulation, and transmission.

[0075]

Further, it is possible to acquire a first sequence of encoded bits from the first encoder 102 and a second sequence of encoded bits from the second encoder 107, and implement thereon a process for a prescribed multiplexing in accordance with data on encoding modes, permitting a variety of encoded bit sequences to be created, affording to make a selective decoding at a decoding system end.

[0076]

Further, it is possible to operate according to the present embodiment, to keep the first super-resolution enlarger 103 and the first resolution converter 104 from working, to supply pictures input with the standard resolution and stored in the first accumulation buffer 101, as super-resolution enlarged and converted signals of input pictures with the standard resolution, to

the second encoder 107, to implement thereon a process for a prescribed second encoding at the second encoder 107 in a configuration operable according to the present embodiment, thereby affording to have input pictures with the standard resolution as encoding target pictures at the second encoder 107, permitting the second encoder 107 to make more efficient use of reference pictures than in typical processes for inter-layer prediction to create predictive pictures, reducing information amounts of difference data to be created, thus allowing for an enhanced encoding efficiency of the second sequence of encoded bits, with an enabled encoding process rendered the nearer to original moving pictures with the standard resolution.

[0077]

Description is now made of a process for a prescribed super-resolution enlargement applied to the present embodiment according to the present invention.

[0078]

For resolution enhancement of pictures using a super-resolution enlarging process, there have been generalized techniques including those employing low-resolution pictures relatively strongly correlating with each other, such as those simply deviated in position, to predict a single high-resolution picture, there having been many studies reported in recent years. For instance, there is "Super-Resolution Image Reconstruction, by Sung C. P. and Min K. P. : A Technical Overview, IEEE Signal Proc. Magazine, Vol. 26, No. 3, pp. 21-36, 2003", among others.

[0079]

Further, there is "Reconstruction of a high-resolution image by simultaneous registration, restoration, and interpolation of low-resolution images, by B. C. Tom and A. K. Katsaggelos, Proc. IEEE Int. Conf. Image Processing, Vol. 2, pp. 539-542, 1995" disclosing an ML (Maximum-likelihood) method as a proposal. The ML method has an evaluation function in terms of a square error between a set of pixel values of a low-resolution picture estimated from a high-resolution picture and a set of actual observed pixel values, and an estimated picture as such a high-resolution picture that minimizes the evaluation function. This method is a method of implementing a super-resolution process based on the principle of maximum likelihood estimation.

[0080]

Further, there is "Extraction of high-resolution frames from video sequences, by R. R. Schulz and R. L. Stevenson, IEEE Trans. Image Processing, Vol. 5, pp. 996-1011, 1996" disclosing an MAP (Maximum A Posterior) method as a proposal. The MAP method makes an estimation of such a high-resolution picture that minimizes an evaluation function having probability information of high-resolution picture added to a square error. This method is a method for super-resolution process that makes the estimation of high-resolution picture as an optimization problem making use of some prior information on a high-resolution picture, to maximize the posterior probability.

[0081]

Further, there is "High resolution image recovery from image-plane arrays, using convex projections, by H. Stark and P. Oskoui, J. Opt. Soc. Am. A, Vol. 6, pp. 1715-1726, 1989" disclosing a POCS (Projection Onto Convex Sets) method as a proposal. The POCS method is a method for super-resolution process that writes simultaneous equations on sets of pixel values of high-resolution picture and low-resolution picture, and solves them sequentially, to thereby obtain a high-resolution picture.

[0082]

According to the present embodiment, the process for the prescribed super-resolution enlargement may for instance be an application of any such super-resolution process as described above.

[0083]

There will be description made of an example of basic configuration of a process for super-resolution enlargement employed in the present embodiment according to the present invention.

[0084]

Part (a) of Fig. 4 is a block diagram showing a detailed configuration of the first super-resolution enlarger 103 in the first embodiment according to the present invention, Part (b) of Fig. 4, a combination of conceptual diagrams illustrating a process for super-resolution enlargement, and Fig. 5, a flowchart of exemplary actions in the process for super-resolution enlargement.

[0085]

In Part (a) of Fig. 4, according to the first embodiment, the first super-resolution enlarger 103 includes a positioner 1031, an interpolator 1032, an estimated picture creator 1033, and a repetition determiner 1034. It is noted that the second the super-resolution enlarger 105 has a similar configuration.

[0086]

The positioner 1031 is configured to work in a processing for super-resolution enlargement, to acquire combination of a base picture constituting a base in therein and one or more observation pictures, such as those illustrated in Section (I) in Part (b) of Fig. 4. It is now assumed to acquire such a combination of base picture, observation picture 1, and observation picture 2, as illustrated in Section (I) in Part (b) of Fig. 4. As illustrated in Section (II) in Part (b) of Fig. 4, the positioner 1031 is configured for functions to make a registration or positioning to pixel positions of a resolution higher than resolutions of observation pictures 1and 2 and base picture thus acquired, for an interval-unequal sampling to create nonhomogeneous high resolution pictures. Further, it is configured for a function to supply created nonhomogeneous high resolution pictures to the interpolator 1032 and the repetition determiner 1034. For the creation of nonhomogeneous high resolution pictures, preferably, as illustrated in Section (II) in Part (b) of Fig. 4, observation pictures should be each positioned relative to pixels of the base picture, to arrange in place to have a highest correlation with the base picture. Further, in application of a resolution to a certain positioning, preferably, the resolution used to make the positioning should be a higher resolution than would be obtained after an associated process for super-resolution enlargement. For Part (c) of Fig. 4, there will be description made later on in comparison with Part (c) of Fig. 6.

[0087]

The interpolator 1032 is configured for functions to acquire nonhomogeneous high resolution pictures created at the positioner 1031, and use acquired nonhomogeneous high resolution pictures, for implementing a process for a prescribed nonhomogeneous interpolation to create therefrom interpolated pictures with a desirable high resolution, to supply to the estimated picture creator 1033. Further, the interpolator 1032 acquires from the repetition determiner 1034 necessary information for control to continue the process. The control information for continuation of process may well include a nonhomogeneous estimated picture

created at the estimated picture creator 1033. The interpolator 1032 may be configured to work when implementing a repetition process in accordance with the control information, to operate following a prescribed updating method, for use of a nonhomogeneous estimated picture to update a nonhomogeneous high resolution picture acquired from the positioner 1031, while correcting respective interpolated pixels.

[0088]

The estimated picture creator 1033 is configured for functions to acquire interpolated pictures created at the interpolator 1032, and implement thereon a process for a prescribed reconstruction in consideration of a point spread (PSF) function obtained from a prescribed camera model, implementing a process for a prescribed noise removal, as necessary, to create such estimated pictures with a desirable resolution as illustrated in Section (III) in Part (b) of Fig. 4. Further, it is configured for functions to implement a re-sampling process on estimated pictures, to create nonhomogeneous estimated pictures corresponding to pixels of nonhomogeneous high resolution pictures, to supply to the repetition determiner 1034. Further, it is configured for functions to acquire control information from the repetition determiner 1034, and operate in accordance with the control information, to create and externally output estimated pictures as high resolution pictures with a desirable resolution.

[0089]

The repetition determiner 1034 is configured for functions to acquire a nonhomogeneous high resolution picture from the positioner 1031 and a nonhomogeneous estimated picture from the estimated picture creator 1033, for employment of the acquired pictures to follow a prescribed determination method to determine whether or not a repetition of the process for super-resolution enlargement is necessary, and work depending on a result thereof, to operate as the repetition is necessary, to provide the interpolator 1032 with information for a control to continue the process, and operate as the repetition is unnecessary, to provide the estimated picture creator 1033 with information for a control to output estimated pictures with a high resolution as a result of the process for super-resolution enlargement.

[0090]

For a process for super-resolution enlargement required to implement at a still higher rate, there may be application of such a rate increasing method for super-resolution process as

disclosed in Japanese Patent No. 3837575 for instance, to a picture processing system according to the present invention, to thereby attain a still better configuration.

[0091]

Description is now made of actions of the super-resolution enlarger 103 shown in Part (a) of Fig. 4, with reference to a flowchart in Fig. 5.

[0092]

First, the positioner 1031 acquires a base picture as a base in an associated process for super-resolution enlargement, and one or more observation pictures (S500). After that, for each picture acquired, it makes a positioning at a resolution higher than a desirable resolution (S510). On this occasion, after arrangement of pixels of the base picture to corresponding positions, it arranges pixels of observation pictures, making highest correlations with the base picture, thereby creating an interval-unequally sampled nonhomogeneous high resolution picture.

[0093]

After that, the interpolator 1032 acquires the created nonhomogeneous high resolution picture, and implements thereon a process for a prescribed nonhomogeneous interpolation to effect interpolation of pixels (S520). This creates an interpolated picture with a desirable high resolution.

[0094]

Next, the estimated picture creator 1033 acquires the interpolated picture, and implements thereon a process for a prescribed reconstruction, implementing a process for a prescribed noise removal, as necessary, to create an estimated picture with a desirable resolution (S530). Further, it implements a re-sampling process on the estimated picture, to create a nonhomogeneous estimated picture corresponding to a set of pixels of the nonhomogeneous resolution picture.

[0095]

Next, the repetition determiner 1034 acquires the nonhomogeneous resolution picture from the positioner 1031, while acquiring the nonhomogeneous estimated picture from the estimated picture creator 1033. Employing the acquired pictures, it follows a prescribed

determination method, thereby determining whether or not a repetition of the process for super-resolution enlargement is necessary (S540).

[0096]

If the repetition of the process for super-resolution enlargement is determined as being necessary (YES at S540), it provides the interpolator 1032 with information for a control to continue the process. If the repetition of the process for super-resolution enlargement is determined as being unnecessary (NO at S540), it provides the estimated picture creator 1033 with information for a control to output an estimated picture with a high resolution as a result of the process for super-resolution enlargement, whereby the estimated picture creator 1033 operates in accordance with the control information, to output the estimated picture created with the desirable resolution, as a high resolution picture obtained by the process for super-resolution enlargement (S550). Then, according to the first embodiment, the process for super-resolution enlargement goes to an end.

[0097]

Description is now made of an example of process for a prescribed resolution conversion applied to the first resolution converter 104 as well as to the second resolution converter 106.

[0098]

Part (a) of Fig. 6 is a block diagram showing an example of configuration of the first resolution converter 104.

[0099]

In Part (a) of Fig. 6, the first resolution converter 104 includes a pixel inserter 1041, a filtering processor 1042, and a pixel thinner 1043. It is noted that among others the second resolution converter 106 is likewise configured, as well as a third resolution converter 110 in a later-described embodiment.

[0100]

The pixel inserter 1041 is adapted for enlargement of resolution of an input picture to extend the band of spatial frequencies available to handle, and is configured to insert new pixels between pixels, to create an upsampled picture, to supply to the filtering processor 1042.

[0101]

The filtering processor 1042 is configured to acquire the upsampled picture from the pixel inserter 1041, and implement thereon a process for a filtering using a prescribed low-pass filter, to create a band-limited picture, to supply to the pixel thinner 1043. The process for the filtering using a prescribed low-pass filter may well be a filtering process implemented on an upsampled picture, by using a low-pass filter adapted for band limitation and interpolation, within a band of spatial frequencies that can represent the spatial resolution of a picture finally output at the resolution converter, and the filter used may be, for instance, a filter based on the sinc function or Lanczos function, or an IIR filter or FIR filter designed with a precipitous cut-off frequency characteristic for a frequency response to be flat over an entirety of band. There may be a process reduced in duty by use of such a filter as based on the Nearest-neighbor method, the Bilinear method, or the Spline method.

[0102]

The pixel thinner 1043 is configured to acquire the band-limited picture from the filtering processor 1042, and implement thereon a process for a prescribed pixel thinning or decimation for a match with the resolution of a picture finally output at the resolution converter, to create a picture to be output.

[0103]

Part (b) of Fig. 6 is a combination of conceptual diagrams illustrating how signal components vary in a picture subjected to a contraction process by decimation after a process for enlargement of picture by resolution conversion at a resolution converter such as the first resolution converter 104.

[0104]

As illustrated in Section (I) in Part (b) of Fig. 6, assuming an input picture inherently containing a range of spatial frequency components not exceeding an 'fa', in the process for resolution conversion at the resolution converter, even if this was operated to implement a process for enlargement of the picture with a resolution enhanced to enlarge the range of spatial frequency components available to handle, and created a picture with an increased number of pixels, the range of spatial frequency components contained therein as itself could not have increased instead. Therefore, as illustrated in Section (II) in Part (b) of Fig. 6, there would have been resulted a state simply containing the range of spatial frequency components left as it

was, so even if this was subjected to a low-pass filtering process to limit the band to an 'fmax', still combined with a process for an inter-pixel thinning down to the pixel number of an original spatial resolution, there would have been created a picture containing the range of spatial frequency components left as it was.

[0105]

On the other hand, Part (c) of Fig. 4 is a combination of conceptual diagrams illustrating how signal components vary in a picture subjected to a decimation process after a process for super-resolution enlargement at a super-resolution enlarger such as the first super-resolution enlarger 103.

[0106]

As illustrated in Section (I) in Part (c) of Fig. 4, assuming an input picture inherently containing a range of spatial frequency components not exceeding an 'fa', in the process for super-resolution enlargement at the super-resolution enlarger that makes such a processing as illustrated in Part (b) of Fig. 4, the range of spatial frequency components contained therein as itself does increase. Therefore, as illustrated in Section (II) in Part (c) of Fig. 4, assuming a resultant state having a range of contained spatial frequency components extended up to an 'fb', if this is subjected to a low-pass filtering process to limit the band to an 'fmax', there appears a picture created with such components inclusive that exceed the range of spatial frequency components inherently contained up to the 'fa', but are still contained in the picture which can express a range of spatial frequencies up to the 'fmax'.

[0107]

Such the process is implemented for a super-resolution enlargement at the super-resolution enlarger 103, and provides a picture that is equal in resolution to a resolution conversion at the first resolution converter 104, but is essentially different therefrom in that the former can create and make use of such a picture as compensated for those picture components to be inherently contained. This is similar also in relationships such as associated with the second super-resolution enlarger 105 or the third super-resolution enlarger 110.

[0108]

There may be configuration with a function to have a ratio of resolution conversion set up upon implementation of the process for the prescribed resolution conversion as preset

information on a prescribed resolution conversion ratio, or as acquired information on resolution conversion ratio such as set up by an external user, and work on the basis of acquired information on resolution conversion ratio to establish a resolution conversion ratio to implement the process for the prescribed resolution conversion.

[0109]

For instance, assuming among others the first resolution converter 104 or the second resolution converter 106 configured as illustrated in Part (a) of Fig. 6, this operates upon a process being implemented for a decimation of picture from a super-resolution enlarged picture with a resolution higher than a standard resolution to a super-resolution enlarged and converted picture with the standard resolution, to set up combination of a proportion of new pixels to be inserted between pixels at the pixel inserter 1041 and a proportion of pixels to be thinned out at the pixel thinner 1043, depending on a given resolution conversion ratio.

[0110]

The resolution conversion ratio can be expressed such that the resolution conversion ratio = a pixel insertion ratio / a pixel thinning ratio, where the pixel insertion ratio is such that pixel insertion ratio = input pixels / output pixels, and the pixel thinning ratio is such that pixel thinning ratio = input pixels / output pixels.

[0111]

For instance, assuming a super-resolution enlarged picture created from the standard resolution with a resolution conversion ratio of 2, there are operations to return the picture to the standard resolution with a resolution conversion ratio of 1/2, including a setting made at the pixel inserter 1041, such that input pixels : output pixels = 1 : 1, i.e., to have an input picture supplied, as it is, in the form of an upsampled picture to the filtering processor 1042. At the pixel thinner 1043 , there is a setting made such that input pixels : output pixels = 2 : 1, i.e., to implement a process of thinning one pixel out of each set of two pixels to create a picture to be output.

[0112]

Further, to implement a process for enlargement of picture using the first resolution converter 104 configured as illustrated in Part (a) of Fig. 6, assuming creating a picture enlarged twice the standard resolution with a resolution conversion ratio of 2 = 2/1, for instance, there are

operations including a setting made at the pixel inserter 1041 such that input pixels : output pixels = 1 : 2, i.e., to insert one pixel per one pixel to create an upsampled picture to supply to the filtering processor 1042. At the pixel thinner 1043, there is a setting made such that input pixels : output pixels = 1 : 1, i.e., to have a picture output as it is to output without implementing the thinning process.

[0113]

It is noted that the configuration of first resolution converter 104 illustrated in Part (a) of Fig. 6 is a simple example, and there may be an example configured as necessary for a process for enlargement or contraction to a more flexible resolution, such as by use of the Spline method, to prepare from an input picture a set of pixels arranged in arbitrary positions with a fractal positional precision, to create a picture with a desirable resolution.

[0114]

Therefore, according to the first embodiment, there is a moving picture encoding system adapted to set a spatial resolution that an input moving picture has as a standard resolution, and process information on frequency components in the spatial direction and the temporal direction that has been potentially contained in the input moving picture but unable to express to a sufficient degree by the standard resolution, to reconstruct on basis of a prescribed super-resolution process at a first super-resolution enlarger 103, describing with a resolution higher than the standard resolution, to create a super-resolution enlarged picture with an extended amount of information of the information on frequency components the input moving picture has, to implement thereon a moving picture encoding process, permitting an encoding of input moving pictures based on a greater amount of information than the moving pictures have, as an advantageous effect.

[0115]

Moreover, according to the first embodiment, there is a moving picture encoding system adapted to operate on a super-resolution enlarged picture created at a first super-resolution enlarger 103, to implement a process for a prescribed resolution conversion at a first resolution converter 104 to create a super-resolution enlarged and converted picture described with a standard resolution, thus creating information on frequency components in the spatial direction and the temporal direction that has been potentially contained in an input

moving picture but unable to express to a sufficient degree by the standard resolution, while processing information on frequency components that have not been inherently contained, to restrict within a range of information on frequency components that can be expressed with the standard resolution, to include in the super-resolution picture, thereby reflecting on the super-resolution picture such information on frequency components that have been unable to express in the input moving picture, to implement a moving picture encoding process on the super-resolution picture, permitting an encoding of input moving pictures based on a greater amount of information than the moving pictures have, as an advantageous effect.

[0116]

Further, according to the first embodiment, there is a moving picture encoding system adapted to operate on a decoded picture with a standard resolution as encoded and decoded to create at a firs encoder 102, to implement a combination of processes for prescribed super-resolution enlargement and resolution conversion at a second super-resolution enlarger 105 and a second resolution converter 106, respectively, creating a super-resolution enlarged decoded picture and a super-resolution enlarged and converted signal of the decoded picture with the standard resolution, and operate at a second encoder 107, as this is given an input picture after another combination of processes for super-resolution enlargement and resolution conversion at a first super-resolution enlarger 103 and a first resolution converter 104, respectively, to have a super-resolution enlarged and converted signal of the input picture, as an encoding target picture, the decoded picture being the input picture encoded and decoded as it is at the firs encoder 102, as a first reference picture, and the super-resolution enlarged and converted signal of the decoded picture that is the decoded picture after the combination of processes for super-resolution enlargement and resolution conversion at the second super-resolution enlarger 105 and the second resolution converter 106, as a second reference picture, to implement thereon a combination of processes for prescribed second prediction and encoding, thus affording to obtain a predictive picture or predictive blocks with an image quality better than predictive pictures or predictive blocks obtainable by motion picture encoding techniques in the past, with resultant enhancement in encoding efficiency, as an advantageous effect.

[0117]

(Second Embodiment)

In the first embodiment described above, there has been a second encoder 107 working as illustrated in Fig. 1 to have a pair of reference pictures input thereto, that is, combination of a first reference picture being an input picture as encoded and decoded as it is at a first encoder 102 to provide as a decoded picture, and a second reference picture being the decoded picture as subjected to a combination of second super-resolution enlargement and resolution conversion through a second super-resolution enlarger 105 and a second resolution converter 106 to provide as a super-resolution enlarged and converted signal of the decoded picture, to employ the reference pictures enabling a high efficient prediction to create a predictive picture, whereas there may well be an example adapted for instance, as illustrated in Fig. 7, for operation to supply a second encoder 107 simply with a first reference picture being an input picture as encoded and decoded as it is at a first encoder 102 to provide as a decoded picture, or as illustrated in Fig. 8, for operation to supply a second encoder 107 simply with a second reference picture being a decoded picture from a first encoder 102 as subjected to a combination of second super-resolution enlargement and resolution conversion through a second super-resolution enlarger 105 and a second resolution converter 106 to provide as a super-resolution enlarged and converted signal of the decoded picture, combined with operations for the second encoder 107 to employ simply the first or the second reference picture to make a combination of prediction and encoding using an encoding target picture being a super-resolution enlarged and converted signal of an input picture as subjected to a combination of first super-resolution enlargement and resolution conversion.

[0118]

Or else, there may well be an example adapted, as illustrated in Fig. 9, for operations for a second encoder 107 to make a combination of prediction and encoding using an encoding target picture being a super-resolution enlarged and converted signal of an input picture as subjected to a combination of first super-resolution enlargement and resolution conversion, excluding operations to supply the second encoder 107 with either of two reference pictures, that is, without an operation to supply a first reference picture being an input picture as encoded and decoded as it is at a first encoder 102 to provide as a decoded picture, and an operation to supply a second reference picture being the decoded picture as subjected to a combination of

second super-resolution enlargement and resolution conversion through a second super-resolution enlarger 105 and a second resolution converter 106 to provide as a super-resolution enlarged and converted signal of the decoded picture.

[0119]

(Third Embodiment)

Description is now made of a moving picture encoding system according to a third embodiment of the present invention.

[0120]

Fig. 10 is a block diagram showing an example of configuration of the moving picture encoding system according to the third embodiment.

[0121]

Referring to Fig. 10, the moving picture encoding system according to the third embodiment is configured as a specific example of the moving picture encoding system according to the first embodiment shown in Fig. 1, including an accumulation controller 412, a second accumulation buffer 416, a second reference picture buffer 418, and a code rate controller 423 added anew.

[0122]

In Fig. 10, there is a first encoder 102 including a first predictor 402, a first encoder element 403, a first decoder element 404, an intra-predictor 405, a first predictive picture buffer 406, a first reference picture buffer 407, a motion estimator 408, a motion compensator 409, an adder 410, and a deblocker 411. This configuration affords to implement an equivalent function to MPEG-4 AVC specified to standardize under the ISO/IEC SC29 WG11 as a typical motion picture encoding. However, this specific configuration of the first encoder 102 is an example, so there may well be any example else subject to functions of the first encoder 102 to be implemented. For instance, there may be an example compliant with MPEG-2 employed in digital broadcasting or the like, or an example compliant with MPEG-4 SVC being a scalable extension of MPEG-4 AVC. There may be use of a pre-super-resolution encoder element based on a wavelet transform, as typified by JPRG2000.

[0123]

Further, in Fig. 10, there is a second encoder 107 including a third accumulation buffer 415, a second predictor 420, and a second encoder element 421.

[0124]

Description is now made of those component elements of the moving picture encoding system according to the third embodiment shown in Fig. 10, which have different functions or new functions relative to component elements of the first embodiment shown in Fig. 1.

[0125]

The first predictor 402 is configured for functions to acquire from a first accumulation buffer 101 a set of pictures with a standard resolution as necessary for a process for a prescribed encoding, and from the first predictive picture buffer 406 a set of predictive pictures or predictive blocks stored therein, and implement a process for a prescribed prediction on acquired pictures and predictive pictures, to create data on differences, to supply to the first encoder element 403. The process for prediction at the first predictor 402 may well be a process of having a respective one of pictures acquired with the standard resolution, as an encoding target picture, and subtracting acquired predictive pictures or predictive blocks from the target picture, creating data on differences in between, to supply to the first encoder element 403.

[0126]

The first encoder element 403 is configured for functions to acquire from the first predictor 402 data on differences after the process for prediction, and implement thereon the process for the prescribed encoding, to create a first sequence of encoded bits with the standard resolution, to supply to the first decoder element 404 and to a multiplexer 109. The first encoder element 403 may be configured to supply a first sequence of encoded bits to the first decoder element 404, as illustrated in Part (a) of Fig. 11, or may be configured to create data after quantization in a course of the process for the prescribed encoding, to supply to the first decoder element 404, as illustrated in Part (b) of Fig. 11. The first encoder element 403 is configured for a function to vary the code rate of a first sequence of encoded bits being created in the process for encoding, in accordance with control information from the code rate controller 423.

[0127]

The first decoder element 404 is configured for functions to work in accordance with the type of output at the first encoder element 403 illustrated in Part (a) or (b) of Fig. 11, to acquire a first sequence of encoded bits from the first encoder element 403 as illustrated in Part (a) Fig. 12 or acquire post-quantization data from the first encoder element 403 as illustrated in Part (b) Fig. 12, and implement a process for a prescribed decoding on the first sequence of encoded bits or the post-quantization data, to create decoded data on differences, to supply to the adder 410.

[0128]

The intra-predictor 405 is configured for functions to acquire data on decoded pictures as necessary for a process for a prescribed intra-prediction, and implement thereon the process for the prescribed intra-prediction, to create intra-predictive data, to supply to the first predictive picture buffer 406. For creation of intra-predictive data, the intra-predictor 405 may well implement the process for the prescribed intra-prediction on blocks as decoded about a block constituting a target of prediction to create a set of intra-predictive blocks.

[0129]

The first predictive picture buffer 406 is configured for functions to acquire intra-predictive data from the intra-predictor 405 and motion compensation predictive data from the motion compensator 409, to accumulate as predictive pictures or predictive blocks, and supply predictive pictures or predictive blocks to the first predictor 402 and the adder 410. The first predictive picture buffer 406 may be configured to acquire information on control for accumulation from the accumulation controller 412, and work on the accumulation control information to control acquisition, accumulation, and supply of predictive pictures or predictive blocks.

[0130]

The first reference picture buffer 407 is configured for functions to acquire deblocked decoded pictures or decoded blocks from the deblocker 411 and decoded pictures or decoded blocks from the adder 410, to accumulate as reference pictures or reference blocks, and supply accumulated reference pictures or reference blocks, as necessary, to demanding ends inclusive of the intra-predictor 405, the motion estimator 408, the motion compensator 409, and the

second accumulation buffer 416. The first reference picture buffer 407 may be configured to acquire information on control for accumulation from the accumulation controller 412, and work on the accumulation control information to control acquisition, accumulation, and supply of reference pictures or reference blocks.

[0131]

The motion estimator 408 is configured for functions to acquire encoding target pictures from the first accumulation buffer 101 and reference pictures from the first reference picture buffer 407, and makes thereon a prescribed estimation of motions to create data on motion vectors. The motion estimator 408 is configured for a function to supply created motion vector data at least to the motion compensator 409. Preferably, there should be a configuration for motion vector data created at the motion estimator 408 to be processed for a prescribed entropy encoding at an unshown entropy encoder, to supply to the multiplexer 109.

[0132]

The motion compensator 409 is configured for functions to acquire reference pictures from the first reference picture buffer 407 and motion vector data from the motion estimator 408, and make a prescribed motion compensation on acquired reference pictures and motion vector data, to create predictive pictures, to supply to the first predictive picture buffer 406.

[0133]

The adder 410 is configured for functions to acquire decoded difference data from the first decoder element 404 and predictive pictures or predictive blocks from the first predictive picture buffer 406, and make an addition thereof, to create decoded pictures, to supply to the first reference picture buffer 407 and the deblocker 411.

[0134]

The deblocker 411 is configured for functions to acquire decoded pictures from the adder 410, and implement thereon a process for a prescribed deblocking, to create deblocked decoded pictures, to supply to the first reference picture buffer 407.

[0135]

Part (a) and Part (b) of Fig. 11 show examples of configuration of the first encoder element 403 according to the third embodiment.

[0136]

In an example, the first encoder element 403 includes an orthogonal transformer 4031, a quantizer 4032, and an entropy encoder 4033.

[0137]

The orthogonal transformer 4031 is configured for functions to acquire data on differences, and implement thereon a process for a prescribed orthogonal transform, to create data on orthogonal transform coefficients, to supply to the quantizer.

[0138]

The quantizer 4032 is configured for functions to acquire data on orthogonal transform coefficients from the orthogonal transformer 4031, and implement thereon a process for a prescribed quantization, to create quantized data, to supply to the entropy encoder 4033. For application to a model of first decoder element 404 configured to work without making an entropy decoding on an encoded bit sequence, to acquire quantized data as a result of local decoding and implement thereon a process for a prescribed decoding, there may be use of a quantizer 4032 configured to supply quantized data to the first decoder element 404, as illustrated in Part (b) of Fig. 11.

[0139]

The entropy encoder 4033 is configured for functions to acquire quantized data from the quantizer 4032, and implement thereon a process for a prescribed entropy encoding, to create a first sequence of encoded bits, to supply to the multiplexer 109. For application to a model of first decoder element 404 configured to make an entropy decoding on a first encoded bit sequence, to acquire quantized data and implement thereon a process for a prescribed decoding, there may be use of an entropy encoder 4033 configured to create a first sequence of encoded bits, to supply to the first decoder element 404, as illustrated in Part (a) of Fig. 11.

[0140]

Part (a) and Part (b) of Fig. 12 show examples of configuration of the first decoder element 404 according to the third embodiment.

[0141]

For adaptation to a local decoding process, the first decoder element 404 includes at least an inverse quantizer 4042, and an inverse orthogonal transformer 4043, as illustrated in Part (a) and Part (b) of Fig. 12. For configuration to acquire a first sequence of encoded bits to

implement thereon a complete decoding process, it may additionally include an entropy decoder 4041, as illustrated in Part (a) of Fig. 12.

[0142]

The entropy decoder 4041 is configured for functions to acquire a first sequence of encoded bits from the first encoder element 403, and implement thereon a process for a prescribed entropy decoding, to create quantized data, to supply to the inverse quantizer 4042.

[0143]

The inverse quantizer 4042 is configured for functions to acquire quantized data from the entropy decoder 4041 or the quantizer 4032, and implement thereon a process for a prescribed inverse quantization, to create inverse quantized data on orthogonal transform coefficients, to supply to the inverse orthogonal transformer 4043.

[0144]

The inverse orthogonal transformer 4043 is configured for functions to acquire inverse quantized data on orthogonal transform coefficients from the inverse quantizer 4042, and implement thereon a process for a prescribed inverse orthogonal transform, to create decoded data on differences, to supply to the adder 410.

[0145]

Referring again to Fig. 10, according to the third embodiment, the second encoder 107 includes the third accumulation buffer 415, the second predictor 420, and the second encoder element 421.

[0146]

The third accumulation buffer 415 is configured for functions to acquire from a first resolution converter 104 super-resolution enlarged and converted signals of input pictures with a standard resolution, to accumulate therein, and supply to the second predictor 420. The third accumulation buffer 415 is configured for functions to acquire from the accumulation controller 412 information on control for accumulation, and work on the accumulation control information to control acquisition, accumulation, and supply of super-resolution enlarged and converted signals of input pictures with the standard resolution.

[0147]

The second predictor 420 is configured for functions to acquire from the third accumulation buffer 415 super-resolution enlarged and converted signals of input pictures with the standard resolution, from the second accumulation buffer 416 decoded pictures with the standard resolution, and from a second resolution converter 106 super-resolution enlarged and converted signals of decoded pictures with the standard resolution, and have the super-resolution enlarged and converted signals of input pictures, as encoding target pictures, the decoded pictures derived from the first encoder 102, as first reference pictures, and super-resolution enlarged and converted decoded pictures of the super-resolution enlarged and converted signals of decoded pictures with the standard resolution, as second reference pictures, to implement thereon a process for a prescribed prediction to create predictive pictures, and subtract the predictive pictures from the target pictures, to create data on differences, to supply to the second encoder element 421.

[0148]

The second encoder element 421 is configured for functions to acquire data on differences from the second predictor 420, and implement thereon a process for a prescribed encoding to create the above-noted second sequence of encoded bits, to supply to the multiplexer 109, while working on control information from the code rate controller 423, to vary the code rate of the second sequence of encoded bits being created by the encoding process.

[0149]

The accumulation controller 412 is configured for functions to supply information on control for accumulation to each accumulation buffer, to control among others the state of accumulation, acquisition of pictures, and timings of supply of the accumulation buffer.

[0150]

The second accumulation buffer 416 is configured for functions to acquire decoded pictures with the standard resolution from the first reference picture buffer 407, and supply acquired decoded pictures to the second predictor 420 as well as to a second super-resolution enlarger 105.

[0151]

The second accumulation buffer 416 is configured for functions to acquire information on control for accumulation from the accumulation controller 412, and work on the accumulation control information to control acquisition, accumulation, and supply of decoded pictures.

[0152]

The second reference picture buffer 407 is configured for functions to acquire super-resolution enlarged decoded pictures from the second super-resolution enlarger 105, to accumulate therein, and supply acquired super-resolution enlarged decoded pictures to the second resolution converter 106. In doing so, the second reference picture buffer 407 acquires information on control for accumulation from the accumulation controller 412, and works on the accumulation control information to control acquisition, accumulation, and supply of super-resolution enlarged and converted signals of input pictures with the standard resolution.

[0153]

The code rate controller 423 is configured for functions to monitor code rates of encoded bit sequences created at respective encoder elements, to control actions of the encoder elements to have the code rates fall within prescribed ranges, and work in accordance with among others states of the code rates and states of accumulation buffers obtained from the accumulation controller 412, to control the accumulation controller 412 to change actions of the accumulation buffers. The code rate controller 423 is configured to work when controlling actions of the encoder elements to control the code rates, to change data on parameters of quantization at the encoder elements to thereby control the code rates. There may be an example preferably configured to work on among others information on states of signal amplitudes of difference data at each encoder elements and information on reference picture selection adapted to identify which reference picture is used at each predictor, as necessary to determine whether a process for super-resolution enlargement on a decoded picture is effective or ineffective, to operate when it is ineffective, to command the accumulation controller 412 to control the second accumulation buffer 416 to stop supplying decoded pictures to the second super-resolution enlarger 105, and make a changeover to use data on parameters of quantization created as information on predictive differences based on first reference pictures, as they are

different from those data on parameters of quantization which have been used while the process for super-resolution enlargement has been effective, to control the code rates.

[0154]

Therefore, the moving picture encoding system according to the third embodiment is adapted to exhibit similar advantageous effects to the moving picture encoding system according to the first embodiment shown in Fig. 1, and besides configured with components such as an accumulation controller 412 and a code rate controller 423, implementing among others accumulation control at respective buffers and code rate control at a first encoder 102 and a second encoder 107, thus permitting an encoding to be executed taking into consideration among others accumulation amounts at the buffers and code rates at the first encoder 102 and the second encoder 107.

[0155]

In the third embodiment described, there have been components such as an accumulation controller 412 and a code rate controller 423 incorporated in the moving picture encoding system according to the first embodiment shown in Fig. 1, to effect accumulation control at respective buffers and code rate control at a first encoder 102 and a second encoder 107, whereas there may well be an example having components such as an accumulation controller 412 and a code rate controller 423 incorporated in the moving picture encoding system according to the second embodiment shown in Fig. 7 as well as in Fig. 8 and Fig. 9, to likewise effect among others accumulation control and code rate control.

[0156]

(Fourth Embodiment)

Description is now made of a moving picture encoding system according to a fourth embodiment of the present invention.

[0157]

Fig. 13 is a block diagram showing an example of configuration of the moving picture encoding system according to the fourth embodiment.

[0158]

Referring to Fig. 13, the moving picture encoding system according to the fourth embodiment includes a first accumulation buffer 101, a first encoder 102, a first super-resolution

enlarger 103, a second super-resolution enlarger 105, a third resolution converter 110, a third encoder 108, and a multiplexer 109.

[0159]

The first accumulation buffer 101 is configured for equivalent functions to the embodiment shown in Fig. 1, and redundant description is omitted.

[0160]

The first encoder 102 is configured for equivalent functions to the embodiment shown in Fig. 1. In the fourth embodiment, there is a set of decoded pictures created to supply to the second super-resolution enlarger 105 and the third resolution converter 110.

[0161]

The first super-resolution enlarger 103 is configured for equivalent functions to the embodiment shown in Fig. 1. According to the fourth embodiment, the first super-resolution enlarger 103 is configured for functions to create super-resolution enlarged pictures with a resolution higher than a standard resolution, to supply to the third encoder 108.

[0162]

The second super-resolution enlarger 105 is configured for equivalent functions to the embodiment shown in Fig. 1. According to the fourth embodiment, the second super-resolution enlarger 105 is configured for functions to create super-resolution enlarged decoded pictures with a resolution higher than the standard resolution, to supply to the third encoder 108.

[0163]

The third resolution converter 110 is configured for functions to acquire decoded pictures with the standard resolution from the first encoder 102, and implement a process for a prescribed resolution conversion on acquired decoded pictures with the standard resolution to create resolution conversion enlarged decoded pictures being high resolution enlarged decoded pictures with a resolution equal to the spatial resolution of super-resolution enlarged pictures created at the first super-resolution enlarger 103 and that of super-resolution enlarged decoded pictures created at the second super-resolution enlarger 105, to supply to the third encoder 108. There may be configuration with a function to have a ratio of resolution conversion set up upon implementation of the process for the prescribed resolution conversion as preset information on

a prescribed resolution conversion ratio, or as acquired information on resolution conversion ratio such as set up by an external user, and work on the basis of acquired information on resolution conversion ratio to establish a resolution conversion ratio to implement the process for the prescribed resolution conversion.

[0164]

The third encoder 108 is configured for functions to acquire from the first super-resolution enlarger 103 super-resolution enlarged pictures, from the third resolution converter 110 resolution conversion enlarged decoded pictures with a high resolution, and from the second super-resolution enlarger 105 super-resolution enlarged decoded pictures with the high resolution, to have acquired super-resolution enlarged pictures as encoding target pictures, resolution conversion enlarged decoded pictures from the third resolution converter 110 as first reference pictures, and super-resolution enlarged decoded pictures from the second super-resolution enlarger 105 as second reference pictures, and implement thereon a combination of processes for prescribed prediction and encoding to create a third sequence of encoded bits, and supply the multiplexer 109 with the third sequence of encoded bits thus created.

[0165]

For a reference picture to be used in a process for the prescribed prediction at the third encoder 108, there may be a configuration to employ either a first reference picture obtained from a resolution conversion enlarged decoded picture or a second reference picture obtained from a super-resolution enlarged decoded picture, to create a predictive picture, and subtract the predictive picture from a target picture, to create a data on a difference in between.

[0166]

There may be a configuration involved to create a difference data from a target picture, using neither first reference picture nor second reference picture.

[0167]

For control to make a selection of reference picture for each picture or for each set of a prescribed number of pictures, the third encoder 108 may be configured to create a set of data on the selection of reference picture to identify a first reference picture or a second reference picture whichever is used, and implement thereon a process for a prescribed entropy encoding

using an unshown entropy encoder to create a sequence of encoded bits of data on the reference picture selection, to supply to the multiplexer 109.

[0168]

There may be use of combination of target pictures each respectively divided with no spaces left into regions of a prescribed area and first and second reference pictures likewise divided with no spaces left into regions of a prescribed area, to operate for each commensurate region to identify a first reference picture or a second reference picture whichever is selective to create a predictive picture, and subtract the predictive picture from a target picture, to create a data on a difference in between. There may be operations made for each region of a prescribed area to have data for identification of which reference picture has been used, as data on reference picture selection, and implement thereon a process for a prescribed entropy encoding using an unshown entropy encoder, to create, and supply to the multiplexer 109, a resultant sequence of encoded bits of data on reference picture selection. There may well be regions of a prescribed area shaped as regions of a prescribed rectangular form, or as regions of an arbitrary form conforming to a prescribed domain division.

[0169]

The third encoder 108 may be configured for combination of a set of operations to subtract a first reference picture as a predictive picture from an encoding target picture, to obtain a data on a difference in between as a first difference data, and implement thereon a process for a prescribed third encoding to create a first sequence of bits encoded by the third encoding, a set of operations to subtract a second reference picture as a predictive picture from the encoding target picture, to obtain a data on a difference in between as a second difference data, and implement thereon the process for the prescribed third encoding to create a second sequence of bits encoded by the third encoding, and a set of operations to create a data on difference simply from the encoding target picture, using neither first reference picture nor second reference picture, to use as a third difference data, and implement thereon the process for the prescribed third encoding to create a third sequence of bits encoded by the third encoding, to provide the multiplexer 109 with thus created first to third sequences of bits encoded by third encoding. There are data on methods for selection of respective types of reference pictures and data on encoding methods as described, which may be collected as data on reference picture selection

modes and as data on encoding modes for the third encoding, respectively, and processed by implementing thereon a process for a prescribed entropy encoding using an unshown entropy encoder, to supply to the multiplexer 109.

[0170]

The multiplexer 109 is configured for functions to acquire from the first encoder 102 a first sequence of encoded bits and from the third encoder 108 a third sequence of encoded bits, and operate complying with a prescribed syntax structure to implement a process of multiplexing the first sequence of encoded bits, the third sequence of encoded bits, and sequences of encoded bits of sets of data used in encoding processes, involving data on motion vectors, data on quantizing parameters, data on reference picture selection, and data on encoding parameters, as they are each respectively processed through an unshown entropy encoder, while inserting identification data for identification of a set of subsequent sequences of encoded bits and the like, to create a sequence of multiplexed bits to be output. The multiplexer 109 may well be configured for functions to additionally acquire data on modes of reference picture selection and data on reference picture selection as created at the third encoder 108 in the form of sequences of encoded bits encoded through an unshown entropy encoder, and implement thereon a process for a multiplexing to create a sequence of bits multiplexed as described above.

[0171]

The multiplexer 109 may be configured to acquire from the first encoder 102 a first sequence of encoded bits, and from the third encoder 108 the first to the third sequence of bits encoded by the third encoding. The multiplexer 109 may then be configured to reproduce the acquired first sequence of encoded bits with the standard resolution, to create a first to a third sequence of bits encoded by a first encoding with the standard resolution. The multiplexer 109 may then be configured to operate complying with a prescribed syntax structure to implement a process of multiplexing a respective one of combination of the first sequence of bits encoded by the third encoding and the first sequence of bits encoded by the first encoding with the standard resolution, combination of the second sequence of bits encoded by the third encoding and a second sequence of bits encoded by the first encoding with the standard resolution, and combination of the third sequence of bits encoded by the third encoding and the third sequence of bits encoded by the first encoding with the standard resolution, and sequences of encoded bits

of sets of data used in encoding processes, involving data on motion vectors, data on quantizing parameters, data on reference picture selection, and data on encoding parameters, as they are each respectively processed through an unshown entropy encoder, while inserting identification data for identification of a set of subsequent sequences of encoded bits and the like, to create a first to a third sequence of encoded bits as multiplexed to output. The multiplexer 109 may then be configured to operate in response to a demand such as from a data on encoding mode, to selectively create any of the first to the third sequence of encoded bits as multiplexed. The data on encoding mode then used may be formatted to include at least information to control the multiplexing.

[0172]

According to the fourth embodiment, there is a moving picture encoding system configured for the foregoing functions, and adapted to work on input moving pictures, to implement a process for a prescribed super-resolution enlargement and a process for a prescribed resolution conversion, creating super-resolution enlarged and converted pictures, to make use of them allowing for a moving picture encoding based on an increased amount of information relative to an information amount of input moving pictures. In the configuration shown in Fig. 13, the first super-resolution enlarger 103 and the second super-resolution enlarger 105 have enlargement ratios applied thereto, which may well be enlargement ratios equal to each other, while they may be unequal to each other. Further, the resolution conversion ratio applied to the third resolution converter 110 may well be such a resolution conversion ratio that would provide the same resolution as the spatial resolution of super-resolution enlarged pictures created at the first super-resolution enlarger 103 and super-resolution enlarged decoded pictures created at the second super-resolution enlarger 105, while it may not be so.

[0173]

Description is now made of actions of the moving picture encoding system according to the fourth embodiment shown in Fig. 13, with reference to a flowchart of Fig. 14.

[0174]

Fig. 14 is a flowchart showing actions of the moving picture encoding system according to the fourth embodiment.

[0175]

First, in the moving picture encoding system according to the fourth embodiment, the first accumulation buffer 101 stores therein input moving pictures, as necessary in number of pictures for the first super-resolution enlarger 103 to implement a process for a first super-resolution enlargement (S1401).

[0176]

The first super-resolution enlarger 103 acquires from the first accumulation buffer 101 two or more pictures, as necessary for a process for a prescribed first super-resolution enlargement, and implements thereon the process for the prescribed super-resolution enlargement (S1402), whereby it creates super-resolution enlarged pictures with a resolution higher than a standard resolution that input moving pictures have as a spatial resolution thereof, to supply to the third encoder 108.

[0177]

The third encoder 108 acquires super-resolution enlarged pictures from the first super-resolution enlarger 103, storing them in a prescribed buffer for temporary accumulation (S1403).

[0178]

On the other hand, the first encoder 102 acquires from the first accumulation buffer 101 a sequence of moving pictures with the standard resolution as necessary for implementation of a process for a prescribed pre-super-resolution encoding, and implements thereon a process for an encoding and a decoding at the standard resolution (S1404), whereby it creates a first sequence of encoded bits with the standard resolution as a result of the encoding process, and a set of decoded pictures with the standard resolution as a result of the decoding.

[0179]

After that, the first encoder 102 works to supply the first sequence of encoded bits thus created to the multiplexer 109, and store the set of decoded pictures thus created in a prescribed buffer for temporary accumulation (S1405).

[0180]

The second super-resolution enlarger 105 acquires the set of decoded pictures from the first encoder 102, and implements thereon a process for a prescribed super-resolution

enlargement (S1406), whereby it creates a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution, to supply to the third encoder 108.

[0181]

After that, the third encoder 108 acquires super-resolution enlarged decoded pictures from the second super-resolution enlarger 105, storing them in a prescribed buffer for temporary accumulation (S1407).

[0182]

Further, the third resolution converter 110 acquires the set of decoded pictures from the first encoder 102, and implements thereon a process for a prescribed resolution conversion (S1408), whereby it creates resolution conversion enlarged decoded pictures being high resolution enlarged decoded pictures with a resolution higher than the standard resolution, to supply to the third encoder 108.

[0183]

After that, the third encoder 108 acquires resolution conversion enlarged decoded pictures with a high resolution from the third resolution converter 110, storing them in a prescribed buffer for temporary accumulation (S1409).

[0184]

The combination of processes associated with steps S1402 to S1403, the combination of processes associated with steps S1404 to S1407, and the combination of processes associated with steps S1408 to S1409 may be implemented in parallel, or in series.

[0185]

With the foregoing processes completed, the third encoder 108 has super-resolution enlarged pictures acquired from the first super-resolution enlarger 103 as encoding target pictures, resolution conversion enlarged decoded pictures acquired from the third resolution converter 110 as first reference pictures, and super-resolution enlarged decoded pictures acquired from the second super-resolution enlarger 105 as second reference pictures, and implements thereon a process for a prescribed third prediction (S1410), whereby it creates data on differences at the high resolution. After that, it works on the created data on differences, to implement a third encoding process that is a prescribed third encoding (S1411), whereby it creates a third sequence of encoded bits, to supply to the multiplexer 109.

[0186]

After that, the multiplexer 109 acquires a first sequence of encoded bits from the first encoder 102 and a third sequence of encoded bits from the third encoder 108, and works complying with a prescribed syntax structure, to implement a process of multiplexing them together with sets of data used in encoding processes, involving data on motion vectors, data on quantizing parameters, data on reference picture selection, and data on encoding parameters, as they area each respectively processed through an unshown entropy encoder, while inserting identification data for identification of a set of subsequent sequences of encoded bits and the like (S1412), to create such a sequence of multiplexed bits as illustrated in Fig. 15. The present embodiment involves a series of actions to be complete through the foregoing steps.

[0187]

Fig. 15 is a diagram of data format illustrating an example of structure of a multiplexed bit sequence 300 created at the multiplexer 109 according to the fourth embodiment.

[0188]

The multiplexed bit sequence 300 has multiplexed therein a bit sequence 310 of data on encoding parameters, a first sequence 320 of encoded bits from the first encoder 102, and a third sequence 340 of encoded bits from the third encoder 108.

[0189]

There have been operations described as being parallel processes according to the fourth embodiment, while those processed in parallel may well be consecutively processed in a configuration operable according to the present embodiment.

[0190]

According to the fourth embodiment, like the first embodiment described, the moving picture encoding system is configured with the first super-resolution enlarger 103 and the second super-resolution enlarger 105 working to implement processes for a first and a second super-resolution enlargement, affording to have a spatial resolution of input pictures as a standard resolution, permitting the process for the first super-resolution enlargement to create super-resolution enlarged pictures with a resolution higher than the standard resolution.

[0191]

As a result, the process for the first super-resolution enlargement is allowed to process information on spatial and temporal frequency components that have been potentially contained in input moving pictures but unable to express to a sufficient degree by the standard resolution, to reconstruct from the input moving pictures on the basis of a prescribed super-resolution process, to describe with a resolution higher than the standard resolution. It is thus possible to extend information on frequency components that input moving pictures have, to implement thereon a process for moving picture encoding, to make a moving picture encoding based on a greater amount of information than input moving pictures have.

[0192]

Further, it is possible to work on moving pictures input with the standard resolution, to implement a process for prescribed encoding and decoding to create decoded pictures with the standard resolution, and implement a process for a prescribed second super-resolution enlargement on the decoded pictures to create super-resolution enlarged decoded pictures with a resolution higher than the standard resolution with enlarged information on spatial and temporal frequency components, and to have thus created super-resolution enlarged decoded pictures as reference pictures with a high resolution, and use to implement a process for a prescribed prediction relative to super-resolution enlarged pictures, before implementing a process for a prescribed third encoding to create a third sequence of encoded bits. Like this, there can be use of super-resolution enlarged decoded pictures as reference pictures, to effect a hierarchical encoding making use of correlations of spatial resolution relative to super-resolution enlarged pictures, to make a moving picture encoding based on a greater amount of information than input moving pictures have.

[0193]

That is, according to the fourth embodiment, like the first embodiment described, such information on frequency components of pictures that could have been expressed simply within a range that can be described with an inherent spatial resolution of standard resolution as input, is reconstructed making use of correlations that the pictures themselves potentially contain, so it is possible to implement a process for a prescribed super-resolution enlargement to create anew such information on frequency components that can be described simply within a range of spatial resolutions higher than the standard resolution, and reflect in super-resolution

enlarged pictures, permitting differences between the super-resolution enlarged pictures being new final encoding targets thus created and information on frequency components of spatial resolution respectively contained in sequences of original moving pictures with the standard resolution, to be encoded and transmitted according to the present invention, as an essential point. Instead, even with a moving picture decoding system adapted to simply implement a process for a second super-resolution enlargement to create super-resolution enlarged decoded pictures to output to an external display system, there would have been a prescribed decoding process implemented on a first sequence of encoded bits as decoding targets with a standard resolution to create decoded pictures with the standard resolution, which should have contained not a little deterioration in the encoding, so even if the process for the second super-resolution enlargement were implemented as prescribed on the decoded pictures, the process implemented should have been for a super-resolution enlargement on decoded pictures with the standard resolution containing encoding deteriorations, and could not always have been a proper process implemented for super-resolution enlargement, while it might have had a certain effect. According to the present invention, there is a configuration adapted to implement a process for a prescribed extension encoding on super-resolution enlarged decoded pictures being not always sufficient as described, to encode and transmit their differences relative to information on frequency components contained in super-resolution enlarged pictures as inherently would be, thus allowing for more and accurate information on frequency components contained in super-resolution enlarged pictures to be supplied to a decoding system end.

[0194]

Further, according to the fourth embodiment, it is possible to work upon creation of a predictive picture, to use a first reference picture from the third resolution converter 110 or a second reference picture from the second super-resolution enlarger 105, whichever is selective to implement a third encoding process that is a prescribed third encoding, permitting a hierarchical encoding to be made by utilization of a correlation of spatial resolution between a super-resolution enlarged picture and a resolution conversion enlarged decoded picture being the first reference picture or by utilization of a correlation of spatial resolution between the super-resolution enlarged picture and a super-resolution enlarged decoded picture being the

second reference picture, whichever is requested, thus allowing for different multiplexed bit sequences to be created to supply to, accumulate at, and /or transmit to a decoding system end.

[0195]

Further, according to the fourth embodiment, it is possible to work along creation of predictive pictures, to control selection of reference picture for each picture or for each set of a prescribed number of pictures, permitting an adaptive creation of predictive picture in accordance with the image quality of decoded picture, resulting in an enhanced encoding efficiency.

[0196]

Further, according to the fourth embodiment, it is possible to provide a configuration for services to create a data of reference picture selection for identifying a first reference picture or a second reference picture whichever is used, to supply to the multiplexer 109, allowing for a facilitated identification of a reference picture used in an encoding according to the present invention.

[0197]

Further, according to the fourth embodiment, it is possible to provide a target picture divided with no spaces left into regions each having a prescribed area, and combination of a first reference picture and a second reference picture likewise divided into regions each having a prescribed area, and identify the first reference picture or the second reference picture whichever is selective for a respective region to create a predictive picture, thereby permitting an adaptive creation of predictive picture in accordance with the image quality of decoded picture, resulting in an enhanced encoding efficiency.

[0198]

Further, it is possible to work on moving pictures input with the standard resolution, to implement a process for prescribed encoding and decoding to create a first sequence of encoded bits, and implement a process for third encoding to create a third sequence of encoded bits with the standard resolution, and to operate complying with a prescribed syntax structure, to implement a process of multiplexing the sequences of encoded bits, together with sequences of encoded bits of sets of data used in encoding processes, involving data on motion vectors, data on quantizing parameters, data on reference picture selection, and data on encoding parameters,

as they are each respectively processed through an unshown entropy encoder, while inserting identification data for identification of a set of subsequent sequences of encoded bits and the like, to create a sequence of multiplexed bits. The sequence of multiplexed bits thus created is configured as a single sequence of encoded bits including both of a result of encoding on inherent input moving pictures and a result of encoding on a set of errors in a prediction using information on frequency components as enlarged in super-resolution enlarged pictures having undergone a process for super-resolution enlargement, and is adaptive for services such as transmitting to an unshown external accumulator before recording in a prescribed recording medium, or delivering through a network using an unshown external communication system, thereby permitting a moving picture encoding system according to the present embodiment to operate on moving pictures with heavy amounts of information, allowing for efficient encoding, accumulation, and transmission.

[0199]

Further, it is possible to work to acquire a first and a second sequence of bits encoded by the third encoding, identify a set of sequences of encoded bits to be multiplexed in accordance with data on encoding modes, and implement a process for a prescribed multiplexing on identified sequences of encoded bits to create a sequence of multiplexed bits, permitting a variety of encoded bit sequences to be created, affording to make a selective decoding at a decoding system end.

[0200]

(Fifth Embodiment)

In the fourth embodiment described above, there has been a third encoder 108 working as illustrated in Fig. 13 to have a pair of reference pictures input thereto, that is, combination of a first reference picture being a decoded picture from a first encoder 102 as processed for a third resolution conversion at a third resolution converter 110 to provide as a resolution conversion enlarged decoded picture, and a second reference picture being the decoded picture from the first encoder 102 as processed for a second super-resolution enlargement at a second super-resolution enlarger 105 to provide as a super-resolution enlarged decoded picture, to employ the reference pictures enabling a high efficient prediction to create a predictive picture, whereas there may well be an example adapted for instance as illustrated in

Fig. 16, for operation to simply input a resolution conversion enlarged decoded picture from a third resolution converter 110, as a reference picture, or for instance as illustrated in Fig. 17, for operation to simply input a super-resolution enlarged decoded picture from a second super-resolution enlarger 105, as a reference picture, and have a super-resolution enlarged picture from a first super-resolution enlarger 103, as an encoding target picture, for use to make a combination of prediction and encoding.

[0201]

(Sixth Embodiment)

Description is now made of a moving picture encoding system according to a sixth embodiment of the present invention.

[0202]

Fig. 18 is a block diagram showing an example of configuration of the moving picture encoding system according to the sixth embodiment.

[0203]

Referring to Fig. 18, the moving picture encoding system according to the sixth embodiment is configured as a specific example of the moving picture encoding system according to the fourtht embodiment shown in Fig. 13, including an accumulation controller 412, a second accumulation buffer 416, a second reference picture buffer 418, and a code rate controller 423 added anew.

[0204]

Description is now made of those component elements in Fig. 18, which have different functions or new functions relative to component elements of the fourth embodiment shown in Fig. 13.

[0205]

There is a fourth accumulation buffer 501 configured for functions to acquire super-resolution enlarged pictures from a first super-resolution enlarger 103, to accumulate therein, and supply accumulated super-resolution enlarged pictures to a third predictor 502. The fourth accumulation buffer 501 may work to acquire information on control for accumulation from the accumulation controller 412, and operate on the accumulation control

information to control acquisition, accumulation, and supply of super-resolution enlarged pictures.

[0206]

The third predictor 502 may well be configured for functions to acquire from the fourth accumulation buffer 501 super-resolution enlarged pictures, from the second accumulation buffer 418 super-resolution enlarged decoded pictures, and from a third resolution converter 110 resolution conversion enlarged decoded pictures, and have a respective one of the super-resolution enlarged pictures thus acquired, as an encoding target picture, a respective one of the resolution conversion enlarged decoded pictures, as a first reference picture from resolution conversion enlarged decoded picture, and a respective one of the super-resolution enlarged decoded pictures, as a second reference picture from super-resolution enlarged decoded picture, to implement thereon a process for a prescribed prediction to create a predictive picture, and subtract the predictive picture from the encoding target picture, to create data on a difference in between, to supply to a third encoder element 503.

[0207]

The third encoder element 503 is configured for functions to acquire difference data from the third predictor 502, and implement thereon a process for a prescribed encoding to create a third sequence of encoded bits, to supply to a multiplexer 109. The third encoder element 503 may well be configured for functions to work on control information from the code rate controller 423, to vary the code rate of the third sequence of encoded bits being created by the encoding process.

[0208]

The third resolution converter 110 is configured for functions to acquire decoded pictures from the second accumulation buffer 416, and implement thereon a process for a prescribed resolution conversion, to create resolution conversion enlarged decoded pictures being enlarged decoded pictures with a high resolution, to supply to the third predictor 502. The third resolution converter 110 may be configured to implement the process for the prescribed resolution conversion to create resolution conversion enlarged decoded pictures with a high resolution equal to the spatial resolution of super-resolution enlarged pictures created at

the first super-resolution enlarger 103 and that of super-resolution enlarged decoded pictures created at the second super-resolution enlarger 105.

[0209]

There will be supplemental description of the accumulation controller 412, the second accumulation buffer 416, the second accumulation buffer 418, and the code rate controller 423.

[0210]

The accumulation controller 412 can do with functions equivalent to those of the accumulation controller 412 in the third embodiment show in Fig. 10, and redundant description is omitted.

[0211]

The second accumulation buffer 416 can do with functions equivalent to those of the second accumulation buffer 416 in the third embodiment show in Fig. 10, and redundant description is omitted.

[0212]

The second accumulation buffer 418 is configured for additional functions to supply super-resolution enlarged decoded pictures acquired from the second super-resolution enlarger 105, to the third predictor 502.

[0213]

Also the code rate controller 423 is configured for functions equivalent to those of the code rate controller 423 in the third embodiment show in Fig. 10.

[0214]

Such being the case, the sixth embodiment shown in Fig. 18 is adapted for operations similar to those of the third embodiment show in Fig. 10, and redundant description is omitted.

[0215]

The moving picture encoding system according to the sixth embodiment is adapted to exhibit similar advantageous effects to the moving picture encoding system according to the fourth embodiment shown in Fig. 1, and like the third embodiment show in Fig. 10, configured with components, such as an accumulation controller 412 and a code rate controller 423, implementing among others accumulation control at respective buffers and code rate control at a first encoder 102 and a third encoder 108, thus permitting an encoding to be executed taking

into consideration among others accumulation amounts at the buffers and code rates at the first encoder 102 and the third encoder 108.

[0216]

In the sixth embodiment described, there have been components such as an accumulation controller 412 and a code rate controller 423 incorporated in the moving picture encoding system according to the fourth embodiment shown in Fig. 13, to effect accumulation control at respective buffers and code rate control at a first encoder 102 and a third encoder 108, whereas there may well be an example having components such as an accumulation controller 412 and a code rate controller 423 incorporated in an example of moving picture encoding system according to the fifth embodiment shown in Fig. 16 or Fig. 17, to likewise effect among others accumulation control and code rate control.

[0217]

(Seventh Embodiment)

Description is now made of a moving picture encoding system according to a seventh embodiment of the present invention.

[0218]

Fig. 19 is a block diagram showing an example of configuration of the moving picture encoding system according to the seventh embodiment.

[0219]

As shown in Fig. 19, the moving picture encoding system according to the seventh embodiment is configured as an integration of the moving picture encoding system according to the first embodiment shown in Fig. 1 and the moving picture encoding system according to the fourth embodiment shown in Fig. 13, so as for basic functions of component elements, different ones will be described, omitting redundancy.

[0220]

There is a multiplexer 109 configured for functions to acquire from a first encoder 102 a first sequence of encoded bits, from a second encoder 107 a second sequence of encoded bits, and from a third encoder 108 a third sequence of encoded bits, and operate complying with a prescribed syntax structure to implement a process of multiplexing the first sequence of encoded bits, the second sequence of encoded bits, and the third sequence of encoded bits,

together with sequences of encoded bits of sets of data used in encoding processes, involving data on motion vectors, data on quantizing parameters, data on reference picture selection, and data on encoding parameters, as they are each respectively processed through an unshown entropy encoder, while inserting identification data for identification of a set of subsequent sequences of encoded bits and the like, to create a sequence of multiplexed bits. The multiplexer 109 may then be configured to reproduce a first sequence of encoded bits acquired from the first encoder 102 with a standard resolution, to have a first sequence of bits encoded by a first encoding, and a second sequence of bits encoded by the first encoding, and operate complying with a prescribed syntax structure to implement a process of multiplexing the first sequence of bits encoded by the first encoding as reproduced with the standard resolution, and the second sequence of encoded bits as acquired, together with sequences of encoded bits of sets of data used in encoding processes, involving data on motion vectors, data on quantizing parameters, data on reference picture selection, and data on encoding parameters, as they are each respectively processed through an unshown entropy encoder, while inserting identification data for identification of a set of subsequent sequences of encoded bits, to create a sequence of encoded bits as multiplexed to output. The multiplexer 109 may be configured to operate complying with a prescribed syntax structure to implement a process of multiplexing the second sequence of bits encoded by the first encoding as reproduced, and the third sequence of encoded bits as acquired, together with sequences of encoded bits of sets of data used in encoding processes, involving data on motion vectors, data on quantizing parameters, data on reference picture selection, and data on encoding parameters, as they are each respectively processed through an unshown entropy encoder, while inserting identification data for identification of a set of subsequent sequences of encoded bits and the like, to create a second sequence of encoded bits as multiplexed to output.

[0221]

Further , the multiplexer 109 may be configured to acquire from the second encoder 107 a first to a third sequence of bits encoded by a second encoding, and from the third encoder 108 a first to a third sequence of bits encoded by a third encoding. The multiplexer 109 may then be preferably configured for functions to reproduce a first sequence of encoded bits acquired with a standard resolution, to have a first to a sixth sequence of bits encoded by a first

encoding, and operate complying with a prescribed syntax structure to implement a process of multiplexing a respective one of a combination of the first sequence of bits encoded by the second encoding and the first sequence of bits encoded by the first encoding with the standard resolution, a combination of a second sequence of bits encoded by the second encoding and a second sequence of bits encoded by the first encoding with the standard resolution, a combination of the third sequence of bits encoded by the second encoding and a third sequence of bits encoded by the first encoding with the standard resolution, a combination of the first sequence of bits encoded by the third encoding and a fourth sequence of bits encoded by the first encoding with the standard resolution, a combination of a second sequence of bits encoded by the third encoding and a fifth sequence of bits encoded by the first encoding with the standard resolution, and a combination of the third sequence of bits encoded by the third encoding and the sixth sequence of bits encoded by the first encoding with the standard resolution, and sequences of encoded bits of sets of data used in encoding processes, involving data on motion vectors, data on quantizing parameters, data on reference picture selection, and data on encoding parameters, as they are each respectively processed through an unshown entropy encoder, while inserting identification data for identification of a set of subsequent sequences of encoded bits and the like, to create a first to a sixth sequence of encoded bits as multiplexed to output as requested. The multiplexer 109 may then be configured to operate in response to a demand, to selectively create any of the first to the sixth sequence of encoded bits as multiplexed.

[0222]

With functions inclusive of the foregoing, the seventh embodiment is configured to work on input moving pictures, to implement a process for a prescribed super-resolution enlargement and a process for a prescribed resolution conversion, to create among others super-resolution enlarged signals and super-resolution enlarged and converted signals of input pictures, to make use of them allowing for a moving picture encoding based on an increased amount of information relative to an information amount of input moving pictures. In the configuration shown in Fig. 19, there is combination of a first super-resolution enlarger 103 and a second super-resolution enlarger 105 that have enlargement ratios applied thereto, which may well be equal to each other, while they may be unequal to each other. Moreover, there is

combination of a first resolution converter 104 and a second resolution converter 106 that have resolution conversion ratios applied thereto, which may well be such an identical resolution conversion ratio that would provide a standard resolution as a spatial resolution after the process for resolution conversion, while they may be different enlargement ratios. Further, there is a third resolution converter 110 that has a resolution conversion ratio applied thereto, which may well be such a resolution conversion ratio that would provide the same resolution as the spatial resolution of super-resolution enlarged pictures created at the first super-resolution enlarger 103 and super-resolution enlarged decoded pictures created at the second super-resolution enlarger 105, while it may be a different enlargement ratio.

[0223]

Description is now made of actions of the moving picture encoding system according to the seventh embodiment shown in Fig. 19, with reference to a flowchart of Fig. 20.

[0224]

First, there are input moving pictures stored in a first accumulation buffer 101, as necessary in number of pictures for the first super-resolution enlarger 103 to implement a process for a first super-resolution enlargement (S1901).

[0225]

The first super-resolution enlarger 103 acquires from the first accumulation buffer 101 two or more pictures, as necessary for a process for a prescribed first super-resolution enlargement, and implements thereon the process for the prescribed super-resolution enlargement (S1902), whereby it creates super-resolution enlarged pictures with a resolution higher than a standard resolution that input moving pictures have as a spatial resolution thereof, to supply to the first resolution converter 104 and the third encoder 108.

[0226]

After that, the third encoder 108 acquires super-resolution enlarged pictures from the first super-resolution enlarger 103, storing them in a prescribed buffer for temporary accumulation (S1903).

[0227]

After that, the first resolution converter 104 acquires super-resolution enlarged pictures from the first super-resolution enlarger 103, and implements thereon a process for a

prescribed resolution conversion (S1904), whereby it creates super-resolution enlarged and converted signals of input pictures with the standard resolution, to supply thus created super-resolution enlarged and converted signals of input pictures with the standard resolution to the second encoder 107.

[0228]

After that, the second encoder 107 acquires from the first resolution converter 104 super-resolution enlarged and converted signals of input pictures with the standard resolution, storing them in a prescribed buffer for temporary accumulation (S1905).

[0229]

On the other hand, the first encoder 102 acquires from the first accumulation buffer 101 a sequence of moving pictures with the standard resolution as necessary for implementation of a process for a prescribed pre-super-resolution encoding, and implements thereon a process for an encoding and a decoding at the standard resolution (S1906), whereby it creates a first sequence of encoded bits with the standard resolution as a result of the encoding process, and a set of decoded pictures with the standard resolution as a result of the decoding. After that, the first encoder 102 works to supply the first sequence of encoded bits thus created to the multiplexer 109, and supply the set of decoded pictures created with the standard resolution to the second super-resolution enlarger 105, the second encoder 107, and the third resolution converter 110.

[0230]

Then, the second encoder 107 acquires the set of decoded pictures from the first encoder 102, storing in a prescribed buffer for temporary accumulation (S1907).

[0231]

Further, the second super-resolution enlarger 105 acquires the set of decoded pictures from the first encoder 102, and implements thereon a process for a prescribed super-resolution enlargement (S1908), whereby it creates a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution, to supply to the second resolution converter 106 and the third encoder 108.

[0232]

Then, the third encoder 108 acquires the set of super-resolution enlarged decoded pictures from the second super-resolution enlarger 105, storing in a prescribed buffer for temporary accumulation (S1909).

[0233]

Further, the second resolution converter 106 acquires the set of super-resolution enlarged decoded pictures from the second super-resolution enlarger 105, and implements thereon a process for a prescribed resolution conversion (S1910), whereby it creates super-resolution enlarged and converted decoded signals with the standard resolution, to supply to the second encoder 107.

[0234]

Then, the second encoder 107 acquires super-resolution enlarged and converted decoded signals with the standard resolution from the second resolution converter 106, storing them in a prescribed buffer for temporary accumulation (S1911).

[0235]

Further, the third resolution converter 110 acquires the set decoded pictures from the first encoder 102, and implements thereon a process for a prescribed resolution conversion (S1912), whereby it creates a set of resolution conversion enlarged decoded pictures being enlarged decoded pictures with a high resolution, to supply to the third encoder 108.

[0236]

After that, the third encoder 108 acquires the set of resolution conversion enlarged decoded pictures with the high resolution from the third resolution converter 110, storing in a prescribed buffer for temporary accumulation (S1913).

[0237]

The combination of processes associated with steps S1902 to S1905, the combination of processes associated with steps S1906 to S1911, and the combination of processes associated with steps S1912 to S1913 may be implemented in parallel, or in series.

[0238]

With the foregoing processes completed, the second encoder 107 has super-resolution enlarged and converted pictures of input pictures acquired from the first resolution converter 104 as encoding target pictures, decoded pictures acquired from the first encoder 102 as first

reference pictures, and super-resolution enlarged and converted decoded pictures acquired from the second resolution converter 106 as second reference pictures, and works to implement thereon a process for a prescribed second prediction to create data on differences at the standard resolution (S1914), implement a second encoding process as a process for a prescribed second encoding on the difference data thus created (S1915), whereby it creates a second sequence of encoded bits, to supply to the multiplexer 109.

[0239]

Further, the third encoder 108 has super-resolution enlarged pictures of input pictures acquired from the first super-resolution enlarger 103 as encoding target pictures, resolution conversion enlarged decoded pictures acquired from the third resolution converter 110 as first reference pictures, and super-resolution enlarged decoded pictures acquired from the second super-resolution enlarger 105 as second reference pictures, and works to implement thereon a process for a prescribed third prediction to create data on differences at the high resolution (S1916), and implement a third encoding process being a prescribed third encoding on the data on differences thus created to (S1917), whereby it creates a third sequence of encoded bits, to supply to the multiplexer 109. After that, it waits for completion of other parallel processes.

[0240]

After that, the multiplexer 109 acquires a first sequence of encoded bits from the first encoder 102, a second sequence of encoded bits from the second encoder 107, and a third sequence of encoded bits from the third encoder 108, and works complying with a prescribed syntax structure, to implement a process of multiplexing the first sequence of encoded bits, the second sequence of encoded bits, and the third sequence of encoded bits, together with sets of data used in encoding processes, involving data on motion vectors, data on quantizing parameters, data on reference picture selection, and data on encoding parameters, as they area each respectively processed through an unshown entropy encoder, while inserting identification data for identification of a set of subsequent sequences of encoded bits and the like (S1918), to create a sequence of multiplexed bits. The present embodiment involves a series of actions to be complete through the foregoing steps.

[0241]

Fig. 21 is a diagram of data format illustrating an example of structure of a multiplexed bit sequence 300 created at the multiplexer 109 according to the seventh embodiment.

[0242]

The multiplexed bit sequence 300 has multiplexed therein a bit sequence 310 of data on encoding parameters, a first sequence 320 of encoded bits from the first encoder 102, a second sequence 330 of encoded bits from the second encoder 107, and a third sequence 340 of encoded bits from the third encoder 108.

[0243]

There have been operations described as being parallel processes according to the present embodiment, while those processed in parallel may well be consecutively processed in a configuration operable according to the present embodiment.

[0244]

Therefore, the seventh embodiment, configured as shown in Fig. 19, affords to make simultaneous use of advantageous effects available from the first embodiment shown in Fig. 1 and those from the fourth embodiment shown in Fig. 12.

[0245]

Further, according to the seventh embodiment, there is a system including a first encoder 102 configured to work on moving pictures input with a standard resolution, to implement thereon a combination of processes for prescribed encoding and decoding to create a first sequence of encoded bits with the standard resolution, a second encoder 107 configured to implement a process for a second encoding to create a second sequence of encoded bits with the standard resolution, and a third encoder 108 configured to implement a process for a third encoding to create a third sequence of encoded bits with a high resolution, the system being adapted to implement a process for a prescribed multiplexing on the first to the third sequence of encoded bits to create a sequence of multiplexed bits, as a single stream of encoded bits carrying results of encoding on inherent input moving pictures, and results of encoding on a set of errors in a prediction using information on frequency components as enlarged in among others super-resolution enlarged pictures and super-resolution enlarged and converted pictures created by a process for super-resolution enlargement combined with a process for resolution

conversion, permitting their efficient accumulation or transmission, allowing for a selective decoding at a decoding system end.

[0246]

Further, according to the seventh embodiment, there is a system configured with a second encoder 107 adapted to implement a process for a prescribed prediction making use of a first reference picture obtained from a decoded picture with a standard resolution or a second reference picture obtained from a set of super-resolution enlarged and converted signals of the decoded picture with the standard resolution, whichever is used as a reference picture, to create a predictive picture, and subtract the predictive picture from an encoding target picture obtained from a set of super-resolution enlarged and converted signals of an input picture with the standard resolution, to create a data on a difference in between, implementing a process for a prescribed encoding on the difference data to create a second sequence of encoded bits, in combination with a third encoder 108 adapted to implement a process for a prescribed prediction making use of a first reference picture obtained from a resolution conversion enlarged decoded picture with a high resolution or a second reference picture obtained from a super-resolution enlarged decoded picture, whichever is used as a reference picture, to create a predictive picture, and subtract this predictive picture from an encoding target picture obtained from a super-resolution enlarged picture, to create a data on a difference in between, implementing a process for a prescribed encoding on this difference data to create a third sequence of encoded bits, thereby affording to operate in accordance with a request, to perform a hierarchical encoding making use of a correlation of spatial resolution between the decoded picture and the set of super-resolution enlarged and converted signals of the input picture with the standard resolution, as well as in use of a correlation of spatial resolution between the set of super-resolution enlarged and converted decoded signals and the set of super-resolution enlarged and converted signals of the input picture with the standard resolution, and perform a hierarchical encoding making use of a correlation of spatial resolution between the super-resolution enlarged picture and the resolution conversion enlarged decoded picture, as well as in use of a correlation of spatial resolution between the super-resolution enlarged picture and the super-resolution enlarged decoded picture, thus allowing for different multiplexed bit sequences to be created to supply to, accumulate at, and /or transmit to a decoding system end.

[0247]

Moreover, it is possible to provide a configuration for services to create information on reference picture selection including a data on reference picture selection for identifying a first reference picture or a second reference picture whichever is used, to supply to the multiplexer 109, allowing for a facilitated identification of a reference picture used in an encoding according to the seventh embodiment.

[0248]

Further, according to the seventh embodiment, there is a system adapted to operate in accordance with a request, to implement a process for a multiplexing on a domain including a first sequence of encoded bits as derived from a first encoder 102 with a standard resolution, a first to a third sequence of bits encoded by a second encoding as derived from a second encoder 107, and a first to a third sequence of bits encoded by a third encoding as derived from a third encoder 107, to create any of first to sixth sequences of encoded bits as multiplexed, permitting creation of a variety of encoded bit sequences. Further, there is a system adaptive for services such as transmitting to an unshown external accumulator before recording in a prescribed recording medium, or delivering through a network using an unshown external communication system, thereby permitting a moving picture encoding system according to the present embodiment to operate on moving pictures with heavy amounts of information, allowing for efficient encoding, accumulation, and transmission, as well as for selective decoding at a decoding system end.

[0249]

In Fig. 19, the moving picture encoding system according to the seventh embodiment is configured as an integration of the moving picture encoding system according to the first embodiment shown in Fig. 1 and the moving picture encoding system according to the fourth embodiment shown in Fig. 13, while there may well be integrations such as an integration of the moving picture encoding system according to the first embodiment shown in Fig. 1 and an example of moving picture encoding system according to the fifth embodiment shown in Fig. 16 or Fig. 17, an integration of an example of moving picture encoding system according to the second embodiment shown in Fig. 7, Fig. 8, or Fig. 9 and an example of moving picture encoding system according to the fifth embodiment shown in Fig. 16 or Fig. 17, and an

integration of an example of moving picture encoding system according to the second embodiment shown in Fig. 7, Fig. 8, or Fig. 9 and the moving picture encoding system according to the fourth embodiment shown in Fig. 13.

[0250]

(Eighth Embodiment)

Description is now made of a moving picture encoding system according to an eighth embodiment of the present invention.

[0251]

Fig. 22 is a block diagram showing an example of configuration of the moving picture encoding system according to the eighth embodiment.

[0252]

Referring to Fig. 22, the moving picture encoding system according to the eighth embodiment is comprised of a set of component elements equivalent to an integration of the fourth embodiment shown in Fig. 13 and the sixth embodiment shown in Fig. 18. Accordingly, the eighth embodiment is adapted for a set of operations equivalent to a combination of operations of the fourth embodiment and operations of the sixth embodiment shown, so redundant description is omitted.

[0253]

The moving picture encoding system according to the eighth embodiment is adapted to exhibit similar advantageous effects to the moving picture encoding system according to the seventh embodiment shown in Fig. 19, and like the third embodiment show in Fig. 10, the sixth embodiment show in Fig. 18, or the like, configured with components, such as an accumulation controller 412 and a code rate controller 423, implementing among others accumulation control at respective buffers and code rate control at a first encoder 102 and a third encoder 108, thus permitting an encoding to be executed taking into consideration among others accumulation amounts at the buffers and code rates at the first encoder 102 and the third encoder 108.

[0254]

In the first to the eighth embodiment described, there have been moving picture encoding systems depicted by block diagrams and described as hardware configurations, whereas according to the present invention being not limited thereto, there may well be moving

picture encoding programs stored in CPU's and among others memories and HDD's, to attain functions of the first to the eighth embodiment by software processes, respectively. According to the present invention, there are moving picture encoding systems, moving picture encoding methods, and moving picture encoding programs having their ranges of application to such apparatuses or systems, methods, and programs as adapted for encoding moving pictures, without specific limitations. For the present invention, applications cited may involve, for instance, broadcasting equipment typified by TV, mobile telephones, teleconferences, monitors, DVD-R / RW or BD-R / RW, HDD, SD®, recording and reproducing systems using a recordable and rewritable recording medium such as a holographic memory, imaging, recording and reproducing systems such as a camcorder, recording and editing systems such as a an authoring system, and delivering systems for moving pictures.

[0255]

(Ninth Embodiment)

There will be described moving picture decoding systems embodied according to the present invention, as a ninth embodiment et seq.

[0256]

Fig. 23 is a block diagram showing an example of configuration of a moving picture decoding system according to the ninth embodiment.

[0257]

Referring to Fig. 23, the moving picture decoding system according to the ninth embodiment includes a demultiplexer 1801, a first decoder 1802, a first super-resolution enlarger 1803, a first resolution converter 1804, a second decoder 1805, a second resolution converter 1806, and a third decoder 1807.

[0258]

The demultiplexer 1801 is configured for functions to acquire as an input a sequence of multiplexed encoded bits input thereto, and work complying with a prescribed syntax structure, to make a demultiplexing, while identifying identification data for identification of sets of data involving data on encoding modes and data on parameters of respective types as they are used in encoding processes, to acquire from the sequence of multiplexed encoded bits a first sequence of encoded bits to be decoded at the first decoder 1802, a second sequence of

encoded bits to be decoded at the second decoder 1805, and a third sequence of encoded bits to be decoded at the third decoder 1807. The demultiplexer 1801 may well be configured for functions to additionally acquire, if available any from the sequence of multiplexed encoded bits, sequences of bits of data on enlargement ratios, sequences of bits of data on resolution conversion ratios, sequences of encoded bits of data on selection of reference pictures and data on selection modes of reference pictures to be used in a process for a second decoding, and sequences of encoded bits of data on selection of reference pictures and data on selection modes of reference pictures to be used in a process for a third decoding, to supply as necessary. The demultiplexer 1801 is configured for functions at least to supply the first decoder 1802 with the first sequence of encoded bits, the second decoder 1805 with the second sequence of encoded bits, and the third decoder 1807 with the third sequence of encoded bits, as they are acquired. The demultiplexer 1801 may well be configured for functions to acquire, as possible if any from the sequence of multiplexed encoded bits, sequences of encoded bits of data on motion vectors, to supply to the first decoder 1802.

[0259]

The first decoder 1802 is configured for functions to acquire a first sequence of encoded bits with a standard resolution from the demultiplexer 1801, and implement thereon a process for a prescribed first decoding, to create a sequence of decoded pictures with the standard resolution. The first decoder 1802 may well be configured for functions to acquire, as possible if any through an unshown entropy decoder, a set of data on motion vectors obtained by implementation of a process for a prescribed entropy decoding, for use to implement the process for the prescribed decoding. The first decoder 1802 is configured for functions to supply the sequence of decoded pictures created with the standard resolution to the first super-resolution enlarger 1803, the second decoder 1805, and the second resolution converter 1806. The first decoder 1802 may well be configured for functions to temporarily store the sequence of decoded pictures. The first decoder 1802 may well be configured for functions to work in accordance with a request, to supply the sequence of decoded pictures created with the standard resolution to an unshown external display system, affording to provide an output for display of sequences of decoded pictures with the standard resolution.

[0260]

The first super-resolution enlarger 1803 is configured for functions to acquire from the first decoder 1802 a sequence of decoded pictures with the standard resolution, for acquisition of two or more decoded pictures with the standard resolution as necessary for a process for a prescribed super-resolution enlargement, work on the sequence of decoded pictures acquired with the standard resolution to implement the process for the prescribed super-resolution enlargement, to create and output a sequence of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution. For the process for the prescribed super-resolution enlargement to be given an enlargement ratio, there may well be a configuration for functions to acquire data on the enlargement ratio as it is preset as a prescribed enlargement ratio, or obtained as a data acquired at the demultiplexer 1801 and processed for a prescribed entropy decoding at an unshown entropy decoder, and work on the data on enlargement ratio thus acquired to establish an enlargement ratio, for use to implement the process for the prescribed super-resolution enlargement. The first super-resolution enlarger 1803 is configured for functions to supply the sequence of super-resolution enlarged decoded pictures thus created, to the first resolution converter 1804. The first super-resolution enlarger 1803 may well be configured for functions to work in accordance with a request, to supply the sequence of super-resolution enlarged decoded pictures created to an unshown external display system, affording to provide an output for display of sequences of super-resolution enlarged decoded pictures with the resolution higher than the standard resolution.

[0261]

The first resolution converter 1804 is configured for functions to acquire from the first super-resolution enlarger 1803 a sequence of super-resolution enlarged decoded pictures, and work on the sequence of super-resolution enlarged decoded pictures as acquired, to implement a process for a prescribed resolution conversion to create, from the sequence of super-resolution enlarged decoded pictures with the resolution higher than the standard resolution, a sequence of super-resolution decoded pictures with the standard resolution, to supply to the second decoder 1805. For the process for the prescribed resolution conversion to be given a resolution conversion ratio, there may well be a configuration for functions to acquire data on the resolution conversion ratio as is it is preset as a prescribed resolution conversion ratio or, if

possible, obtained as a data from the demultiplexer 1801 as it is processed for a prescribed entropy decoding at an unshown entropy decoder, and work on the data on resolution conversion ratio thus acquired to establish a resolution conversion ratio, for use to implement the process for the prescribed resolution conversion. The first resolution converter 1804 may well be configured for functions to work in accordance with a request, to supply the sequence of super-resolution decoded pictures created to an unshown external display system, affording to provide an output for display of sequences of super-resolution decoded pictures with the standard resolution.

[0262]

The second decoder 1805 is configured for functions to acquire a second sequence of encoded bits with the standard resolution from the demultiplexer 1801, a sequence of decoded pictures with the standard resolution from the first decoder 1802, and a sequence of super-resolution decoded pictures with the standard resolution from the first resolution converter 1804, and work on the second sequence of encoded bits as acquired, to implement a process for a prescribed second decoding being an extension decoding at the standard resolution, to create a set of decoded difference data at the standard resolution. The second decoder 1805 may well be configured for functions to temporarily store the sequences of pictures as acquired.

[0263]

The second decoder 1805 is configured for functions to have a respective decoded picture in the decoded picture sequence, as a first reference picture, and a respective super-resolution decoded picture in the super-resolution decoded picture sequence, as a second reference picture, for use to implement a process for a prescribed prediction to create predictive pictures with the standard resolution. The second decoder 1805 may be configured better with functions to acquire, if possible, data on reference picture selection and data on reference picture selection modes obtained from the demultiplexer 1801 as they are processed for a prescribed entropy decoding at an unshown entropy decoder, and work on the data on reference picture selection and the data on reference picture selection modes, to implement the process for the prescribed prediction to create predictive pictures with the standard resolution. For the process for the prescribed prediction, there may well be a configuration to follow the data on reference picture selection and the data on reference picture selection modes as acquired, to define what

reference pictures were used under what encoding modes to prepare predictive pictures in creation of the second sequence of encoded bits constituting decoding targets, and work so as to make predictive pictures equivalent to those in the encoding. For instance, if it is defined from the data on reference picture selection modes that employed to implement a prediction process was an encoding mode using either a set of first reference pictures or a set of second reference pictures, then the second decoder 1805 is to select a set of reference pictures thus identified, for use to implement the process for the prescribed prediction to create predictive pictures. Or for instance, if it is defined from the data on reference picture selection modes that employed to implement a prediction process was an encoding mode using neither a set of first reference pictures nor a set of second reference pictures, then the second decoder 1805 is to implement the process for the prescribed prediction to create predictive pictures, using neither of the sets of reference pictures. Or for instance, if it is defined from the data on reference picture selection modes that employed to implement a prediction process was an encoding mode comprised of controlling selection of reference picture for each picture or for each set of a prescribed number of pictures, then the second decoder 1805 is to make use of the data on reference picture selection, to identify a first reference picture or a second reference picture, whichever is selective in order, to use reference pictures thus identified to implement the process for the prescribed prediction to create predictive pictures. Or for instance, if it is defined from the data on reference picture selection modes that employed to implement a prediction process was an encoding mode comprised of having a respective target picture divided with no spaces left into regions of a prescribed area and also a first reference picture and a second reference picture each likewise divided with no spaces left into regions of a prescribed area, and making a control for each combination of corresponding regions to select the first or the second reference picture for use, then the second decoder 1805 is to make use of the data on reference picture selection, to identify for each combination of corresponding regions a first reference picture or a second reference picture, whichever is selective in order, to use reference pictures thus identified to implement the process for the prescribed prediction to create predictive pictures.

[0264]

The second decoder 1805 is configured for functions to add decoded difference data

created at the standard resolution to predictive pictures with the standard resolution, to create a sequence of super-resolution pictures as decoded with the standard resolution. The second decoder 1805 may well be configured to work in accordance with a request, to supply the created sequence of super-resolution pictures as decoded with the standard resolution to an unshown external display system, affording to provide an output for display of sequences of super-resolution pictures with the standard resolution.

[0265]

The second resolution converter 1806 is configured for functions to acquire from the first decoder 1802 a sequence of decoded pictures with the standard resolution, and work on the sequence of decoded pictures acquired with the standard resolution, to implement a process for a prescribed resolution conversion, to create a sequence of enlarged decoded pictures with a high resolution having the same resolution as the spatial resolution of the sequence of super-resolution enlarged decoded pictures created at the first super-resolution enlarger 1803, to supply to the third decoder 1807. For the process for the prescribed resolution conversion to be given resolution a conversion ratio, there may well be a configuration for functions to acquire data on the resolution conversion ratio as it is preset as a prescribed resolution conversion ratio or, if possible, obtained as a data from the demultiplexer 1801 as it is processed for a prescribed entropy decoding at an unshown entropy decoder, and work on the data on the resolution conversion ratio thus acquired to establish a resolution conversion ratio, for use to implement the process for the prescribed resolution conversion. The second resolution converter 1806 may well be configured for functions to work in accordance with a request, to supply the sequence of super-resolution decoded pictures created to an unshown external display system, affording to provide an output for display of sequences of super-resolution decoded pictures with the standard resolution.

[0266]

The third decoder 1807 is configured for functions to acquire a third sequence of encoded bits with the high resolution from the demultiplexer 1801, a sequence of enlarged decoded pictures with the high resolution from the second resolution converter 1806, and a sequence of super-resolution enlarged decoded pictures with the high resolution from the first

super-resolution enlarger 1803, and work on the third sequence of encoded bits as acquired, to implement a process for a prescribed third decoding being an extension decoding at the high resolution, to create a set of decoded difference data at the high resolution. The third decoder 1807 may well be configured for functions to temporarily store the sequences of pictures as acquired.

[0267]

The third decoder 1807 is configured for functions to have a respective enlarged decoded picture in the enlarged decoded picture sequence, as a first reference picture, and a respective super-resolution enlarged decoded picture in the super-resolution enlarged decoded picture sequence, as a second reference picture, for use to implement a process for a prescribed prediction to create predictive pictures with the high resolution. The third decoder 1807 may be configured better with functions to acquire, if possible, data on reference picture selection and data on reference picture selection modes obtained from the demultiplexer 1801 as they are processed for a prescribed entropy decoding at an unshown entropy decoder, and work on the data on reference picture selection and the data on reference picture selection modes, to implement the process for the prescribed prediction to create predictive pictures with the high resolution. For the process for the prescribed prediction, there may well be a configuration to follow the data on reference picture selection and the data on reference picture selection modes as acquired, to define what reference pictures were used under what encoding modes to prepare predictive pictures in creation of the third sequence of encoded bits constituting decoding targets, and work so as to make predictive pictures equivalent to those in the encoding. For instance, if it is defined from the data on reference picture selection modes that employed to implement a prediction process was an encoding mode using either a set of first reference pictures or a set of second reference pictures, then the third decoder 1807 is to select a set of reference pictures thus identified, for use to implement the process for the prescribed prediction to create predictive pictures. Or for instance, if it is defined from the data on reference picture selection modes that employed to implement a prediction process was an encoding mode using neither a set of first reference pictures nor a set of second reference pictures, then the third decoder 1807 is to implement the process for the prescribed prediction to create predictive pictures, using neither of the sets of reference pictures. Or for instance, if it is defined from the data on reference picture

selection modes that employed to implement a prediction process was an encoding mode comprised of controlling selection of reference picture for each picture or for each set of a prescribed number of pictures, then the third decoder 1807 is to make use of the data on reference picture selection, to identify a first reference picture or a second reference picture, whichever is selective in order, to use reference pictures thus identified to implement the process for the prescribed prediction to create predictive pictures. Or for instance, if it is defined from the data on reference picture selection modes that employed to implement a prediction process was an encoding mode comprised of having a respective target picture divided with no spaces left into regions of a prescribed area and also a first reference picture and a second reference picture each likewise divided with no spaces left into regions of a prescribed area, and making a control for each combination of corresponding regions to select the first or the second reference picture for use, then the third decoder 1807 is to make use of the data on reference picture selection, to identify for each combination of corresponding regions a first reference picture or a second reference picture, whichever is selective in order, to use reference pictures thus identified to implement the process for the prescribed prediction to create predictive pictures.

[0268]

The third decoder 1807 is configured for functions to add decoded difference data created at the high resolution to predictive pictures with the high resolution, to create a sequence of super-resolution enlarged pictures as decoded with the high resolution. The third decoder 1807 may well be configured to work in accordance with a request, to supply the created sequence of super-resolution enlarged pictures as decoded with the high resolution to an unshown external display system for instance, affording to provide an output for display of sequences of super-resolution enlarged pictures with the high resolution.

[0269]

The moving picture decoding system configured as described is adapted to input multiplexed sequences of encoded bits created at a moving picture encoding system according to any of the first to the eighth embodiment or the like, and decode in reverse to the encoding, affording to acquire decoded picture sequences with more diverse spatial resolutions or frequency components and higher qualities than ever, such as decoded picture sequences with

standard resolution, enlarged decoded picture sequences, super-resolution enlarged decoded picture sequences, super-resolution decoded picture sequences, super-resolution picture sequences as decoded, and super-resolution enlarged picture sequences as decoded. It also is possible to provide a configuration adapted to operate in accordance with a request for a selective output of such diverse decoded picture sequences to an unshown display system. For instance, for users of those display devices non-adaptive to high resolution display, such as mobile terminal display devices, it is possible to request selective one of a decoded picture sequence with standard resolution, a super-resolution decoded picture sequence with standard resolution, and a super-resolution picture sequence as decoded with standard resolution, as an output to view and listen. Or for instance, for users of those display devices adaptive to high resolution display, such as high-definition televisions, it is possible to request selective one of an enlarged decoded picture sequence with high resolution, a super-resolution enlarged decoded picture sequence with high resolution, and a super-resolution enlarged picture sequence as decoded, as an output to view and listen.

[0270]

Description is now made of actions of the moving picture decoding system according to the ninth embodiment shown in Fig. 23, with reference to a flowchart of Fig. 24.

[0271]

First, the demultiplexer 1801 acquires a sequence of multiplexed bits input thereto, and works thereon complying with a prescribed syntax structure, to make a demultiplexing (step S601) while identifying identification data for identification of among others data on encoding modes and data on parameters of respective types used in encoding processes, to acquire a first sequence of encoded bits with the standard resolution, a second sequence of encoded bits with the standard resolution, and a third sequence of encoded bits with the high resolution, and supply the first sequence of encoded bits to the first decoder 1802, the second sequence of encoded bits to the second decoder 1805, and the third sequence of encoded bits to third decoder 1807. Further, the demultiplexer 1801 acquires data on motion vectors if available from the sequence of multiplexed bits, and supplies to the first decoder 1802.

[0272]

After that, the flow branches into a first parallel process (steps S602 and S603), a second parallel process (step S604), and a third parallel process (step S605), to enter parallel actions.

[0273]

In the first parallel process, first, the first decoder 1802 acquires from the demultiplexer 1801 the first sequence of encoded bits and, if available, data on motion vectors, and implements thereon a process for a first decoding at the standard resolution (step S602), to create a sequence of decoded pictures with the standard resolution, and supply to the second decoder 1805.

[0274]

Then, the second decoder 1805 acquires the sequence of decoded pictures created with the standard resolution at the first decoder 1802, and stores in a prescribed buffer for temporary accumulation (step S603). After that, it waits for completion of other parallel processes.

[0275]

In the second parallel process, the second decoder 1805 acquires the second sequence of encoded bits with the standard resolution from the demultiplexer 1801, and implements thereon a process for a prescribed second decoding (step S604), to create a set of decoded difference data at the standard resolution. After that, it waits for completion of other parallel processes.

[0276]

In the third parallel process, the third decoder 1807 acquires the third sequence of encoded bits with the high resolution from the demultiplexer 1801, and implements thereon a process for a prescribed third decoding (step S605), to create a set of decoded difference data at the high resolution. After that, it waits for completion of other parallel processes.

[0277]

With the first to the third parallel process completed, the flow branches into a fourth parallel process (steps S606, S607, S608, and S609), and a fifth parallel process (steps S610 and

S611), to enter parallel actions.

[0278]

In the fourth parallel process, the first super-resolution enlarger 1803 acquires the sequence of decoded pictures with the standard resolution from the first decoder 1802, and implements thereon a process for a prescribed super-resolution enlargement (step S606), to create a sequence of super-resolution enlarged decoded pictures with the high resolution being a resolution higher than the standard resolution, and supply to the first resolution converter 1804 and the third decoder 1807.

[0279]

Then, the third decoder 1807 acquires the sequence of super-resolution enlarged decoded pictures created with the high resolution at the first super-resolution enlarger 1803, and stores in a prescribed buffer for temporary accumulation (step S607).

[0280]

Then, the first resolution converter 1804 acquires the sequence of super-resolution enlarged decoded pictures with the high resolution from the first super-resolution enlarger 1803, and implements thereon a process for a prescribed resolution conversion (step S608) to create, from the sequence of super-resolution enlarged decoded pictures with the resolution higher than the standard resolution, a sequence of super-resolution decoded pictures with the standard resolution, and supply to the second decoder 1805.

[0281]

Then, the second decoder 1805 acquires the sequence of super-resolution decoded pictures created with the standard resolution at the first resolution converter 1804, and stores in a prescribed buffer for temporary accumulation (step S609). After that, it waits for completion of the other parallel process.

[0282]

In the fifth parallel process, the second resolution converter 1806 acquires the sequence of decoded pictures with the standard resolution from the first decoder 1802, and implements thereon a process for a prescribed resolution conversion (step S610), to create a

sequence of enlarged decoded pictures with the high resolution, and supply to the third decoder 1807.

[0283]

Then, the third decoder 1807 acquires the sequence of enlarged decoded pictures created with the high resolution at the second resolution converter 1806, and stores in a prescribed buffer for temporary accumulation (step S611). After that, it waits for completion of the other parallel process.

[0284]

With the foregoing parallel processes completed, the flow branches into a sixth parallel process (step S612) and a seventh parallel process (step S613), to enter parallel actions.

[0285]

In the sixth parallel process, the second decoder 1805 implements a process for a prescribed prediction (step S612) to create a set of predictive pictures with the standard resolution, and makes an addition of created predictive pictures with the standard resolution and decoded difference data at the standard resolution, to create a sequence of super-resolution pictures as decoded with the standard resolution. After that, it waits for completion of the other parallel process.

[0286]

In the seventh parallel process, the third decoder 1807 implements a process for a prescribed prediction (step S613) to create a set of predictive pictures with the high resolution, and makes an addition of created predictive pictures with the high resolution and decoded difference data at the high resolution, to create a sequence of super-resolution enlarged pictures as decoded with the high resolution. After that, it waits for completion of the other parallel process.

[0287]

With the parallel processes completed, there is a set of sequences of decoded pictures created with described resolutions at the first decoder 1802, the first super-resolution enlarger 1803, the first resolution converter 1804, the second decoder 1805, the second resolution

converter 1806, and the third decoder 1807 each operable in response to a request for supply to an unshown external display system or the like, to provide an output for display of a variety of decoding results on demand (step S614). The present embodiment involves a series of actions to be complete through the foregoing steps.

[0288]

According to the ninth embodiment, there is a moving picture decoding system operable through execution of such the steps to create sequences of decoded pictures as necessary.

[0289]

It is noted that there have been operations described as being parallel processes according to the ninth embodiment, while those processed in parallel may well be consecutively processed in a configuration operable according to the present embodiment.

[0290]

Fig. 25 is a flowchart showing an example of operational procedure of the process for decoding at the standard resolution at the step S602 in Fig. 24.

[0291]

Referring to Fig. 25, there is a process for a prescribed decoding to be implemented at the first decoder 1802 that includes an entropy decoder, an inverse quantizer, an inverse orthogonal transformer, an intra-predictor, and a motion compensator, as they are prescribed.

[0292]

The first decoder 1802 first acquires a set of first sequences of encoded bits with the standard resolution from the demultiplexer 1801, and executes a first decoding for a current region of decoding target to be decoded (step S701), by use of the entropy decoder operating to implement a process for a prescribed decoding to create quantized data as decoded, the inverse quantizer operating on the quantized data to implement a process for a prescribed inverse quantization to create data on orthogonal transform coefficients as decoded, and the inverse orthogonal transformer operating on the data on orthogonal transform coefficients to implement a process for a prescribed inverse orthogonal transform to create decoded difference data.

[0293]

Next, the intra-predictor operates for creation of predictive data at the current region of decoding target, by implementing a process for a prescribed prediction based on data of a decoded region neighboring the current decoding target region, to create predictive data (step S702), and makes an addition of the created predictive data and the decoded difference data of the decoding target region, to create decoded data of the decoding target region.

[0294]

After that, there is a determination of whether or not the intra-decoding is complete, in combination with a determination of whether or not a decoded picture set is obtained with a set of decoded data created on whole regions in the planes (step S703).

[0295]

Providing a repetition of the processes for any remaining encoded bit streams to be decoded, if any intra-decoding gets complete (YES at the step S703), then the flow goes to a step S704. If no encoded bit stream to be decoded is left, the foregoing processes for decoding come to an end.

[0296]

After any intra-decoding, if this is in way to the end (NO at the step S703), there is a subsequent decoding target region identified, before the flow again goes to the step S701 for the repetition of processes.

[0297]

If the intra-decoding comes to the end, then the first decoder 1802 enters a service for inter-decoding, where it makes a first decoding (step S704) to create decoded difference data, like the intra-decoding.

[0298]

Further, the motion compensator operates to have a decoded picture set created as a reference picture set, acquire data on motion vectors from the demultiplexer 1801, and work on motion vector data using reference pictures to make a motion compensation (step S705) to create predictive pictures, and make an addition of created predictive pictures and decoded difference data, to create a set of decoded pictures.

[0299]

After that, on bases of encoded mode data or the like, there is a determination of whether the inter-decoding has come to an end (step S706).

[0300]

If there is any subsequent decoding left as an inter-decoding (NO at the step S706), the flow again goes to the step S704 to repeat processes for the inter-decoding to be repeated.

[0301]

If there is no subsequent decoding left as an inter-decoding (YES at the step S706), the inter-decoding goes to the end. Here, if there comes any encoded bit sequence to be decoded by a subsequent decoding to be an intra-decoding, the flow again goes to the step S701 to repeat the foregoing processes for decoding. If there is no encoded bit sequence to be decoded, the processes for decoding go to an end.

[0302]

Also in the ninth embodiment, there has been a moving picture decoding system depicted by a block diagram and described as a hardware configuration, whereas like the first to the eighth embodiment, there may well be a set of functions of the moving picture decoding system in Fig. 23 implemented as software processes using a CPU and a program.

[0303]

(Tenth Embodiment)

Description is now made of an embodiment of moving picture decoding system according to a tenth embodiment.

[0304]

Fig. 26 is a block diagram showing an example of configuration of the moving picture decoding system according to the tenth embodiment.

[0305]

Referring to Fig. 26, the moving picture decoding system according to the tenth embodiment is comprised of a set of component elements of the moving picture decoding system according to the ninth embodiment shown in Fig. 23, with the second resolution converter 1806 and the third decoder 1807 being omitted or kept from working, while

component elements shown in Fig. 26 are equivalent to those in Fig. 23, so redundant description is omitted.

[0306]

The moving picture decoding system configured as described is adapted to acquire multiplexed sequences of encoded bits created by any of moving picture encoding systems, moving picture encoding methods, moving picture encoding programs, moving picture reencoding systems, moving picture reencoding methods, and moving picture reencoding programs corresponding to this embodiment, the moving picture decoding system according to this embodiment being adapted for correct decoding, affording to acquire decoded picture sequences with more diverse spatial resolutions or frequency components and higher qualities than ever, such as decoded picture sequences with standard resolution, super-resolution enlarged decoded picture sequences, super-resolution decoded picture sequences, and super-resolution picture sequences as decoded. It also is possible to provide a configuration adapted to operate in accordance with a request for a selective output of such diverse decoded picture sequences to an unshown display system.

Also in the tenth embodiment described, there has been a hardware configuration depicted by a block diagram, whereas like the first to the ninth embodiment, there may well be a set of functions of the moving picture decoding system in Fig. 26 implemented as software processes using a CPU and a program.

[0307]

(Eleventh Embodiment)

Description is now made of a reencoding system according to an eleventh embodiment of the present invention.

[0308]

Fig. 27 is a block diagram showing an example of configuration of the reencoding system according to the eleventh embodiment.

[0309]

The reencoding system shown in Fig. 27 according to the eleventh embodiment is configured as a moving picture decoding system according to the tenth embodiment sown in

Fig. 26, as combined with a reencoder 1808 and a multiplexer 1809 additionally incorporated therein, for adaptation to a process for a re-encoding as a transcoding from a certain specific encoding style to a different encoding style else.

[0310]

For instance, the reencoding system shown in Fig. 27 according to the eleventh embodiment may be configured for an AVC rewriting (or AVC transcoding), that is, for adaptation to a process for a reencoding to an encoding style of AVC. It is noted that the moving picture decoding system shown in Fig. 23 according to the ninth embodiment may well be configured with a reencoder 1808 and a multiplexer 1809 additionally incorporated therein.

[0311]

The eleventh embodiment includes a demultiplexer 1801 adapted to provide a second sequence of encoded bits with a standard resolution, which may well be configured for a CGS (Coarse Grain Scalability) layer complying with MPEG-4 SVC. Further, this may well be adapted, subject to an encoding with a spatial resolution equalized between a picture sequence with a standard resolution belonging to a base layer and a super-resolution picture sequence with the standard resolution belonging to an extension layer referring to the base layer, to make the encoding for creation of an encoded bit sequence complying with such a prescribed syntax structure that meets the conditions for restriction to permit a facilitated conversion from SVC to AVC, as set forth in rare literatures on AVC rewriting (as literature files on AVC rewriting: JVT-U043, http://ftp3.itu.ch/av-arch/jvt-site/2006_10_Hangzhou/ JVT- U043.zip; and JVT-V035, http://ftp3.itu.ch/av-arch/jvt-site/2007_01_Marrakech/ JVT-V035.zip) in the JVT (Joint Video Team) being a joint group of MPEG and ITU-T. The eleventh embodiment may well be configured for services to acquire an encoded bit sequence thus created, and create an encoded bit sequence enabling a conversion from an encoding style adapted for a handling on an extension layer configured with a CGS layer according to this invention, without such a reencoding as making a combination of complete decoding and encoding.

[0312]

For encoded bit sequences non-adaptive to encoding services suitable to such the AVC

rewriting, there may be a configuration to make a reencoding based on an AVC encoding style for single layers, using a super-resolution picture sequence obtained by decoding an encoded bit sequence with a standard resolution and a second encoded bit sequence with the standard resolution, as well as data on motion vectors and data on encoding modes of respective types or such obtained in the decoding of the encoded bit sequence with the standard resolution, for creation of an encoded bit sequence.

[0313]

Accordingly, the reencoding system shown in Fig. 27 according to the eleventh embodiment may well have the component elements adapted for additional functions as described below.

[0314]

That is, there is a first decoder 1802 further adapted for functions to work on an encoded bit sequence acquired with the standard resolution, implementing processes for prescribed entropy decoding and inverse quantization, to make a decoding to the state of data on orthogonal transform coefficients at the standard resolution on a base layer, without making a complete decoding. Further, the first decoder 1802 is adapted for functions to supply the reencoder 1808 with data on orthogonal transform coefficients in way of the decoding when the AVC rewriting is determined as being possible, or with a decoded picture sequence with the standard resolution when the reencoding is determined as being necessary. The first decoder 1802 may be adapted for functions to supply the reencoder 1808 with data on encoding modes and data on parameters of respective types obtained in the decoding.

[0315]

There is a first resolution converter 1804 further adapted for functions to supply the reencoder 1808 with a super-resolution decoded picture sequence with the standard resolution when the reencoding is determined as being necessary.

[0316]

There is a second decoder 1805 further adapted for functions to work on an extension encoded bit sequence acquired with the standard resolution, implementing processes for prescribed entropy decoding and inverse quantization, to make a decoding to the state of data on

orthogonal transform coefficients at the standard resolution on an extension layer, without making a complete decoding, as well as for functions to supply the reencoder 1808 with data on orthogonal transform coefficients at the standard resolution on the extension layer in way of the decoding when the AVC rewriting is determined as being possible, or with a super-resolution picture sequence as decoded with the standard resolution when the reencoding is determined as being necessary.

[0317]

The reencoder 1808 is adapted for functions to work when the AVC rewriting is determined as being possible, to acquire from the first decoder 1802 data on orthogonal transform coefficients in way of the decoding, and from the second decoder 1805 data on orthogonal transform coefficients at the standard resolution on the extension layer in way of the decoding, make a synthesis of respective data on orthogonal transform coefficients, and afterward implement a process for a prescribed entropy decoding, to create an encoded bit sequence as reencoded, and supply to the multiplexer 1809. The reencoder 1808 is adapted for functions to work when the reencoding is determined as being necessary, to acquire from the first decoder 1802 a decoded picture sequence with the standard resolution, from the first resolution converter 1804 a super-resolution decoded picture sequence with the standard resolution, and from the second decoder 1805 a super-resolution picture sequence as decoded with the standard resolution, as necessary, to implement a process for a prescribed encoding, to create an encoded bit sequence as reencoded, and supply to the multiplexer 1809.

[0318]

The multiplexer 1809 is adapted for functions to acquire an encoded bit sequence as reencoded and supplied, and work complying with a prescribed syntax structure, to implement a process for a multiplexing, while inserting identification data for identification of sets of data used in the encoding, involving data on encoding modes and data on parameters of respective types, to create an encoded bit sequence as multiplexed to output.

[0319]

The moving picture reencoding system configured as described is adapted to acquire

multiplexed sequences of encoded bits created at a moving picture encoding system according to any of the first to the eighth embodiment or the like, in addition to adaptation of the moving picture reencoding system according to this invention to acquire from the first decoder 1802 data on orthogonal transform coefficients in way of the decoding and from the second decoder 1805 data on orthogonal transform coefficients in way of the decoding at the standard resolution on an extension layer, make a synthesis of respective data on orthogonal transform coefficients, and again implement a process for entropy encoding and a process for a multpilexing, to create an encoded bit sequence as reencoded, affording in a facilitated manner to reencod decoded components with more diverse spatial resolutions or frequency components and higher qualities than ever, without making a full decoding for creation of decoded picture sequences, and without consuming many operations for calculation.

[0320]

Further, it is possible to provide a configuration adapted to create an encoded bit sequence as reencoded for conversion into a different encoding style, permitting creation of an encoded bit sequence adaptive to a targeted encoding style.

[0321]

It is possible to provide decoded picture sequences obtained with more diverse spatial resolutions or frequency components and higher qualities than ever, such as a decoded picture sequence with standard resolution, a super-resolution decoded picture sequence, and a super-resolution picture sequence as decoded. Further, it is possible to make a reencodinng on such various decoded picture sequences, to create encoded bit sequences on a single layer.

[0322]

Accordingly, for instance, in application to those devices such as mobile terminal display devices having a moving picture decoding device mounted thereon under restrictions such as to calculation rate or power consumption, and simply adaptive to such a decoding as enabled with the lower calculation rate or power consumption, or lower encoding transmission rate, the moving picture reencoding system according to this invention can be configured for a reencodinng to permit creation of an encoded bit sequence adaptive to a targeted encoding style.

[0323]

The moving picture reencoding system configured as described is adapted to acquire multiplexed sequences of encoded bits created at a moving picture encoding system according to any of the first to the eighth embodiment or the like, in addition to adaptation of the moving picture reencoding system according to this invention to make a correct decoding, affording to obtain decoded picture sequences with more diverse spatial resolutions or frequency components and higher qualities than ever, such as decoded picture sequences with standard resolution, super-resolution decoded picture sequences, and super-resolution picture sequences as decoded.

[0324]

Further, it is possible to make a reencodinng on such various decoded picture sequences, to create encoded bit sequences on a single layer. Therefore, for instance, in application to those devices such as mobile terminal display devices having a moving picture decoding device mounted thereon under restrictions such as to calculation rate or power consumption, and simply adaptive to such a decoding as enabled with the lower calculation rate or power consumption, or lower encoding transmission rate, the moving picture reencoding system according to this invention can be configured to make a reencodinng for conversion to a different encoding style, permitting creation of an encoded bit sequence adaptive to a targeted encoding style.

[0325]

Description is now made of actions of the reencoding system according shown in Fig. 27, with reference to a flowchart of Fig. 28.

[0326]

First, the demultiplexer 1801 acquires a sequence of multiplexed bits input thereto, and works thereon complying with a prescribed syntax structure, to make a demultiplexing (step S701) while identifying identification data for identification of among others data on encoding modes and data on parameters of respective types used in encoding processes, on one hand to thereby obtain from the sequence of multiplexed bits a first sequence of encoded bits with the

standard resolution and a second sequence of encoded bits with the standard resolution, and on the other hand to further obtain, if available from the sequence of multiplexed bits, a sequence of bits of data on enlargement ratio, a sequence of bits of data on resolution conversion ratio, and a sequence of encoded bits of data on an extension prediction at the standard resolution. After that, the demultiplexer 1801 works to supply the first decoder 1802 with the first sequence of encoded bits and the second decoder 1805 with second sequence of encoded bits, as they are obtained, respectively, and further to obtain data on motion vectors, if available from the sequence of multiplexed bits, and supply to the first decoder 1802.

[0327]

After that, the demultiplexer 1801 determines whether the AVC rewriting is possible or impossible (step S702). This determination may be based on determination data contained in the sequence of multiplexed bits, for use to determine whether or not the AVC rewriting is possible.

[0328]

In this system, if the AVC rewriting is possible (YES at the step S702), then the flow branches into a first parallel process (steps S703) and a second parallel process (step S704), to enter subsequent parallel actions.

[0329]

To the contrary, in this system, if the AVC rewriting is impossible (NO at the step S702), then determining a reencoding as being necessary, the flow branches into a third parallel process (step S707 and step S708) and a fourth parallel process (step S709), to enter subsequent parallel actions.

[0330]

If the AVC rewriting is possible, the flow goes to the following processes.

[0331]

In the first parallel process, the first decoder 1802 acquires the first sequence of encoded bits, and implements thereon a process for a prescribed entropy decoding (step S703) combined with a process for an inverse quantization, to create data on orthogonal transform

coefficients on the base layer in way of the decoding, and supply to the reencoder 1808. After that, it waits for completion of the second parallel process.

[0332]

In the second parallel process, the second decoder 1805 acquires the second sequence of encoded bits, and implements thereon a process for a prescribed entropy decoding (step S704) combined with a process for an inverse quantization, to create data on orthogonal transform coefficients on the extension layer in way of the decoding, and supply to the reencoder 1808. After that, it waits for completion of the first parallel process.

[0333]

With the first and the second parallel process completed, the reencoder 1808 acquires from the first decoder 1802 data on orthogonal transform coefficients on the base layer in way of the decoding, and from the second decoder 1805 data on orthogonal transform coefficients on the extension layer in way of the decoding, and makes thereon a synthesis based on a process for a prescribed synthesizing (step S705), making a prescribed entropy encoding on a result of the synthesis (step S706), to create a sequence of encoded bits as reencoded, and supply to the multiplexer 1809. The foregoing processes are processes when the AVC rewriting is possible.

[0334]

If the AVC rewriting is impossible, that is when the reencoding is necessary, the flow goes to the following processes.

[0335]

In the third parallel process, the first decoder 1802 works to acquire from the demultiplexer 1801 a sequence of encoded bits with the standard resolution, and acquire, if available, data on motion vectors, and implements thereon a process for a decoding at the standard resolution (step S707), to create a sequence of decoded pictures, and supply to the second decoder 1805, and to the reencoder 1808 as necessary.

[0336]

Then, the second decoder 1805 acquires the sequence of decoded pictures created with the standard resolution at the first decoder 1802, and stores in a prescribed buffer for

temporary accumulation (step S708). After that, it waits for completion of the fourth parallel process.

[0337]

In the fourth parallel process, the second decoder 1805 acquires the second sequence of encoded bits from the demultiplexer 1801, and implements thereon a process for a prescribed decoding (step S709), to create decoded difference data with the standard resolution. After that, it waits for completion of the third parallel process.

[0338]

With the third and the fourth parallel process completed, a first super-resolution enlarger 1803 acquires the sequence of decoded pictures with the standard resolution from the first decoder 1802, and implements thereon a process for a prescribed super-resolution enlargement (step S710), to create a sequence of super-resolution enlarged decoded pictures with a high resolution being a resolution higher than the standard resolution, and supply to the first resolution converter 1804.

[0339]

Then, the first resolution converter 1804 acquires the sequence of super-resolution enlarged decoded pictures with the high resolution from the first super-resolution enlarger 1803, and implements thereon a process for a prescribed resolution conversion (step S711) to create, from the sequence of super-resolution enlarged decoded pictures with the high resolution being a resolution higher than the standard resolution, a sequence of super-resolution decoded pictures with the standard resolution, and supply to the second decoder 1805, and to the reencoder 1808 as necessary.

[0340]

Then, the second decoder 1805 acquires the sequence of super-resolution decoded pictures created with the standard resolution at the first resolution converter 1804, and stores in a prescribed buffer for temporary accumulation (step S712).

[0341]

The second decoder 1805 implements a process for a prescribed prediction (step S713) to create predictive pictures with the standard resolution, and makes an addition of the

predictive pictures created with the standard resolution and decoded difference data at the standard resolution, to create a sequence of super-resolution pictures as decoded with the standard resolution, and supply to the reencoder 1808 as necessary.

[0342]

The reencoder 1808 thus acquires the sequence of decoded pictures with the standard resolution from the first decoder 1802, the sequence of super-resolution decoded pictures with the standard resolution from the first resolution converter 1804, and the sequence of super-resolution pictures with the standard resolution from the second decoder 1805, as necessary, and implements thereon a process for a prescribed encoding to thereby make a reencoding (step S714) to create a sequence of encoded bits, and supply to the multiplexer 1809.

[0343]

The multiplexer 1809 acquires sequences of encoded bit as reencoded and supplied, and works complying with a prescribed syntax structure, to implement a process for a multiplexing, while inserting identification data for identification of sets of data used in the encoding, involving data on encoding modes and data on parameters of respective types, to create a sequence of encoded bit as multiplexed to output (step S715). The present embodiment involves a series of actions to be complete through the foregoing steps.

[0344]

According to the present embodiment, there is a moving picture reencoding system operable by execution of the foregoing steps, permitting creation of a sequence of encoded bits as reencoded. It is noted that there have been operations described as being parallel processes according to the present embodiment, while those processed in parallel may be consecutively processed in a configuration operable according to the present embodiment.

[0345]

Also in the eleventh embodiment, there has been a configuration depicted by a block diagram and described as a hardware, whereas like the first to the tenth embodiment, there may well be a set of functions of the reencoding system in Fig. 27 implemented as software processes using a CPU and a program.

[0346]

According to the present invention, there are moving picture decoding systems, moving picture decoding methods, and moving picture decoding programs, as well as moving picture reencoding systems, moving picture reencoding methods, and moving picture reencoding programs, having their ranges of application to such apparatuses or systems, methods, and programs as adapted for encoding and decoding moving pictures, without specific limitations. For the present invention, applications cited may involve, for instance, broadcasting equipment typified by TV, mobile telephones, teleconferences, monitors, reproducing systems using a recording medium such as CD, DVD, or Blue-Ray Disc ®, recording and reproducing systems using a recordable and rewritable recording medium such as DVD-R / RW or BD-R / RW, HDD, or SD, imaging, recording and reproducing systems such as a camcorder, recording and editing systems such as a an authoring system, and delivering systems for moving pictures.

Industrial Applicability

[0347]

According to the present invention, there are systems such as a moving picture encoding system, having a first encoder working for services to encode moving pictures input with a standard resolution, in combination with a first super-resolution enlarger working on moving pictures input with the standard resolution, implementing a process for a super-resolution enlargement including information on frequency components in the spatial direction and the temporal direction that has been potentially contained in the input moving pictures but unable to express to a sufficient degree by the standard resolution, followed by implementing processes such as for a prescribed resolution conversion at a first resolution converter, thus permitting a second encoder to make an encoding of moving pictures based on an increased amount of information relative to an information amount of moving pictures input with the standard resolution, as a resultant effect. At the second encoder, as reference signals for the encoding there may be use of, among others, decoded signals as decoded at the first encoder or as additionally processed through processes such as for a second super-resolution enlargement and a second resolution conversion.

[0348]

Moreover, according to the present invention, there are systems such as a moving picture encoding system, having a first encoder working for services to encode moving pictures input with a standard resolution, in combination with a first super-resolution enlarger working on moving pictures input with the standard resolution, implementing a process for a super-resolution enlargement including information on frequency components in the spatial direction and the temporal direction that has been potentially contained in the input moving pictures but unable to express to a sufficient degree by the standard resolution, followed by an encoding of thus obtained signals at a third encoder, permitting the third encoder to make an encoding of moving pictures based on an increased amount of information relative to an information amount of moving pictures input with the standard resolution, as a resultant effect. At the third encoder, as reference signals for the encoding there may be use of decoded signals as decoded at the first encoder and processed through processes such as for a second super-resolution enlargement or a third resolution conversion to enhance the resolution up to the same resolution as first super-resolution enlarged signals. Still more, according to the present invention, there are systems such as a moving picture decoding system, adapted to input thus encoded moving pictures to decode, and yet more, according to the present invention, there are systems such as a moving picture reencoding system, adapted to input thus encoded moving pictures to decode and reencode.

Reference Signs List

[0349]

101 first accumulation buffer
102 first encoder
103 first super-resolution enlarger
104 first resolution converter
105 second super-resolution enlarger
106 second resolution converter
107 second encoder
108 third encoder
109 multiplexer

110	third resolution converter
1801	demultiplexer
1802	first decoder
1803	first super-resolution enlarger
1804	first resolution converter
1805	second decoder
1806	second resolution converter
1807	third decoder
1808	reencoder
1809	multiplexer

CLAIMS

1. A moving picture encoding system comprising:

a first encoder configured to work on a subsequence of a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to work on the subsequence of the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a first resolution converter configured to work on the set of super-resolution enlarged pictures to implement a process for a first resolution conversion to create a set of super-resolution enlarged and converted pictures with the standard resolution; and

a second encoder configured to have the set of super-resolution enlarged and converted pictures from the first resolution converter as a set of encoding target pictures to implement a second combination of processes for a prediction and an encoding to create a second sequence of encoded bits.

2. The moving picture encoding system according to claim 1, wherein the second encoder is configured to have the set of decoded pictures from the first encoder as a set of reference pictures to implement the second combination of processes for the prediction and the encoding to create the second sequence of encoded bits.

3. The moving picture encoding system according to claim 1 or 2, further comprising:

a second super-resolution enlarger configured to acquire the set of decoded pictures with the standard resolution from the first encoder to implement thereon a process for a second super-resolution enlargement to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution; and

a second resolution converter configured to work on the set of super-resolution enlarged decoded pictures to implement a process for a second resolution conversion to create a set of super-resolution enlarged and converted decoded pictures with the standard resolution,

wherein the second encoder is configured to have the set of super-resolution enlarged and converted decoded pictures from the second resolution converter as a set of reference pictures to implement the second combination of processes for the prediction and the encoding to create the second sequence of encoded bits.

4. The moving picture encoding system according to any one of claims 1 to 3, wherein the first super-resolution enlarger comprises:

a positioner configured to work in a processing for super-resolution enlargement, on a combination of a base picture constituting a base therein and one or more observation pictures to be based on, to make a positioning to pixel positions of a desirable high resolution, for an interval-unequal sampling to create nonhomogeneous high resolution pictures;

an interpolator configured to work on nonhomogeneous high resolution pictures created at the positioner, to implement a process for a prescribed nonhomogeneous interpolation to create interpolated pictures with a desirable high resolution;

an estimated picture creator configured to acquire interpolated pictures created at the interpolator, to implement thereon a process for a prescribed reconstruction to create estimated pictures with a desirable resolution; and

a repetition determiner configured to acquire a nonhomogeneous high resolution picture from the positioner and a nonhomogeneous estimated picture from the estimated picture creator, for employment of the acquired pictures to follow a prescribed determination method to determine whether or not a repetition of the processing for super-resolution enlargement is necessary, and work depending on a result thereof, to operate as the repetition is necessary, to provide the interpolator with information for a control to continue the processing, and operate as the repetition is unnecessary, to provide the estimated picture creator with information for a control to output a set of estimated pictures with a high resolution after super-resolution enlargement.

5. The moving picture encoding system according to any one of claims 1 to 4, further comprising a multiplexer configured to operate complying with a prescribed syntax structure to multiplex the first sequence of encoded bits from the first encoder, the second sequence of encoded bits from the second encoder, and information on encoding parameters of respective types used in the encoding at the first encoder and the encoding at the second encoder.

6. The moving picture encoding system according to any one of claims 2 to 5, further comprising:

a first accumulation buffer configured to work in a course before the first encoder and the first super-resolution enlarger, to accumulate subsequences of the sequence of moving pictures with the standard resolution;

a second accumulation buffer configured to work in a course between the first encoder and the second encoder, to accumulate sets of decoded pictures from the first encoder;

an accumulation controller configured to work for detections of buffer accumulation amounts at the first accumulation buffer, the second accumulation buffer, the first encoder, and the second encoder, to control the buffer accumulation amounts; and

a code rate controller configured to work on bases of the detections of buffer accumulation amounts at the accumulation controller, to control code rates at the first encoder and the second encoder.

7. A moving picture encoding system comprising:

a first encoder configured to work on a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a second super-resolution enlarger configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a second super-resolution enlargement

to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution;

a third resolution converter configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a third resolution conversion to create a set of resolution converted enlarged decoded pictures with a resolution higher than the standard resolution; and

a third encoder configured to have the set of super-resolution enlarged pictures from the first super-resolution enlarger as a set of encoding target pictures, employing the set of super-resolution enlarged decoded pictures from the second super-resolution enlarger and the set of resolution converted enlarged decoded pictures from the third resolution converter as sets of reference pictures, to implement thereon a third combination of processes for a prediction and an encoding to create a third sequence of encoded bits.

8. A moving picture encoding system comprising:

a first encoder configured to work on a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a third resolution converter configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a third resolution conversion to create a set of resolution converted enlarged decoded pictures with a resolution higher than the standard resolution; and

a third encoder configured to have the set of super-resolution enlarged pictures from the first super-resolution enlarger as a set of encoding target pictures, employing the set of resolution converted enlarged decoded pictures from the third resolution converter as a set of reference pictures, to implement thereon a third combination of processes for a prediction and an encoding to create a third sequence of encoded bits.

9. A moving picture encoding system comprising:

a first encoder configured to work on a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a second super-resolution enlarger configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a second super-resolution enlargement to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution; and

a third encoder configured to have the set of super-resolution enlarged pictures from the first super-resolution enlarger as a set of encoding target pictures, employing the set of super-resolution enlarged decoded pictures from the second super-resolution enlarger as a set of reference pictures, to implement thereon a third combination of processes for a prediction and an encoding to create a third sequence of encoded bits.

10. A moving picture encoding system comprising:

a first encoder configured to work on a sequence of moving pictures with a standard resolution to implement a first combination of processes for an encoding and a decoding to create a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to work on the sequence of moving pictures with the standard resolution to implement a process for a first super-resolution enlargement to create a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a first resolution converter configured to work on the set of super-resolution enlarged pictures to implement a process for a first resolution conversion to create a set of super-resolution enlarged and converted pictures with the standard resolution;

a second super-resolution enlarger configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a second super-resolution enlargement to create a set of super-resolution enlarged decoded pictures with a resolution higher than the standard resolution;

a second resolution converter configured to work on the set of super-resolution enlarged decoded pictures from the second super-resolution enlarger to implement a process for a second resolution conversion to create a set of super-resolution enlarged and converted decoded pictures with the standard resolution;

a second encoder configured to have the set of super-resolution enlarged and converted pictures from the first resolution converter as a set of encoding target pictures, employing the set of decoded pictures from the first encoder and the set of super-resolution enlarged and converted decoded pictures with the standard resolution from the second resolution converter as sets of reference pictures, to implement thereon a second combination of processes for a prediction and an encoding to create a second sequence of encoded bits;

a third resolution converter configured to acquire the set of decoded pictures from the first encoder to implement thereon a process for a third resolution conversion to create a set of resolution converted enlarged decoded pictures with a resolution higher than the standard resolution; and

a third encoder configured to have the set of super-resolution enlarged pictures from the first super-resolution enlarger as a set of encoding target pictures, employing the set of super-resolution enlarged decoded pictures from the second super-resolution enlarger and the set of resolution converted enlarged decoded pictures from the third resolution converter as sets of reference pictures, to implement thereon a third combination of processes for a prediction and an encoding to create a third sequence of encoded bits.

11. A moving picture encoding method comprising:

a step of implementing a first combination of processes for an encoding and a decoding on a sequence of moving pictures with a standard resolution, creating a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a step of implementing a process for a first super-resolution enlargement on the sequence of moving pictures with the standard resolution, creating a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a step of implementing a process for a first resolution conversion on the set of super-resolution enlarged pictures, creating a set of super-resolution enlarged and converted pictures with the standard resolution; and

a step of having the set of super-resolution enlarged and converted pictures as a set of encoding target pictures, implementing thereon a second combination of processes for a prediction and an encoding, creating a second sequence of encoded bits.

12. A moving picture encoding program configured to have a computer execute:

a step of implementing a first combination of processes for an encoding and a decoding on a sequence of moving pictures with a standard resolution, creating a first sequence of encoded bits and a set of decoded pictures with the standard resolution;

a step of implementing a process for a first super-resolution enlargement on the sequence of moving pictures with the standard resolution, creating a set of super-resolution enlarged pictures with a resolution higher than the standard resolution;

a step of implementing a process for a first resolution conversion on the set of super-resolution enlarged pictures, creating a set of super-resolution enlarged and converted pictures with the standard resolution; and

a step of having the set of super-resolution enlarged and converted pictures as a set of encoding target pictures, implementing thereon a second combination of processes for a prediction and an encoding, creating a second sequence of encoded bits.

13. A moving picture decoding system comprising:

a demultiplexer configured to work on a sequence of input encoded bits to implement a process for a prescribed demultiplexing to output at least a first and a second sequence of encoded bits;

a first decoder configured to acquire the first sequence of encoded bits obtained with a standard resolution at the demultiplexer to implement thereon a process for a prescribed first decoding to create a sequence of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to acquire the sequence of decoded pictures created with the standard resolution at the first decoder to implement thereon a process for a prescribed super-resolution enlargement to create a sequence of super-resolution enlarged decoded pictures;

a first resolution converter configured to acquire the sequence of super-resolution enlarged decoded pictures created at the first super-resolution enlarger to implement thereon a process for a prescribed resolution conversion to create a sequence of super-resolution decoded pictures with the standard resolution; and

a second decoder configured to acquire the second sequence of encoded bits obtained with the standard resolution at the demultiplexer, the sequence of decoded pictures created with the standard resolution at the first decoder, and the sequence of super-resolution decoded pictures created with the standard resolution at the first resolution converter, to implement thereon a combination of processes for a prescribed prediction and a prescribed second decoding being a decoding with an extension of the standard resolution, to create a sequence of super-resolution pictures decoded with the standard resolution.

14. The moving picture decoding system according to claim 13, comprising:

the demultiplexer being configured to work on the sequence of input encoded bits to implement the process for the prescribed demultiplexing to further output a third sequence of encoded bits;

a second resolution converter configured to acquire the sequence of decoded pictures with the standard resolution from the first decoder to implement thereon a process for a prescribed resolution conversion to create a sequence of enlarged decoded pictures with a high resolution as a resolution higher than the standard resolution; and

a third decoder configured to acquire the third sequence of encoded bits obtained with the high resolution at the demultiplexer, the sequence of super-resolution enlarged decoded

pictures created at the first super-resolution enlarger, and the sequence of enlarged decoded pictures with the high resolution from the second resolution converter, to implement thereon a combination of processes for a prescribed prediction and a prescribed third decoding being a decoding with an extension of the high resolution, to create a sequence of super-resolution enlarged pictures as decoded.

15. A moving picture reencoding system comprising:

a demultiplexer configured to work on a sequence of input encoded bits to implement a process for a prescribed demultiplexing to output at least a first and a second sequence of encoded bits;

a first decoder configured to acquire the first sequence of encoded bits obtained with a standard resolution at the demultiplexer to implement thereon a process for a prescribed first decoding to create a sequence of decoded pictures with the standard resolution;

a first super-resolution enlarger configured to acquire the sequence of decoded pictures created with the standard resolution at the first decoder to implement thereon a process for a prescribed super-resolution enlargement to create a sequence of super-resolution enlarged decoded pictures;

a first resolution converter configured to acquire the sequence of super-resolution enlarged decoded pictures created at the first super-resolution enlarger to implement thereon a process for a prescribed resolution conversion to create a sequence of super-resolution decoded pictures with the standard resolution;

a second decoder configured to acquire the second sequence of encoded bits obtained with the standard resolution at the demultiplexer, the sequence of decoded pictures created with the standard resolution at the first decoder, and the sequence of super-resolution decoded pictures created with the standard resolution at the first resolution converter, to implement thereon a process for a prescribed second decoding being a decoding with an extension of the standard resolution, to create a sequence of super-resolution pictures decoded with the standard resolution;

a reencoder configured to acquire from the first decoder information on coefficients of

orthogonal transform in a course of decoding thereof, and from the second decoder information on coefficients of orthogonal transform in an extension layer of the standard resolution in a course of decoding thereof, to make a synthesis of respective information on coefficients of orthogonal transform and implement thereon a process for a prescribed entropy encoding to create a sequence of encoded bits as reencoded; and

a multiplexer configured to acquire the sequence of encoded bits reencoded at the reencoder, to implement thereon a process for a multiplexing complying with a prescribed syntax structure, inserting encoding information inclusive of identification information for identification of information on encoding modes and parameters of respective types used, to create a sequence of encoded bits as multiplexed.

16. The moving picture reencoding system according to claim 15, wherein the reencoder is configured to acquire the sequence of decoded pictures with the standard resolution from the first decoder, the sequence of super-resolution decoded pictures with the standard resolution from the first resolution converter, and the sequence of super-resolution pictures with the standard resolution from the second decoder, to implement thereon a process for a prescribed encoding to create a sequence of encoded bits as reencoded.

17. A moving picture decoding method comprising:

a step of implementing a process for a prescribed demultiplexing on a sequence of input encoded bits, outputting at least a first and a second sequence of encoded bits;

a step of acquiring the first sequence of encoded bits obtained with a standard resolution through the process for the prescribed demultiplexing, implementing thereon a process for a prescribed first decoding, creating a sequence of decoded pictures with the standard resolution;

a step of acquiring the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, implementing thereon a process for a prescribed super-resolution enlargement, creating a sequence of super-resolution enlarged decoded pictures;

a step of acquiring the sequence of super-resolution enlarged decoded pictures created through the process for the prescribed super-resolution enlargement, implementing thereon a process for a prescribed resolution conversion, creating a sequence of super-resolution decoded pictures with the standard resolution; and

a step of acquiring the second sequence of encoded bits obtained with the standard resolution through the process for the prescribed demultiplexing, the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, and the sequence of super-resolution decoded pictures created with the standard resolution through the process for the prescribed resolution conversion, implementing thereon a combination of processes for a prescribed prediction and a prescribed second decoding being a decoding with an extension of the standard resolution, creating a sequence of super-resolution pictures decoded with the standard resolution.

18. The moving picture decoding method according to claim 17, comprising:

a step of implementing the process for the prescribed demultiplexing on the sequence of input encoded bits, outputting a third sequence of encoded bits;

a step of acquiring the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, implementing thereon a process for a prescribed resolution conversion, creating a sequence of enlarged decoded pictures with a high resolution as a resolution higher than the standard resolution; and

a step of acquiring the third sequence of encoded bits obtained with the high resolution through the process for the prescribed demultiplexing, the sequence of super-resolution enlarged decoded pictures created through the process for the prescribed super-resolution enlargement, and the sequence of enlarged decoded pictures created with the high resolution through the process for the prescribed resolution conversion, implementing thereon a combination of processes for a prescribed prediction and a prescribed third decoding being a decoding with an extension of the high resolution, creating a sequence of super-resolution enlarged pictures as decoded.

19. A moving picture reencoding method comprising:

a step of implementing a process for a prescribed demultiplexing on a sequence of input encoded bits;

a step of acquiring a first sequence of encoded bits obtained with a standard resolution through the process for the prescribed demultiplexing, implementing thereon a process for a prescribed first decoding, creating a sequence of decoded pictures with the standard resolution;

a step of acquiring the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, implementing thereon a process for a prescribed super-resolution enlargement, creating a sequence of super-resolution enlarged decoded pictures;

a step of acquiring the sequence of super-resolution enlarged decoded pictures created through the process for the prescribed super-resolution enlargement, implementing thereon a process for a prescribed resolution conversion, creating a sequence of super-resolution decoded pictures with the standard resolution;

a step of acquiring a second sequence of encoded bits obtained with the standard resolution through the process for the prescribed demultiplexing, the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, and the sequence of super-resolution decoded pictures created with the standard resolution through the process for the prescribed resolution conversion, implementing thereon a process for a prescribed second decoding being a decoding with an extension of the standard resolution, creating a sequence of super-resolution pictures decoded with the standard resolution;

a step of acquiring information on coefficients of orthogonal transform in a course of decoding in the process for the prescribed first decoding, and information on coefficients of orthogonal transform in an extension layer of the standard resolution in a course of decoding in the process for the prescribed second decoding being a decoding with an extension of the standard resolution, making a synthesis of respective information on coefficients of orthogonal transform, implementing thereon a process for a prescribed entropy encoding, creating a sequence of encoded bits as reencoded; and

a step of acquiring the sequence of encoded bits as reencoded, implementing thereon a process for a multiplexing complying with a prescribed syntax structure, inserting encoding information inclusive of identification information for identification of information on encoding modes and parameters of respective types used, creating a sequence of encoded bits as multiplexed.

20. A moving picture decoding program configured to have a computer execute:

a step of implementing a process for a prescribed demultiplexing on a sequence of input encoded bits, outputting at least a first and a second sequence of encoded bits;

a step of acquiring the first sequence of encoded bits obtained with a standard resolution through the process for the prescribed demultiplexing, implementing thereon a process for a prescribed first decoding, creating a sequence of decoded pictures with the standard resolution;

a step of acquiring the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, implementing thereon a process for a prescribed super-resolution enlargement, creating a sequence of super-resolution enlarged decoded pictures;

a step of acquiring the sequence of super-resolution enlarged decoded pictures created through the process for the prescribed super-resolution enlargement, implementing thereon a process for a prescribed resolution conversion, creating a sequence of super-resolution decoded pictures with the standard resolution; and

a step of acquiring the second sequence of encoded bits obtained with the standard resolution through the process for the prescribed demultiplexing, the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, and the sequence of super-resolution decoded pictures created with the standard resolution through the process for the prescribed resolution conversion, implementing thereon a combination of processes for a prescribed prediction and a prescribed second decoding being a decoding with an extension of the standard resolution, creating a sequence of super-resolution pictures decoded with the standard resolution.

21. A moving picture reencoding program configured to have a computer execute:

a step of implementing a process for a prescribed demultiplexing on a sequence of input encoded bits;

a step of acquiring a first sequence of encoded bits obtained with a standard resolution through the process for the prescribed demultiplexing, implementing thereon a process for a prescribed first decoding, creating a sequence of decoded pictures with the standard resolution;

a step of acquiring the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, implementing thereon a process for a prescribed super-resolution enlargement, creating a sequence of super-resolution enlarged decoded pictures;

a step of acquiring the sequence of super-resolution enlarged decoded pictures created through the process for the prescribed super-resolution enlargement, implementing thereon a process for a prescribed resolution conversion, creating a sequence of super-resolution decoded pictures with the standard resolution;

a step of acquiring a second sequence of encoded bits obtained with the standard resolution through the process for the prescribed demultiplexing, the sequence of decoded pictures created with the standard resolution through the process for the prescribed first decoding, and the sequence of super-resolution decoded pictures created with the standard resolution through the process for the prescribed resolution conversion, implementing thereon a process for a prescribed second decoding being a decoding with an extension of the standard resolution, creating a sequence of super-resolution pictures decoded with the standard resolution;

a step of acquiring information on coefficients of orthogonal transform in a course of decoding in the process for the prescribed first decoding, and information on coefficients of orthogonal transform in an extension layer of the standard resolution in a course of decoding in the process for the prescribed second decoding being a decoding with an extension of the standard resolution, making a synthesis of respective information on coefficients of orthogonal transform, implementing thereon a process for a prescribed entropy encoding, creating a

sequence of encoded bits as reencoded; and

a step of acquiring the sequence of encoded bits as reencoded, implementing thereon a process for a multiplexing complying with a prescribed syntax structure, inserting encoding information inclusive of identification information for identification of information on encoding modes and parameters of respective types used, creating a sequence of encoded bits as multiplexed.

FIG. 1

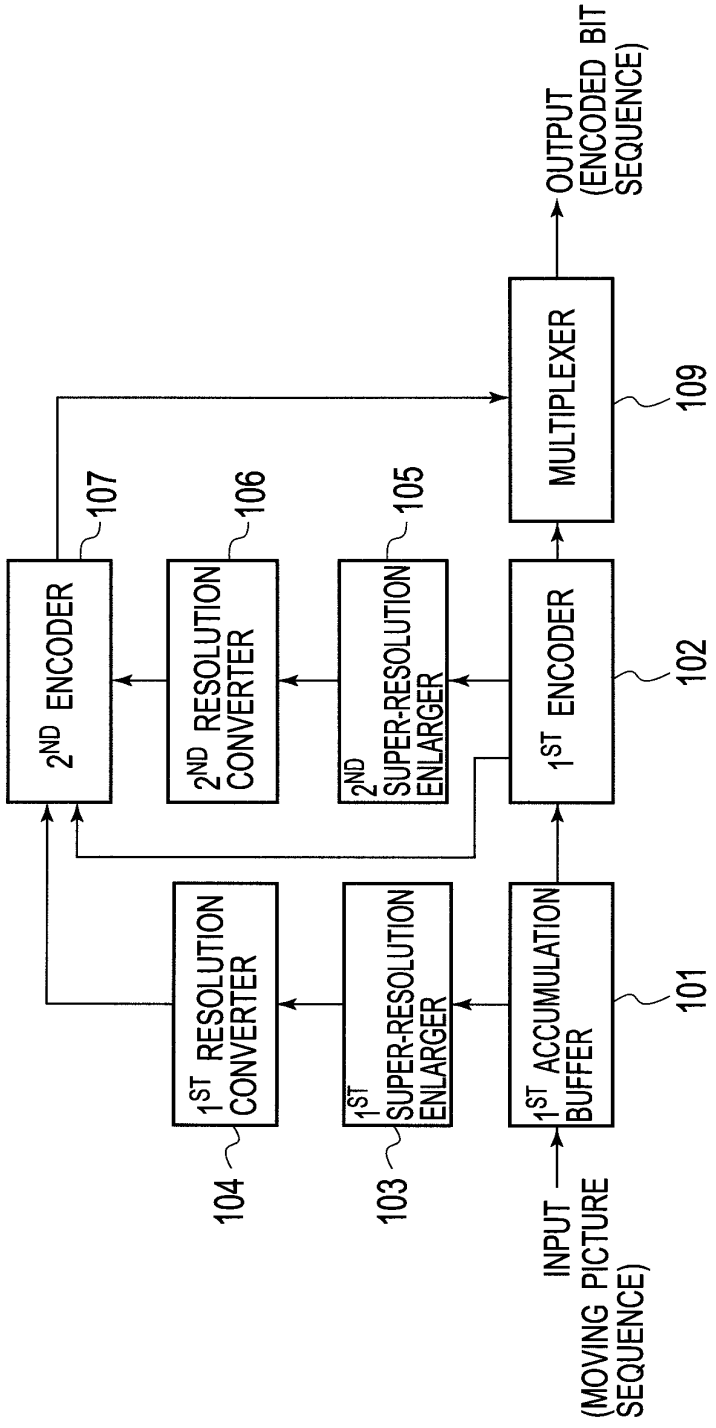

INPUT (MOVING PICTURE SEQUENCE)
1ST ACCUMULATION BUFFER
101
1ST ENCODER
102
1ST SUPER-RESOLUTION ENLARGER
103
1ST RESOLUTION CONVERTER
104
2ND SUPER-RESOLUTION ENLARGER
105
2ND RESOLUTION CONVERTER
106
2ND ENCODER
107
MULTIPLEXER
109
OUTPUT (ENCODED BIT SEQUENCE)

FIG. 2

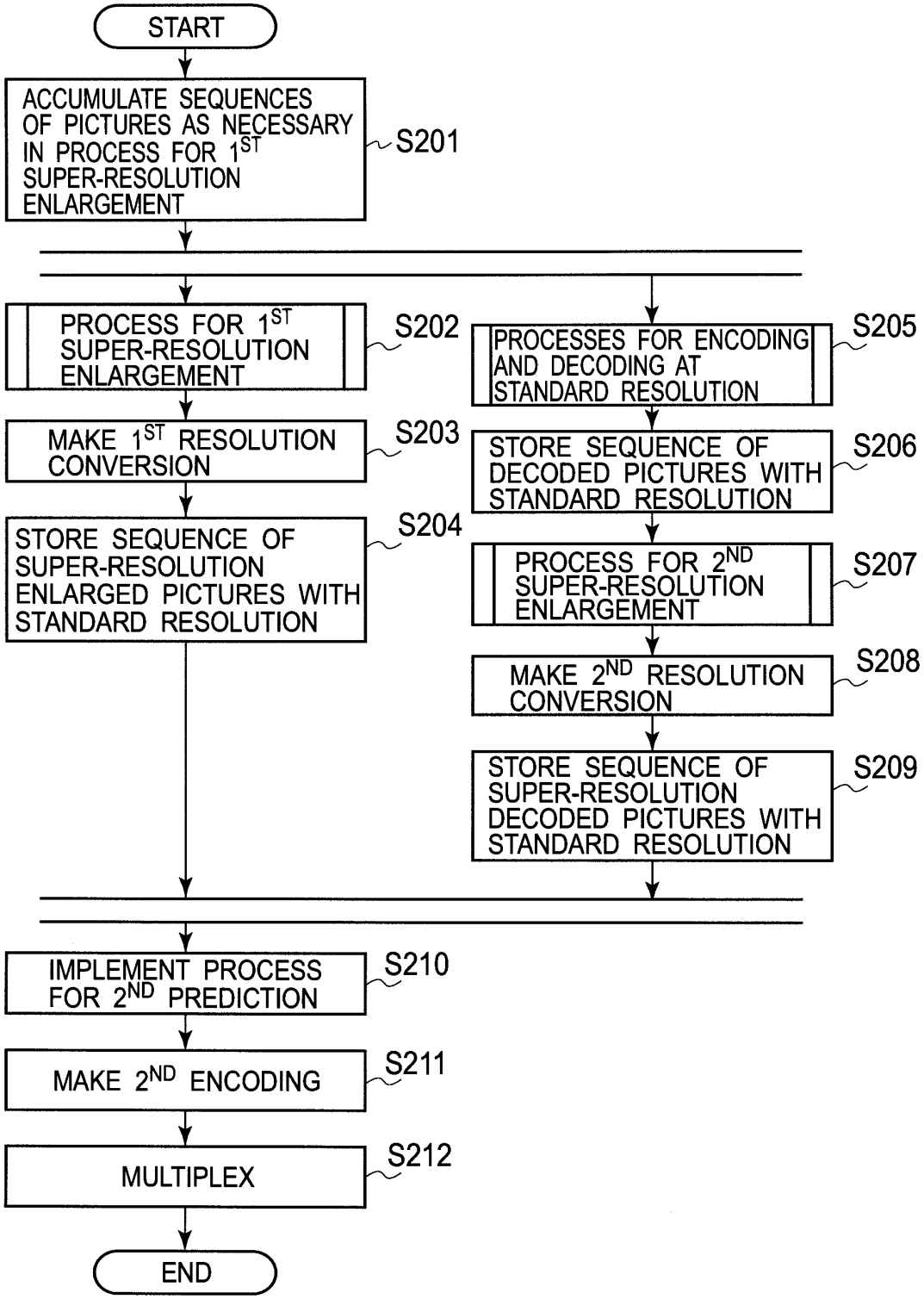

START
ACCUMULATE SEQUENCES OF PICTURES AS NECESSARY IN PROCESS FOR 1ST SUPER-RESOLUTION ENLARGEMENT
S201
PROCESS FOR 1ST SUPER-RESOLUTION ENLARGEMENT
S202
MAKE 1ST RESOLUTION CONVERSION
S203
STORE SEQUENCE OF SUPER-RESOLUTION ENLARGED PICTURES WITH STANDARD RESOLUTION
S204
PROCESSES FOR ENCODING AND DECODING AT STANDARD RESOLUTION
S205
STORE SEQUENCE OF DECODED PICTURES WITH STANDARD RESOLUTION
S206
PROCESS FOR 2ND SUPER-RESOLUTION ENLARGEMENT
S207
MAKE 2ND RESOLUTION CONVERSION
S208
STORE SEQUENCE OF SUPER-RESOLUTION DECODED PICTURES WITH STANDARD RESOLUTION
S209
IMPLEMENT PROCESS FOR 2ND PREDICTION
S210
MAKE 2ND ENCODING
S211
MULTIPLEX
S212
END

FIG. 3

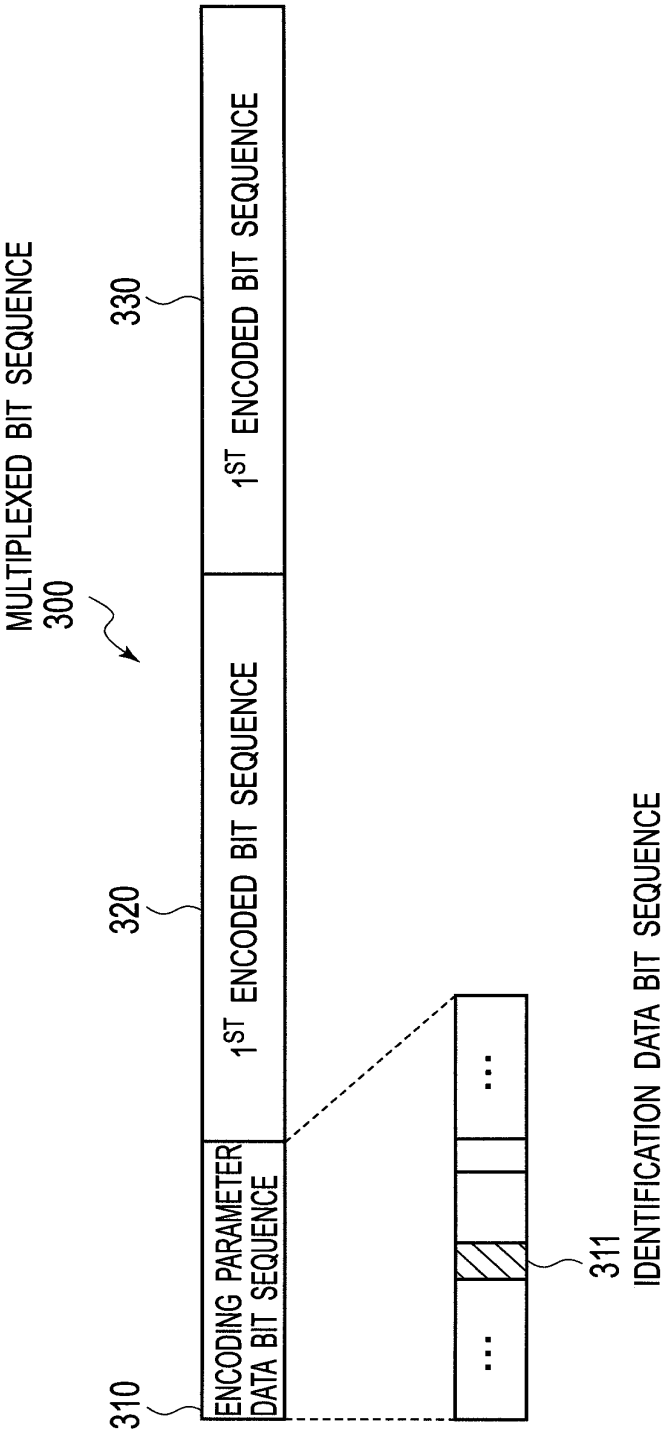

MULTIPLEXED BIT SEQUENCE
300
330
1ST ENCODED BIT SEQUENCE
320
1ST ENCODED BIT SEQUENCE
310
ENCODING PARAMETER DATA BIT SEQUENCE
311
IDENTIFICATION DATA BIT SEQUENCE

FIG. 4

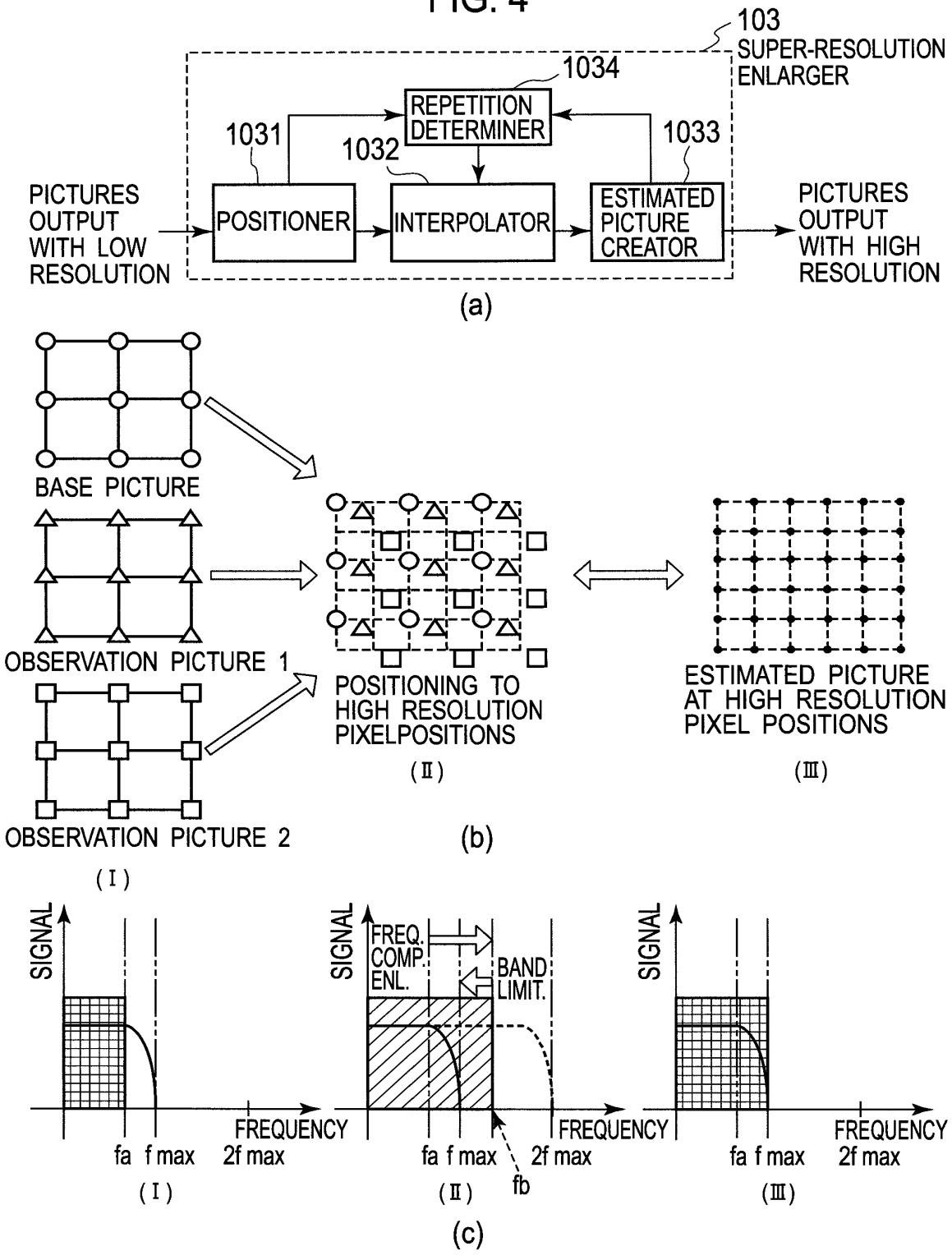

103
SUPER-RESOLUTION ENLARGER
1034
REPETITION DETERMINER
1031
1032
1033
PICTURES OUTPUT WITH LOW RESOLUTION
POSITIONER
INTERPOLATOR
ESTIMATED PICTURE CREATOR
PICTURES OUTPUT WITH HIGH RESOLUTION
(a)
BASE PICTURE
OBSERVATION PICTURE 1
OBSERVATION PICTURE 2
POSITIONING TO HIGH RESOLUTION PIXELPOSITIONS
ESTIMATED PICTURE AT HIGH RESOLUTION PIXEL POSITIONS
(I)
(II)
(III)
(b)
SIGNAL
FREQUENCY
fa
f max
2f max
FREQ. COMP. ENL.
BAND LIMIT.
fb
(I)
(II)
(III)
(c)

FIG. 5

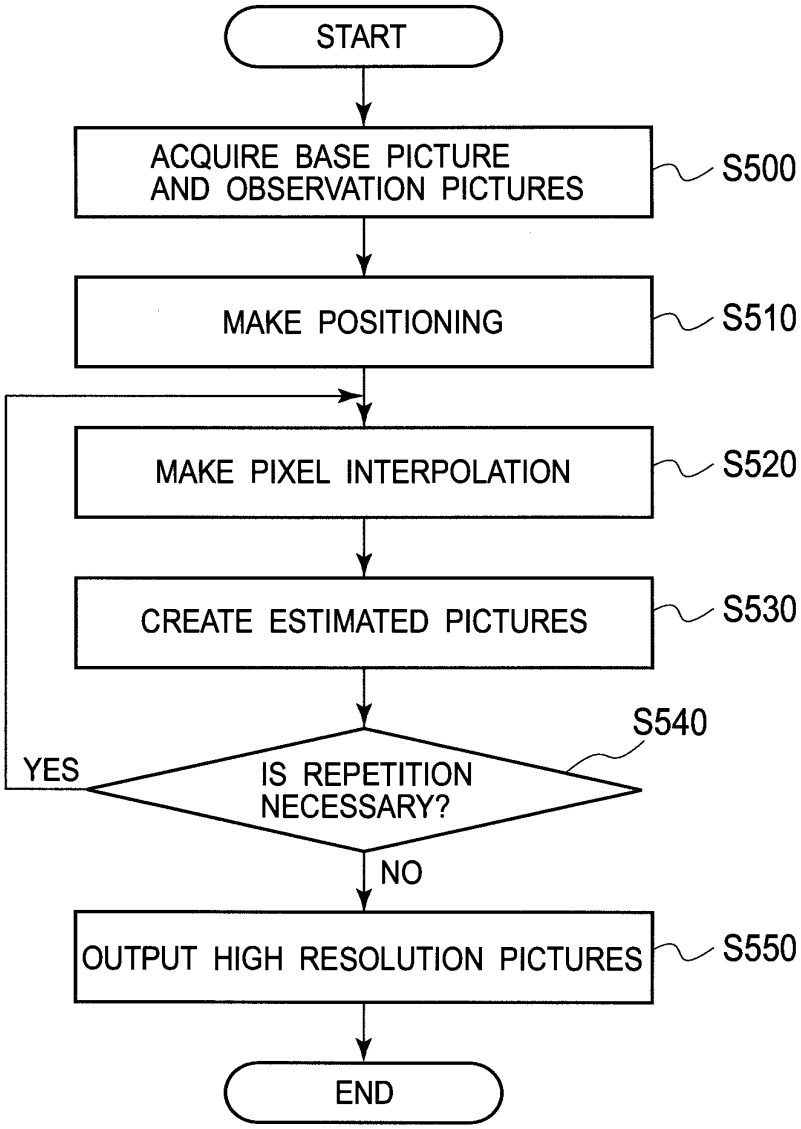
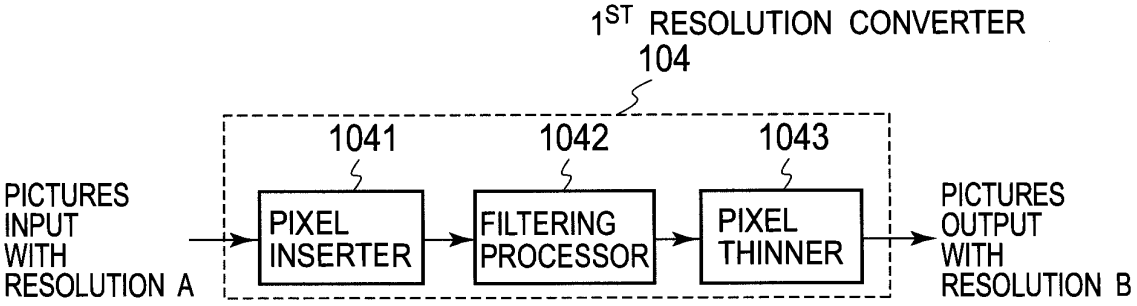
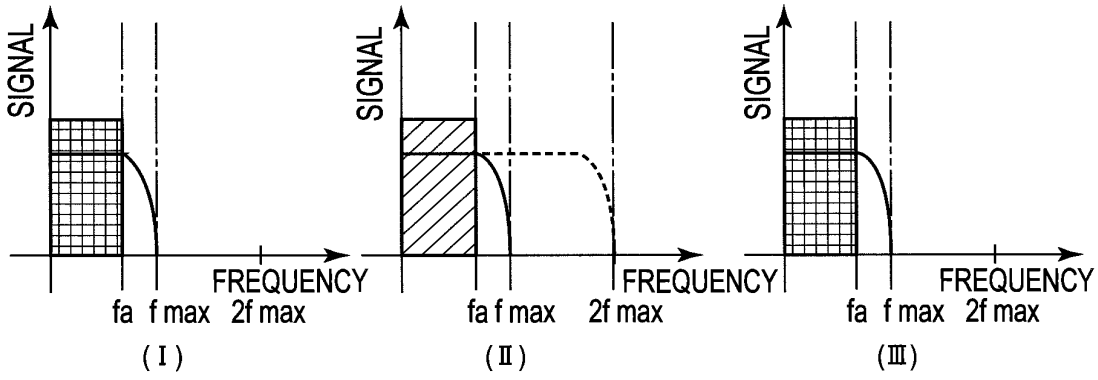

START
ACQUIRE BASE PICTURE AND OBSERVATION PICTURES
S500
MAKE POSITIONING
S510
MAKE PIXEL INTERPOLATION
S520
CREATE ESTIMATED PICTURES
S530
S540
YES
IS REPETITION NECESSARY?
NO
OUTPUT HIGH RESOLUTION PICTURES
S550
END

FIG. 6


1ST RESOLUTION CONVERTER
104
1041
1042
1043
PICTURES INPUT WITH RESOLUTION A
PIXEL INSERTER
FILTERING PROCESSOR
PIXEL THINNER
PICTURES OUTPUT WITH RESOLUTION B

(a)


SIGNAL
FREQUENCY
fa f max 2f max
(I)
SIGNAL
FREQUENCY
fa f max 2f max
(II)
SIGNAL
FREQUENCY
fa f max 2f max
(III)

(b)

FIG. 7

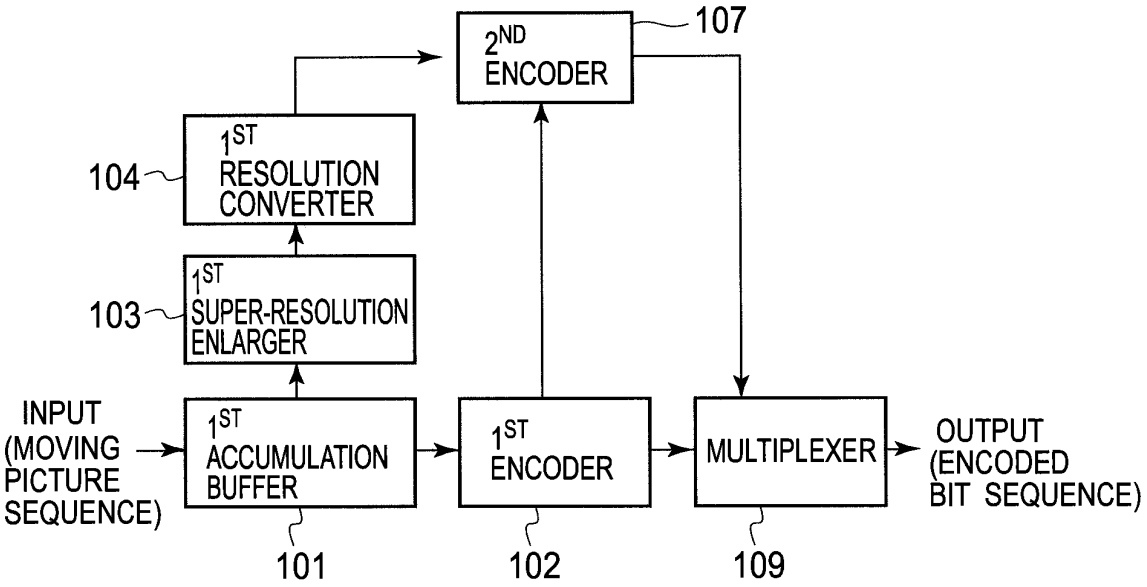

2ND ENCODER
107
1ST RESOLUTION CONVERTER
104
1ST SUPER-RESOLUTION ENLARGER
103
INPUT (MOVING PICTURE SEQUENCE)
1ST ACCUMULATION BUFFER
1ST ENCODER
MULTIPLEXER
OUTPUT (ENCODED BIT SEQUENCE)
101
102
109

FIG. 8

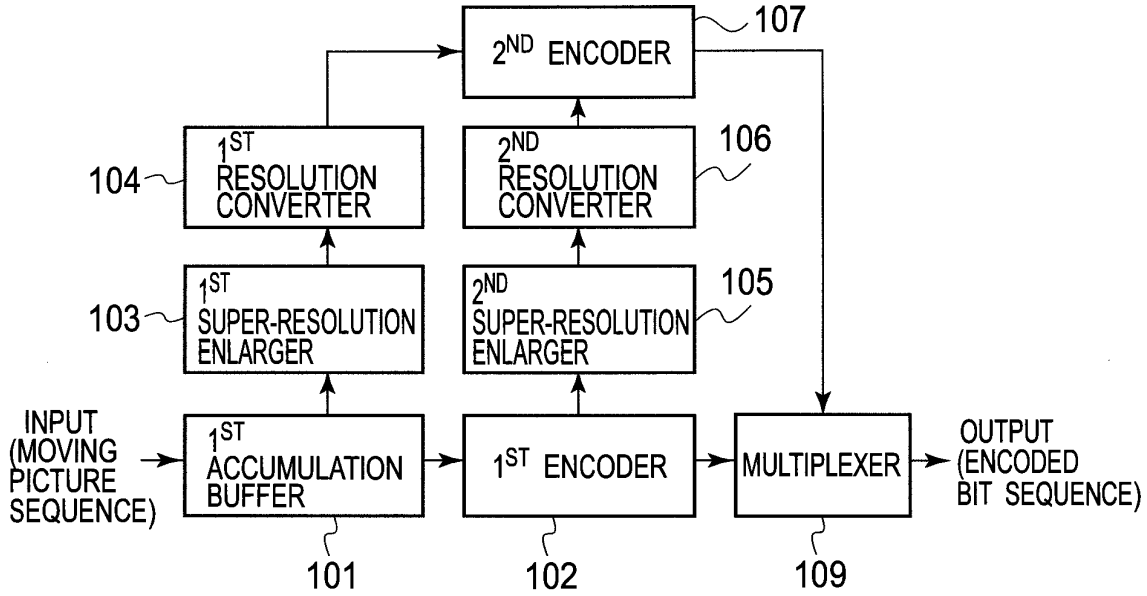

2ND ENCODER
107
1ST RESOLUTION CONVERTER
104
2ND RESOLUTION CONVERTER
106
1ST SUPER-RESOLUTION ENLARGER
103
2ND SUPER-RESOLUTION ENLARGER
105
INPUT (MOVING PICTURE SEQUENCE)
1ST ACCUMULATION BUFFER
1ST ENCODER
MULTIPLEXER
OUTPUT (ENCODED BIT SEQUENCE)
101
102
109

FIG. 9

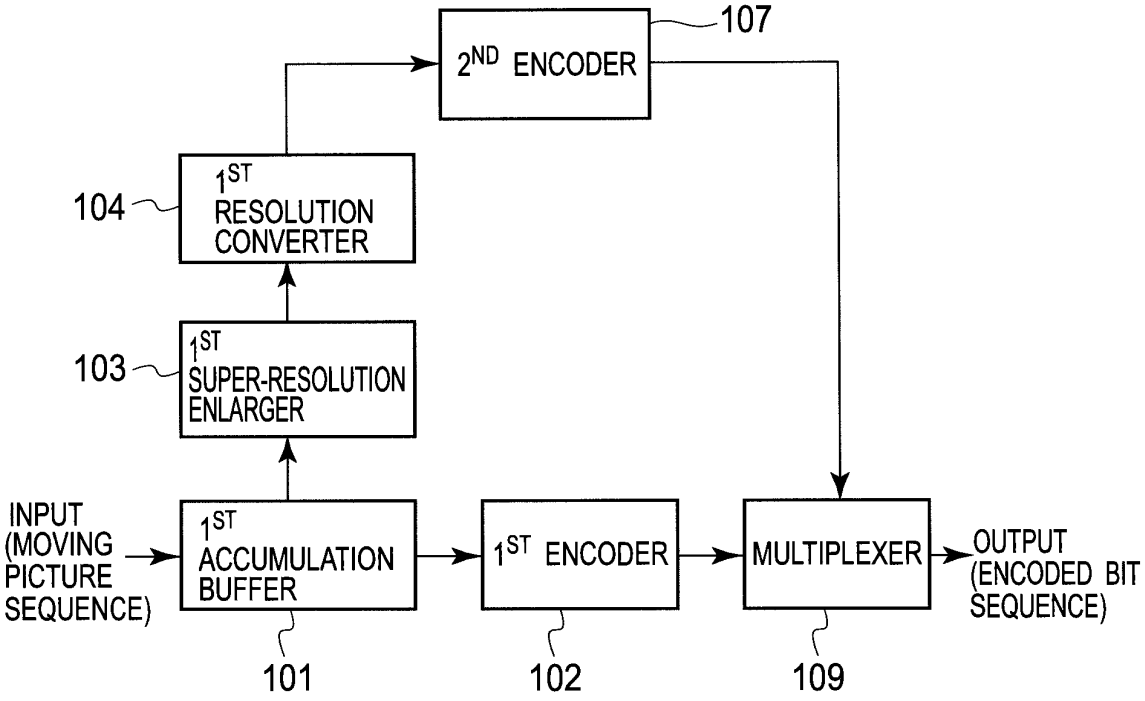

2ND ENCODER
107
1ST RESOLUTION CONVERTER
104
1ST SUPER-RESOLUTION ENLARGER
103
INPUT (MOVING PICTURE SEQUENCE)
1ST ACCUMULATION BUFFER
101
1ST ENCODER
102
MULTIPLEXER
109
OUTPUT (ENCODED BIT SEQUENCE)

FIG. 10

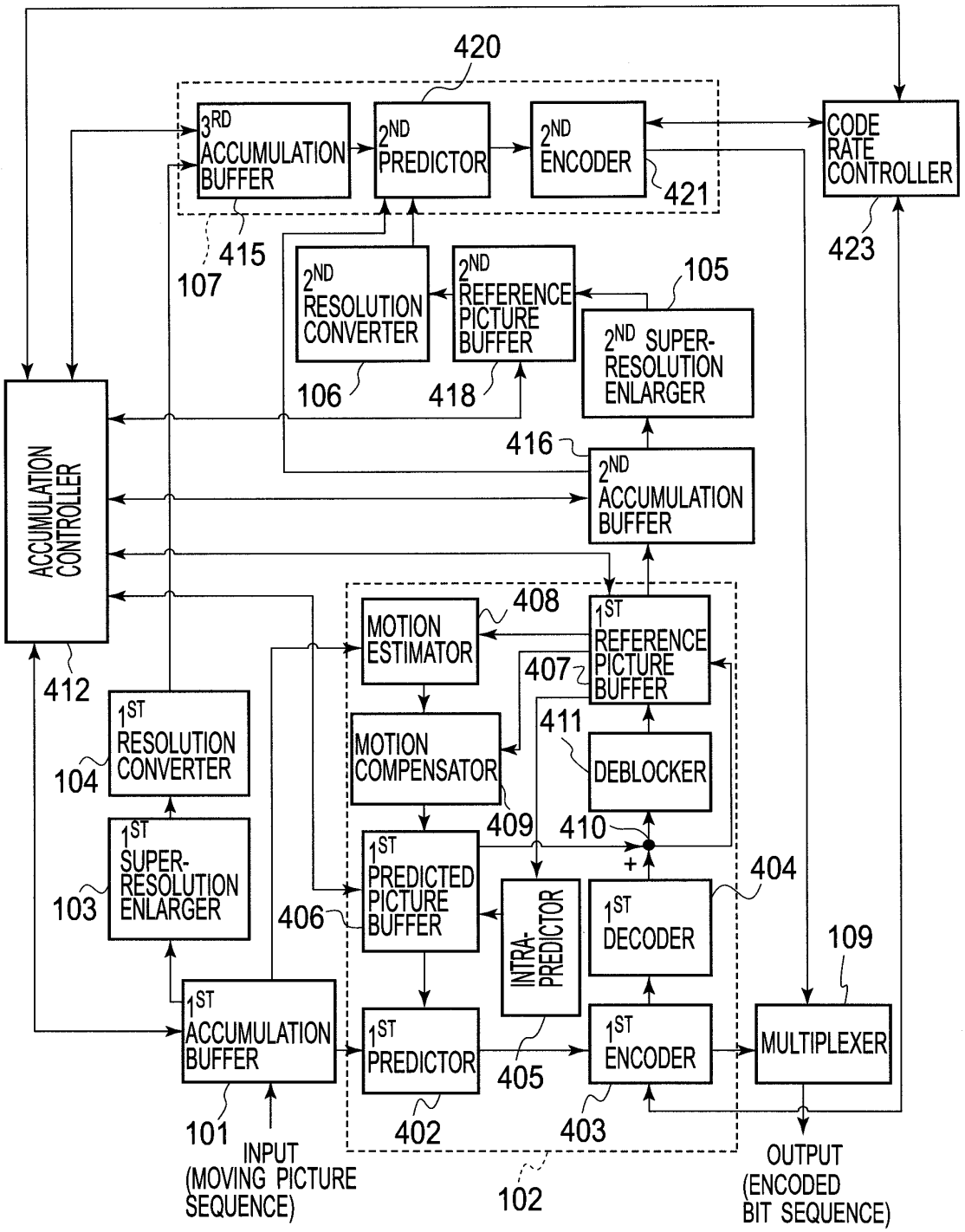

420
3RD ACCUMULATION BUFFER
2ND PREDICTOR
2ND ENCODER
421
CODE RATE CONTROLLER
423
415
107
2ND RESOLUTION CONVERTER
2ND REFERENCE PICTURE BUFFER
105
2ND SUPER-RESOLUTION ENLARGER
106
418
ACCUMULATION CONTROLLER
416
2ND ACCUMULATION BUFFER
408
MOTION ESTIMATOR
1ST REFERENCE PICTURE BUFFER
407
412
1ST RESOLUTION CONVERTER
411
MOTION COMPENSATOR
DEBLOCKER
104
409
410
1ST SUPER-RESOLUTION ENLARGER
1ST PREDICTED PICTURE BUFFER
404
103
406
INTRA-PREDICTOR
1ST DECODER
109
1ST ACCUMULATION BUFFER
1ST PREDICTOR
1ST ENCODER
MULTIPLEXER
405
101
402
403
INPUT (MOVING PICTURE SEQUENCE)
102
OUTPUT (ENCODED BIT SEQUENCE)

FIG. 11

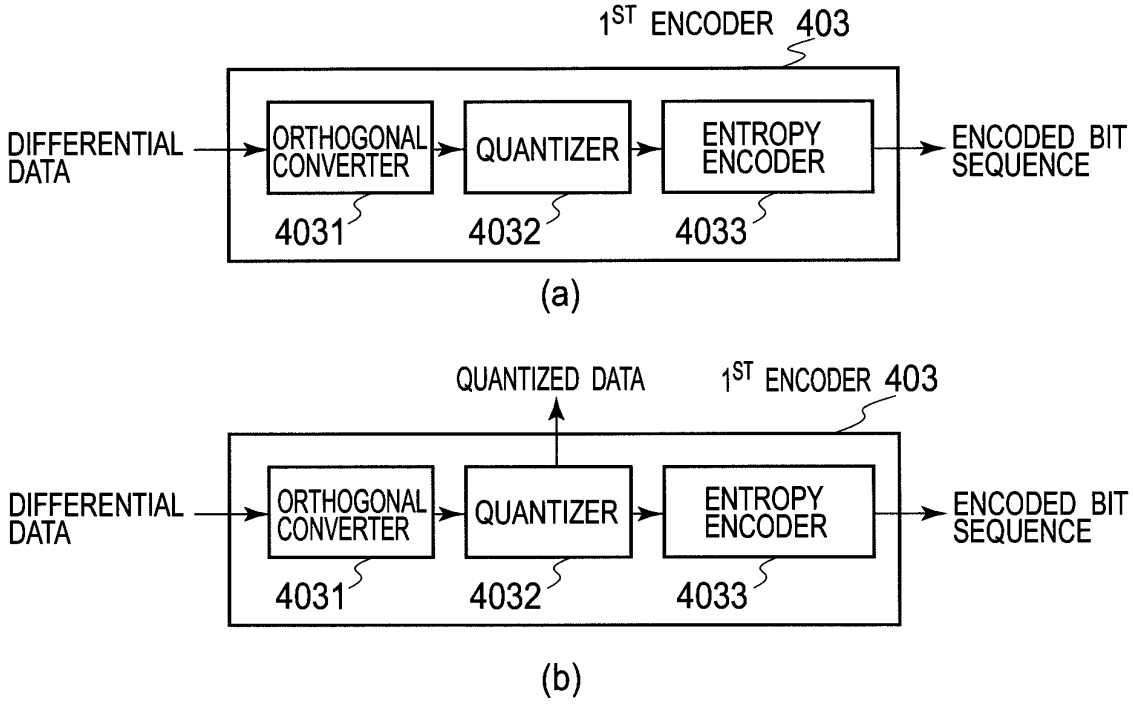

1ST ENCODER 403
DIFFERENTIAL DATA
ORTHOGONAL CONVERTER
QUANTIZER
ENTROPY ENCODER
ENCODED BIT SEQUENCE
4031
4032
4033
(a)
QUANTIZED DATA
1ST ENCODER 403
DIFFERENTIAL DATA
ORTHOGONAL CONVERTER
QUANTIZER
ENTROPY ENCODER
ENCODED BIT SEQUENCE
4031
4032
4033
(b)

FIG. 12

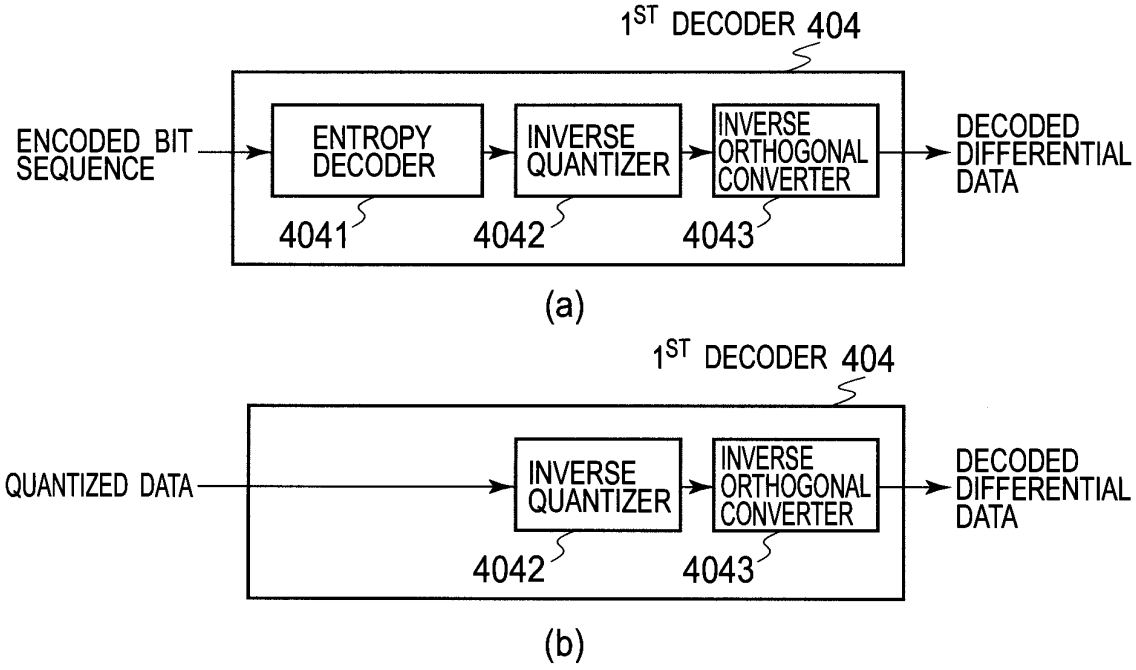

1ST DECODER 404
ENCODED BIT SEQUENCE
ENTROPY DECODER
INVERSE QUANTIZER
INVERSE ORTHOGONAL CONVERTER
DECODED DIFFERENTIAL DATA
4041
4042
4043
(a)
1ST DECODER 404
QUANTIZED DATA
INVERSE QUANTIZER
INVERSE ORTHOGONAL CONVERTER
DECODED DIFFERENTIAL DATA
4042
4043
(b)

FIG. 13

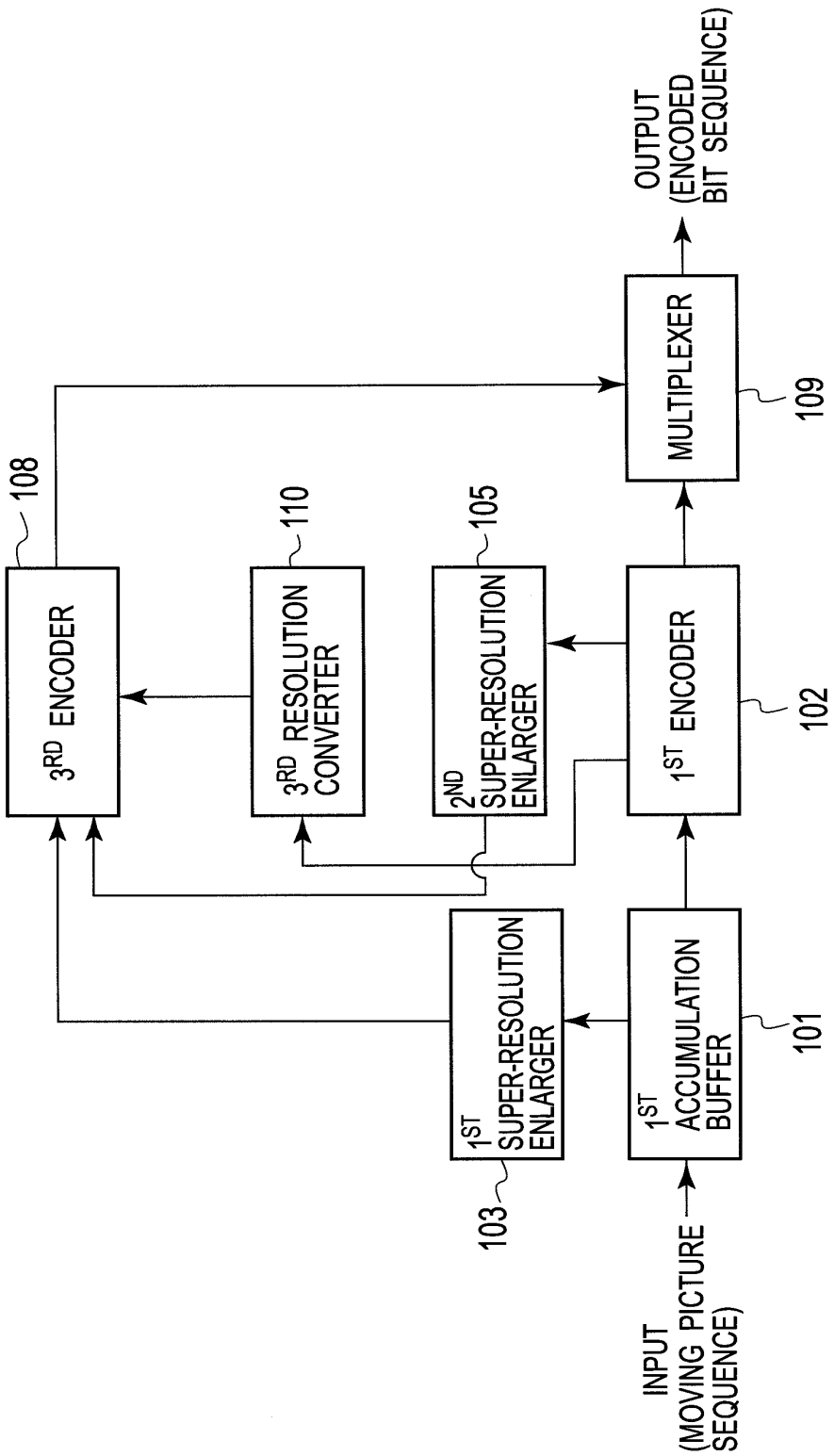

INPUT
(MOVING PICTURE
SEQUENCE)
1ST ACCUMULATION BUFFER
101
1ST SUPER-RESOLUTION ENLARGER
103
1ST ENCODER
102
2ND SUPER-RESOLUTION ENLARGER
105
3RD RESOLUTION CONVERTER
110
3RD ENCODER
108
MULTIPLEXER
109
OUTPUT
(ENCODED
BIT SEQUENCE)

FIG. 14

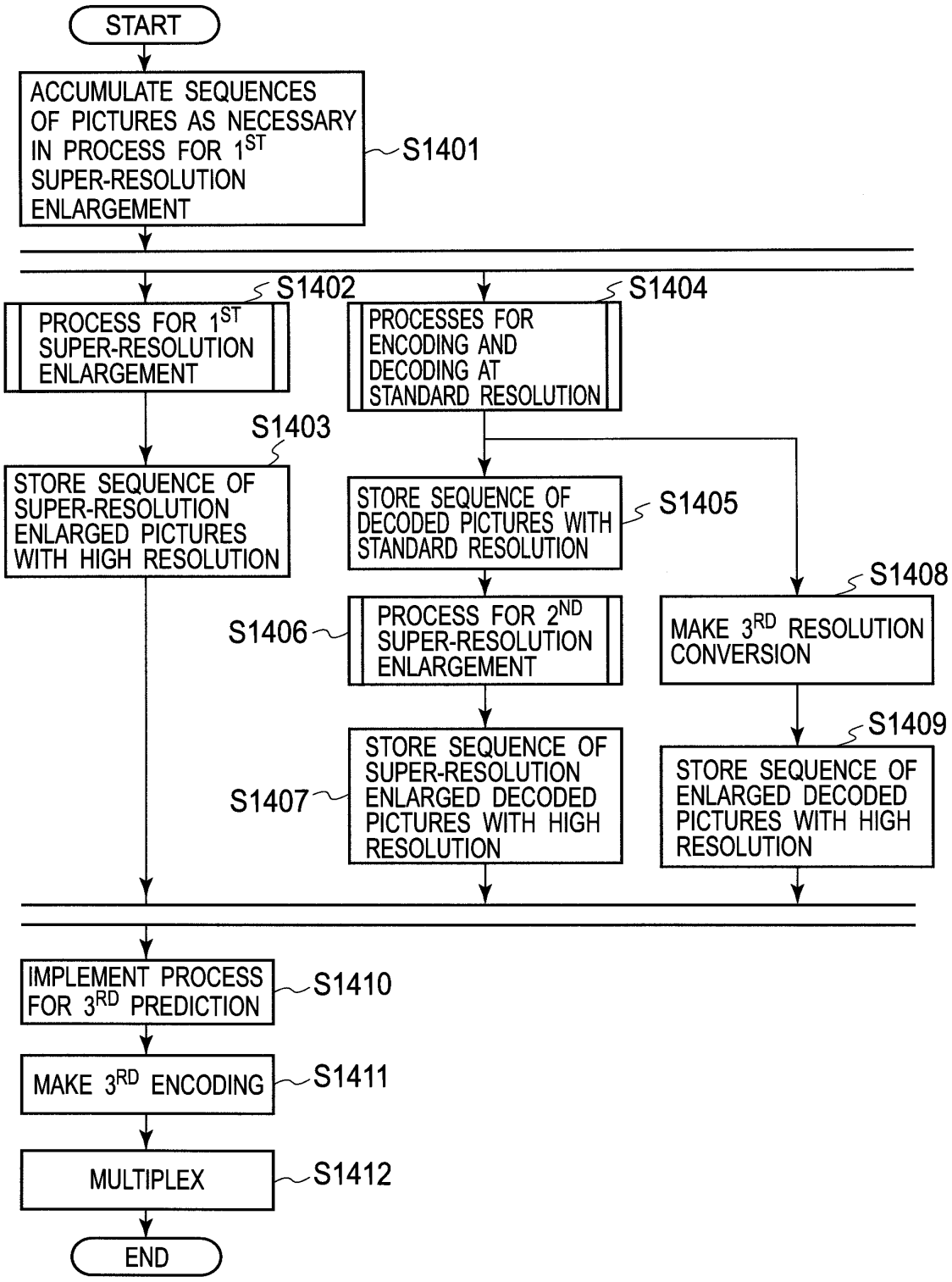

START
ACCUMULATE SEQUENCES OF PICTURES AS NECESSARY IN PROCESS FOR 1ST SUPER-RESOLUTION ENLARGEMENT
S1401
S1402
PROCESS FOR 1ST SUPER-RESOLUTION ENLARGEMENT
S1404
PROCESSES FOR ENCODING AND DECODING AT STANDARD RESOLUTION
S1403
STORE SEQUENCE OF SUPER-RESOLUTION ENLARGED PICTURES WITH HIGH RESOLUTION
STORE SEQUENCE OF DECODED PICTURES WITH STANDARD RESOLUTION
S1405
S1408
S1406
PROCESS FOR 2ND SUPER-RESOLUTION ENLARGEMENT
MAKE 3RD RESOLUTION CONVERSION
S1409
S1407
STORE SEQUENCE OF SUPER-RESOLUTION ENLARGED DECODED PICTURES WITH HIGH RESOLUTION
STORE SEQUENCE OF ENLARGED DECODED PICTURES WITH HIGH RESOLUTION
IMPLEMENT PROCESS FOR 3RD PREDICTION
S1410
MAKE 3RD ENCODING
S1411
MULTIPLEX
S1412
END

FIG. 15

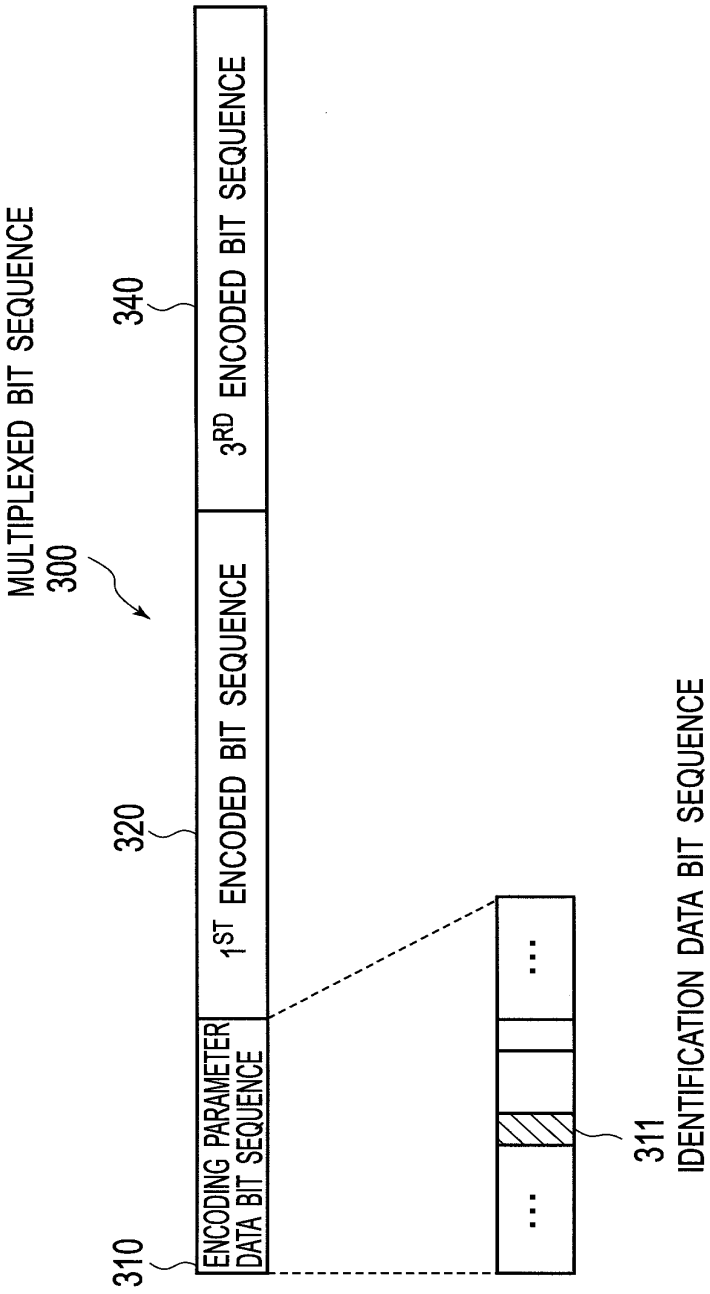

MULTIPLEXED BIT SEQUENCE
300
340
320
310
ENCODING PARAMETER DATA BIT SEQUENCE
1ST ENCODED BIT SEQUENCE
3RD ENCODED BIT SEQUENCE
...
...
311
IDENTIFICATION DATA BIT SEQUENCE

FIG. 16

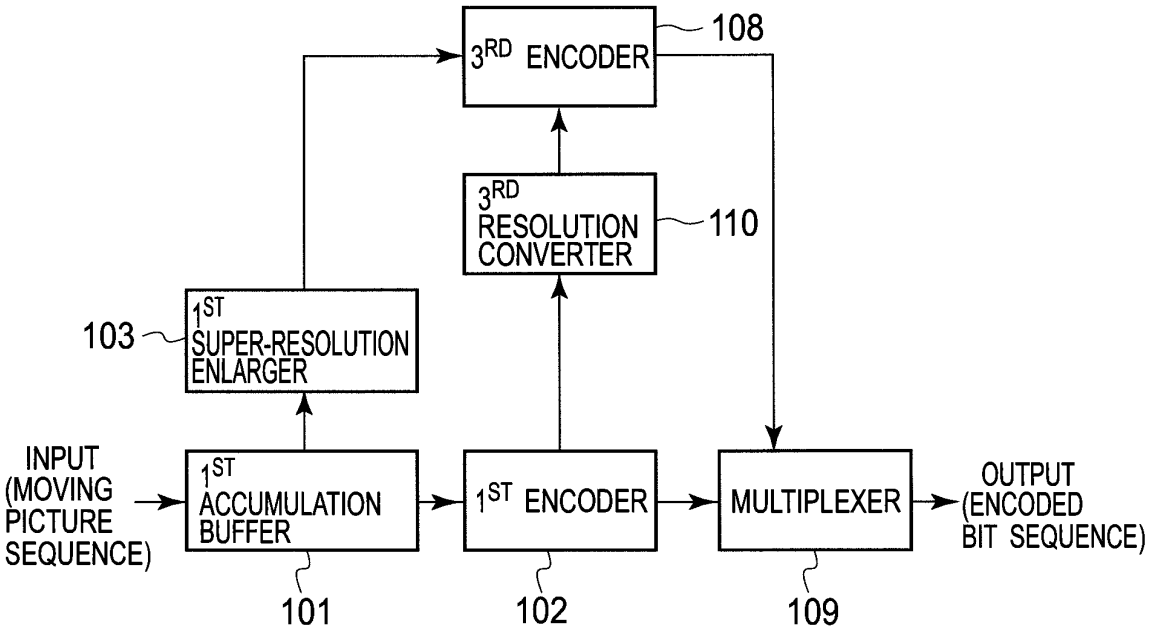

3RD ENCODER
108
3RD RESOLUTION CONVERTER
110
103
1ST SUPER-RESOLUTION ENLARGER
INPUT (MOVING PICTURE SEQUENCE)
1ST ACCUMULATION BUFFER
1ST ENCODER
MULTIPLEXER
OUTPUT (ENCODED BIT SEQUENCE)
101
102
109

FIG. 17

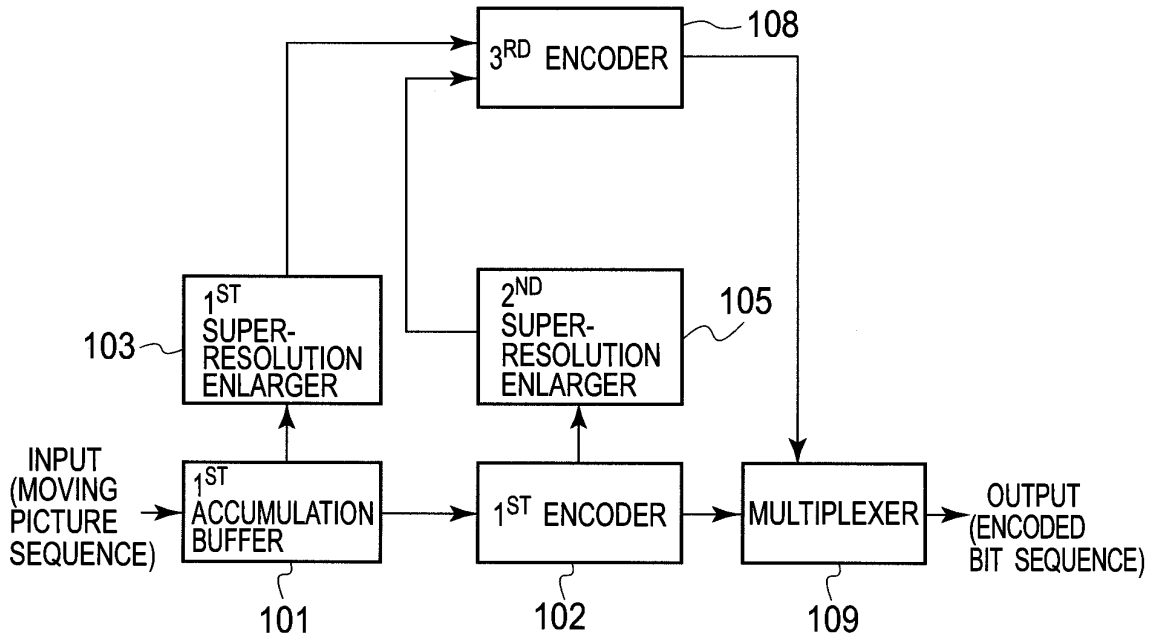

3RD ENCODER
108
103
1ST SUPER-RESOLUTION ENLARGER
2ND SUPER-RESOLUTION ENLARGER
105
INPUT (MOVING PICTURE SEQUENCE)
1ST ACCUMULATION BUFFER
1ST ENCODER
MULTIPLEXER
OUTPUT (ENCODED BIT SEQUENCE)
101
102
109

FIG. 18

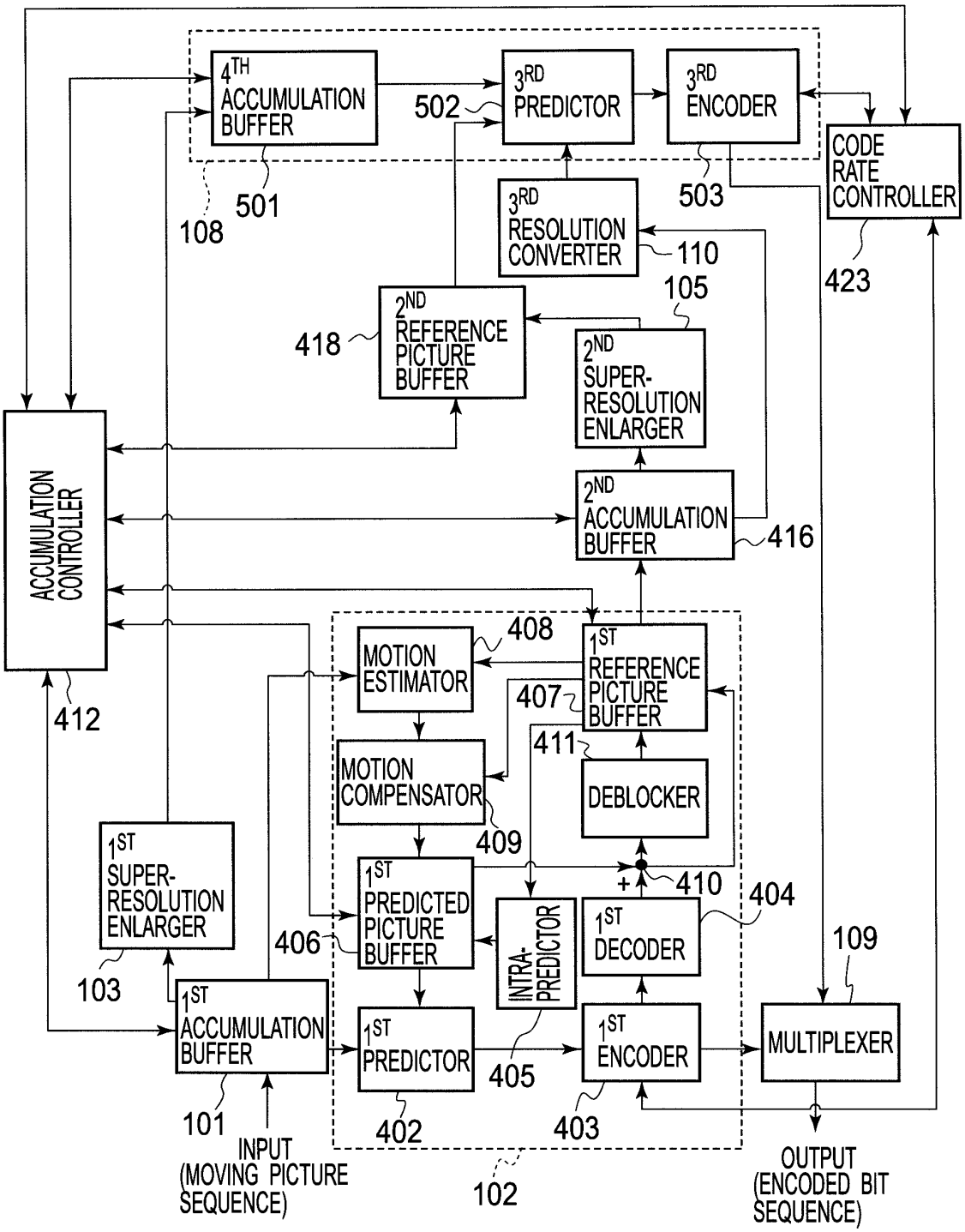

4TH ACCUMULATION BUFFER
502
3RD PREDICTOR
3RD ENCODER
CODE RATE CONTROLLER
108
501
503
3RD RESOLUTION CONVERTER
110
423
105
418
2ND REFERENCE PICTURE BUFFER
2ND SUPER-RESOLUTION ENLARGER
ACCUMULATION CONTROLLER
2ND ACCUMULATION BUFFER
416
408
MOTION ESTIMATOR
1ST REFERENCE PICTURE BUFFER
407
412
411
MOTION COMPENSATOR
DEBLOCKER
409
1ST SUPER-RESOLUTION ENLARGER
1ST PREDICTED PICTURE BUFFER
410
404
406
INTRA-PREDICTOR
1ST DECODER
109
103
1ST ACCUMULATION BUFFER
1ST PREDICTOR
1ST ENCODER
MULTIPLEXER
405
101
402
403
INPUT (MOVING PICTURE SEQUENCE)
102
OUTPUT (ENCODED BIT SEQUENCE)

FIG. 19

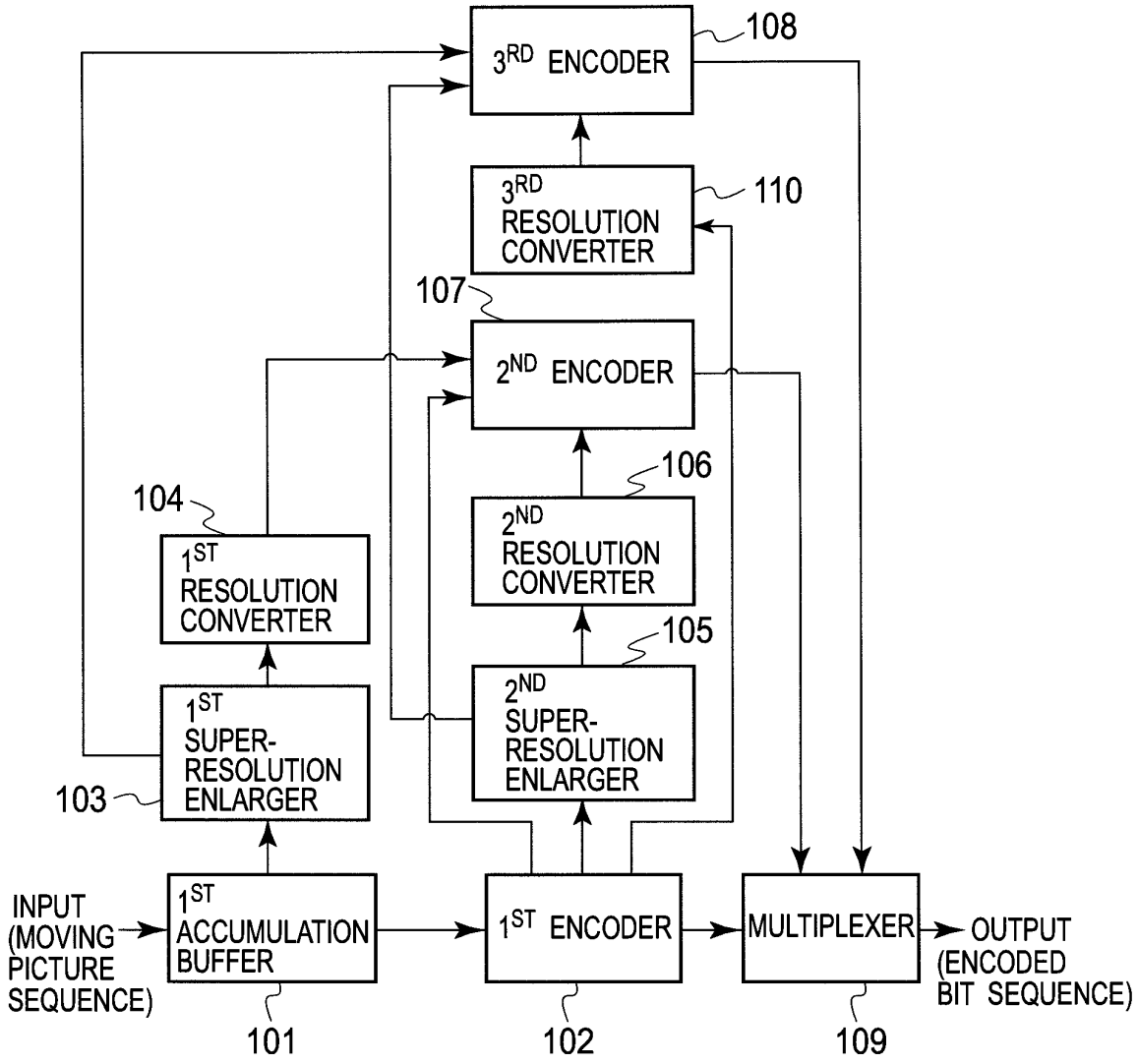

3RD ENCODER
108
3RD RESOLUTION CONVERTER
110
107
2ND ENCODER
106
2ND RESOLUTION CONVERTER
105
2ND SUPER-RESOLUTION ENLARGER
104
1ST RESOLUTION CONVERTER
1ST SUPER-RESOLUTION ENLARGER
103
INPUT (MOVING PICTURE SEQUENCE)
1ST ACCUMULATION BUFFER
101
1ST ENCODER
102
MULTIPLEXER
109
OUTPUT (ENCODED BIT SEQUENCE)

FIG. 20

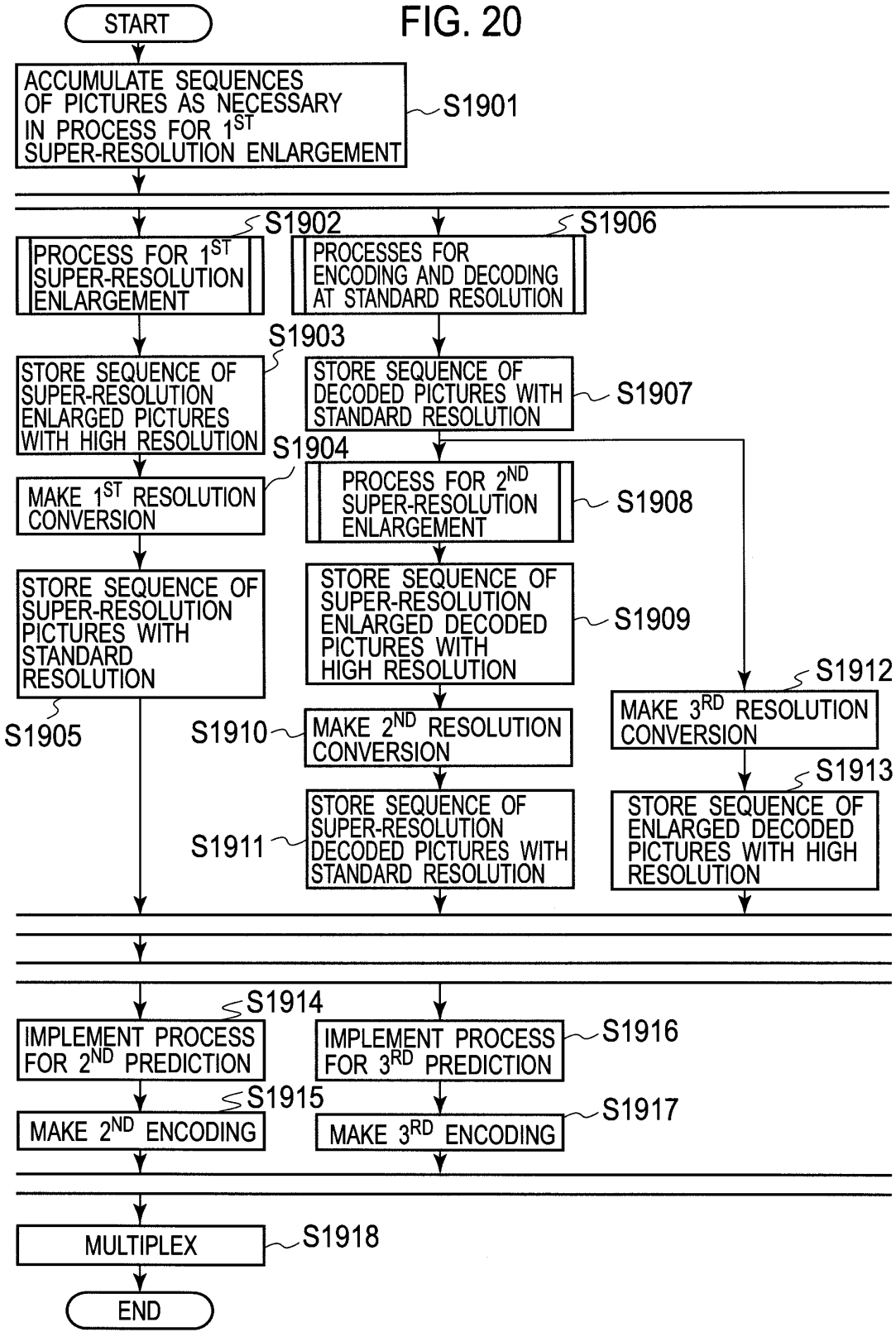

START
ACCUMULATE SEQUENCES OF PICTURES AS NECESSARY IN PROCESS FOR 1ST SUPER-RESOLUTION ENLARGEMENT
S1901
S1902
PROCESS FOR 1ST SUPER-RESOLUTION ENLARGEMENT
S1906
PROCESSES FOR ENCODING AND DECODING AT STANDARD RESOLUTION
S1903
STORE SEQUENCE OF SUPER-RESOLUTION ENLARGED PICTURES WITH HIGH RESOLUTION
STORE SEQUENCE OF DECODED PICTURES WITH STANDARD RESOLUTION
S1907
S1904
MAKE 1ST RESOLUTION CONVERSION
PROCESS FOR 2ND SUPER-RESOLUTION ENLARGEMENT
S1908
STORE SEQUENCE OF SUPER-RESOLUTION PICTURES WITH STANDARD RESOLUTION
STORE SEQUENCE OF SUPER-RESOLUTION ENLARGED DECODED PICTURES WITH HIGH RESOLUTION
S1909
S1912
MAKE 3RD RESOLUTION CONVERSION
S1905
S1910
MAKE 2ND RESOLUTION CONVERSION
S1913
STORE SEQUENCE OF SUPER-RESOLUTION DECODED PICTURES WITH STANDARD RESOLUTION
S1911
STORE SEQUENCE OF ENLARGED DECODED PICTURES WITH HIGH RESOLUTION
S1914
IMPLEMENT PROCESS FOR 2ND PREDICTION
IMPLEMENT PROCESS FOR 3RD PREDICTION
S1916
S1915
MAKE 2ND ENCODING
MAKE 3RD ENCODING
S1917
MULTIPLEX
S1918
END

FIG. 21

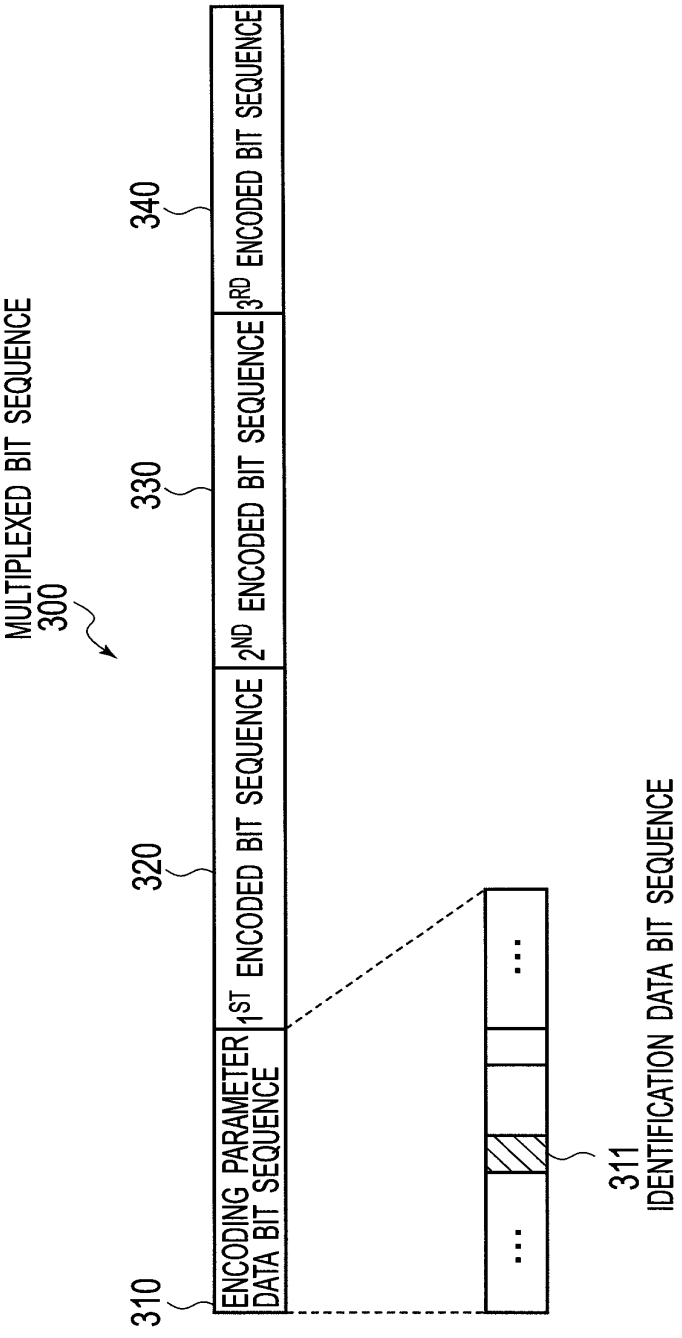

MULTIPLEXED BIT SEQUENCE
300
310
ENCODING PARAMETER DATA BIT SEQUENCE
320
1ST ENCODED BIT SEQUENCE
330
2ND ENCODED BIT SEQUENCE
340
3RD ENCODED BIT SEQUENCE
311
IDENTIFICATION DATA BIT SEQUENCE

FIG. 22

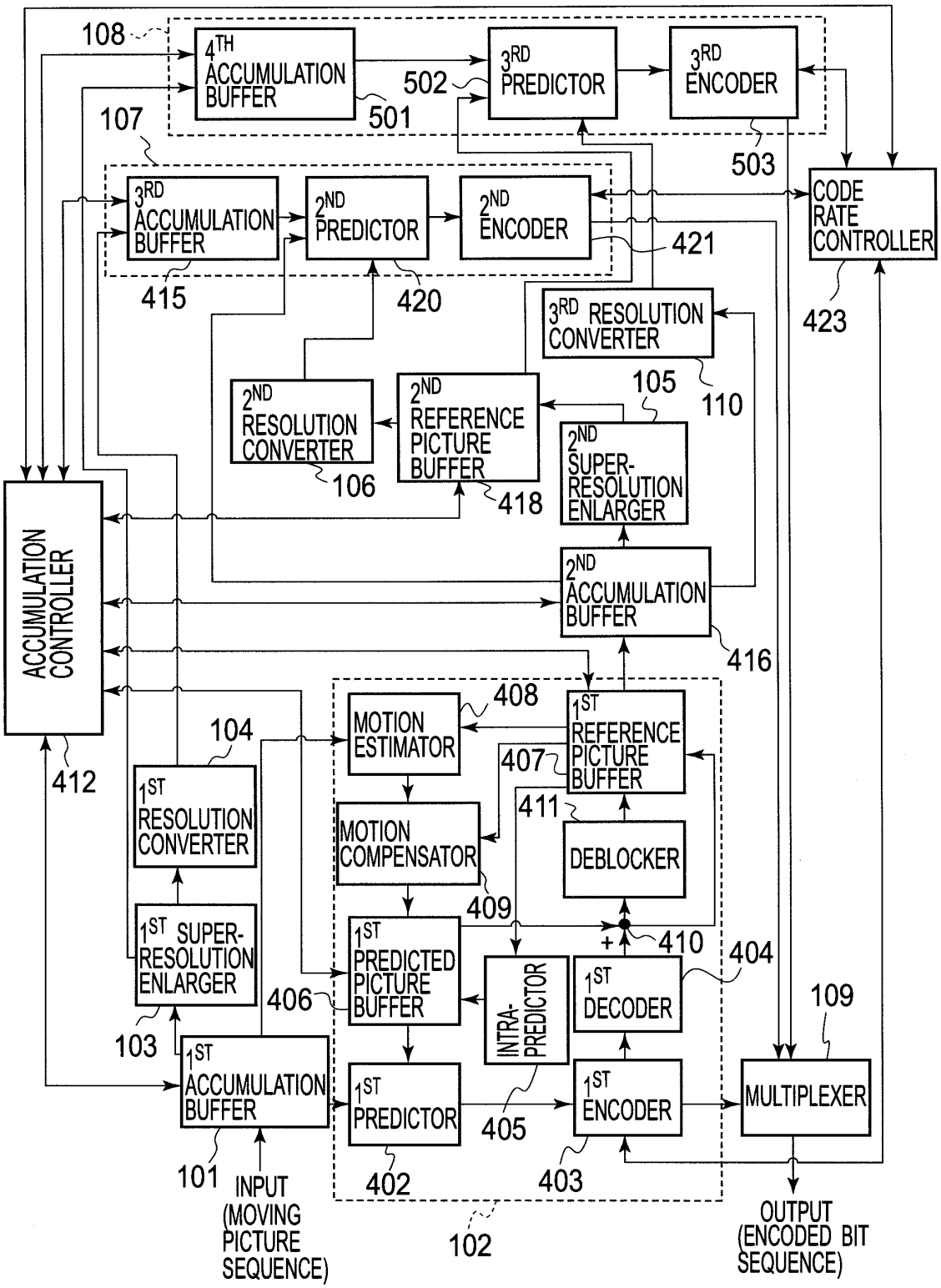

108
4TH ACCUMULATION BUFFER
501
502
3RD PREDICTOR
3RD ENCODER
503
107
3RD ACCUMULATION BUFFER
415
2ND PREDICTOR
420
2ND ENCODER
421
CODE RATE CONTROLLER
423
3RD RESOLUTION CONVERTER
110
105
2ND RESOLUTION CONVERTER
106
2ND REFERENCE PICTURE BUFFER
418
2ND SUPER-RESOLUTION ENLARGER
ACCUMULATION CONTROLLER
2ND ACCUMULATION BUFFER
416
412
104
MOTION ESTIMATOR
408
1ST REFERENCE PICTURE BUFFER
407
1ST RESOLUTION CONVERTER
MOTION COMPENSATOR
411
DEBLOCKER
409
1ST SUPER-RESOLUTION ENLARGER
1ST PREDICTED PICTURE BUFFER
410
404
406
INTRA-PREDICTOR
1ST DECODER
109
103
1ST ACCUMULATION BUFFER
1ST PREDICTOR
405
1ST ENCODER
MULTIPLEXER
101
INPUT (MOVING PICTURE SEQUENCE)
402
403
102
OUTPUT (ENCODED BIT SEQUENCE)

FIG. 23

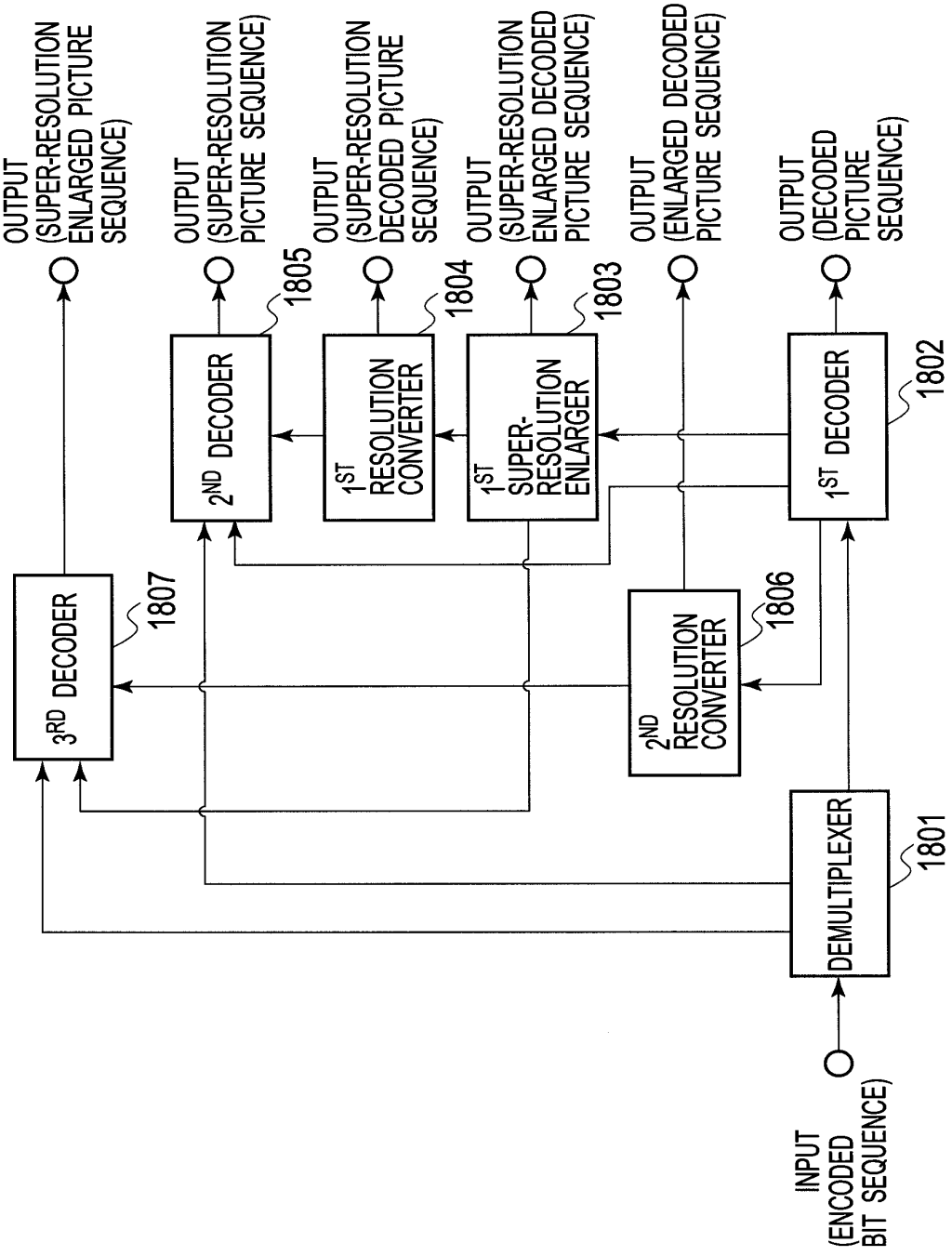

INPUT (ENCODED BIT SEQUENCE)
DEMULTIPLEXER
1801
1ST DECODER
1802
2ND RESOLUTION CONVERTER
1806
3RD DECODER
1807
1ST SUPER-RESOLUTION ENLARGER
1803
1ST RESOLUTION CONVERTER
1804
2ND DECODER
1805
OUTPUT (DECODED PICTURE SEQUENCE)
OUTPUT (ENLARGED DECODED PICTURE SEQUENCE)
OUTPUT (SUPER-RESOLUTION ENLARGED DECODED PICTURE SEQUENCE)
OUTPUT (SUPER-RESOLUTION DECODED PICTURE SEQUENCE)
OUTPUT (SUPER-RESOLUTION PICTURE SEQUENCE)
OUTPUT (SUPER-RESOLUTION ENLARGED PICTURE SEQUENCE)

FIG. 24

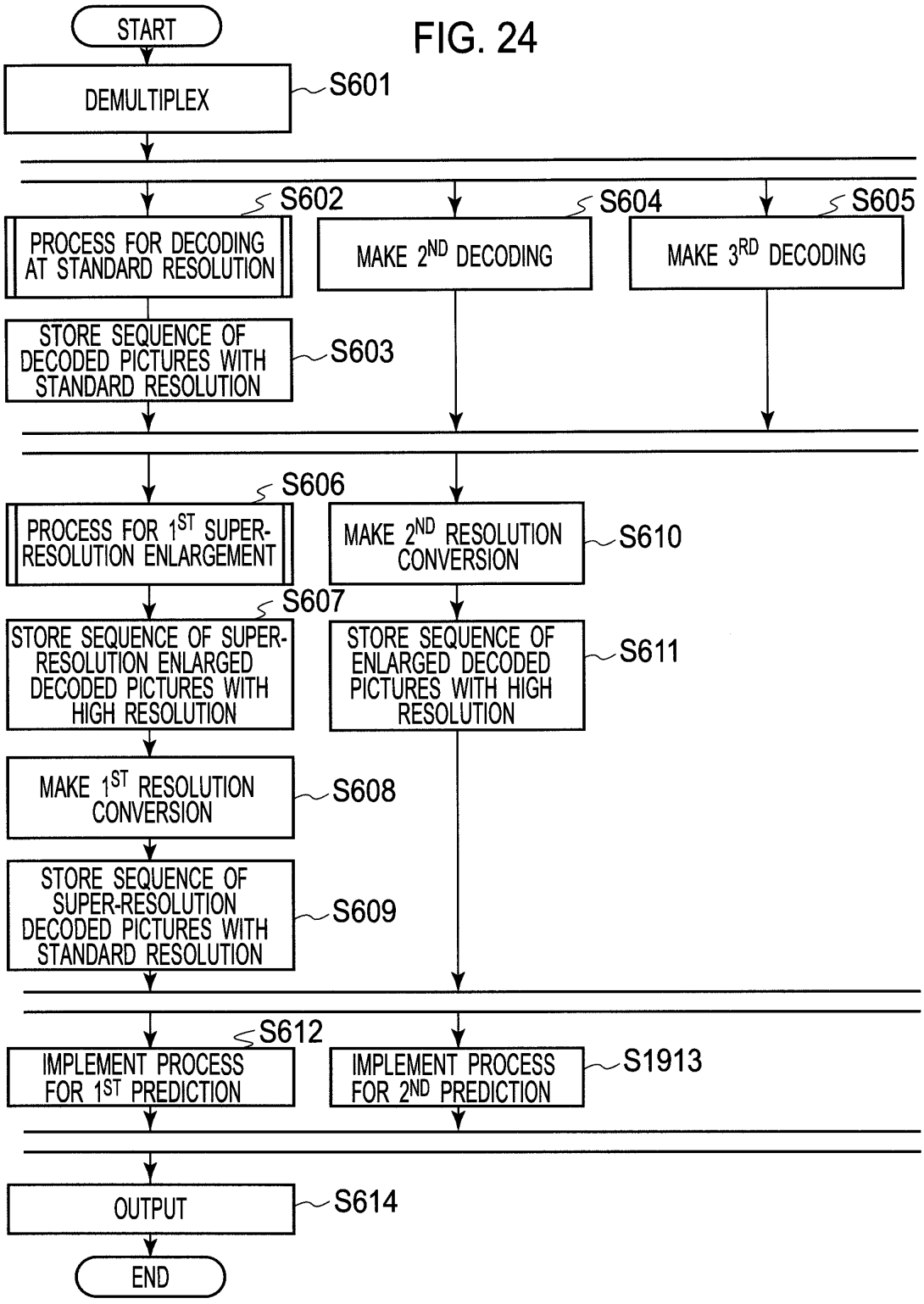

START
DEMULTIPLEX
S601
S602
S604
S605
PROCESS FOR DECODING AT STANDARD RESOLUTION
MAKE 2ND DECODING
MAKE 3RD DECODING
STORE SEQUENCE OF DECODED PICTURES WITH STANDARD RESOLUTION
S603
S606
PROCESS FOR 1ST SUPER-RESOLUTION ENLARGEMENT
MAKE 2ND RESOLUTION CONVERSION
S610
S607
STORE SEQUENCE OF SUPER-RESOLUTION ENLARGED DECODED PICTURES WITH HIGH RESOLUTION
STORE SEQUENCE OF ENLARGED DECODED PICTURES WITH HIGH RESOLUTION
S611
MAKE 1ST RESOLUTION CONVERSION
S608
STORE SEQUENCE OF SUPER-RESOLUTION DECODED PICTURES WITH STANDARD RESOLUTION
S609
S612
IMPLEMENT PROCESS FOR 1ST PREDICTION
IMPLEMENT PROCESS FOR 2ND PREDICTION
S1913
OUTPUT
S614
END

FIG. 25

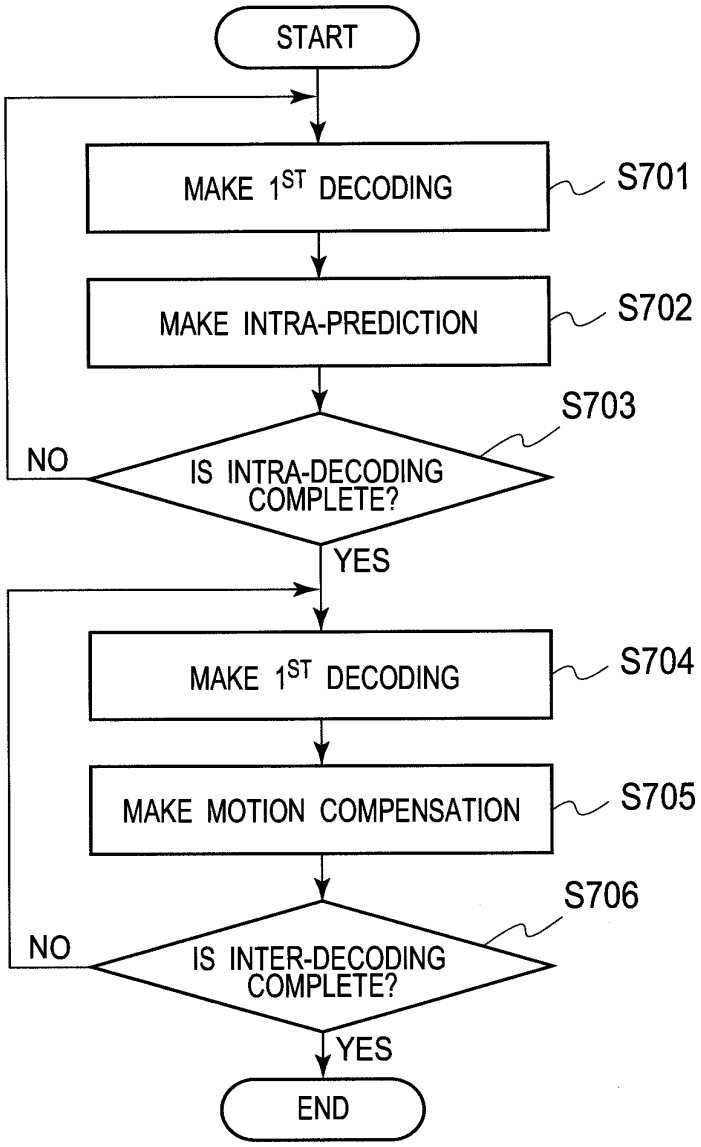

START
MAKE 1ST DECODING
S701
MAKE INTRA-PREDICTION
S702
S703
NO
IS INTRA-DECODING COMPLETE?
YES
MAKE 1ST DECODING
S704
MAKE MOTION COMPENSATION
S705
S706
NO
IS INTER-DECODING COMPLETE?
YES
END

FIG. 26

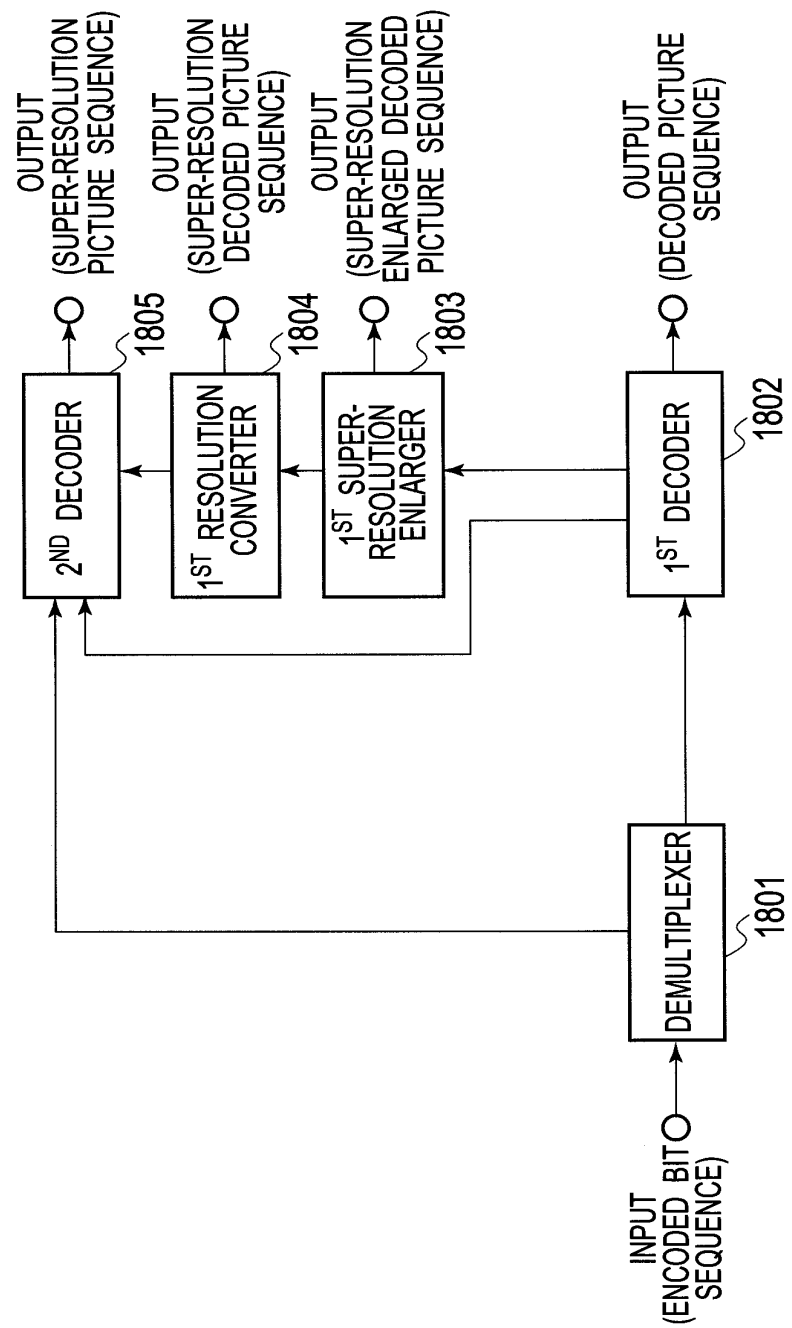

INPUT (ENCODED BIT SEQUENCE)
DEMULTIPLEXER
1801
1ST DECODER
1802
1ST SUPER-RESOLUTION ENLARGER
1803
1ST RESOLUTION CONVERTER
1804
2ND DECODER
1805
OUTPUT (DECODED PICTURE SEQUENCE)
OUTPUT (SUPER-RESOLUTION ENLARGED DECODED PICTURE SEQUENCE)
OUTPUT (SUPER-RESOLUTION DECODED PICTURE SEQUENCE)
OUTPUT (SUPER-RESOLUTION PICTURE SEQUENCE)

FIG. 27

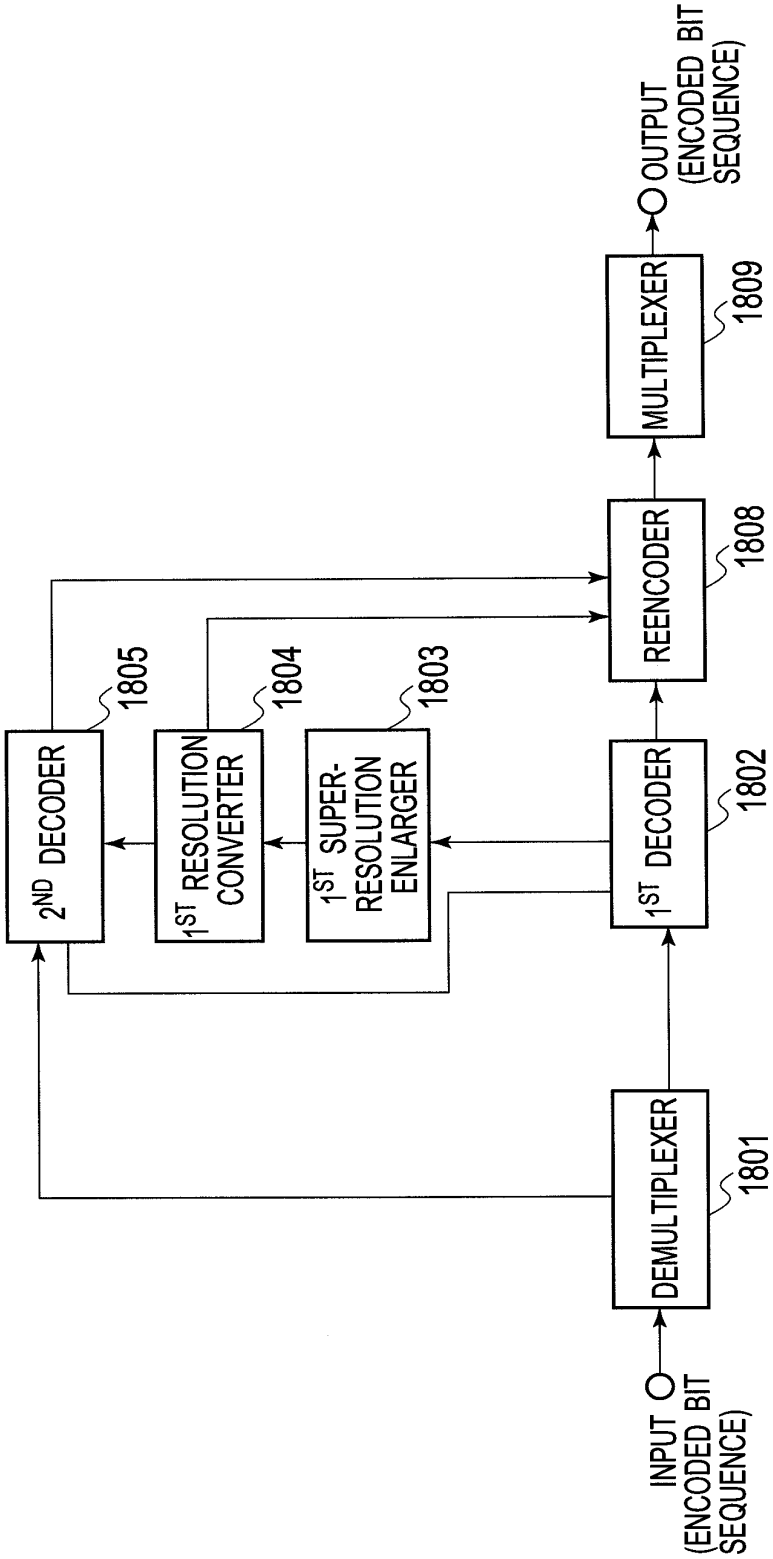
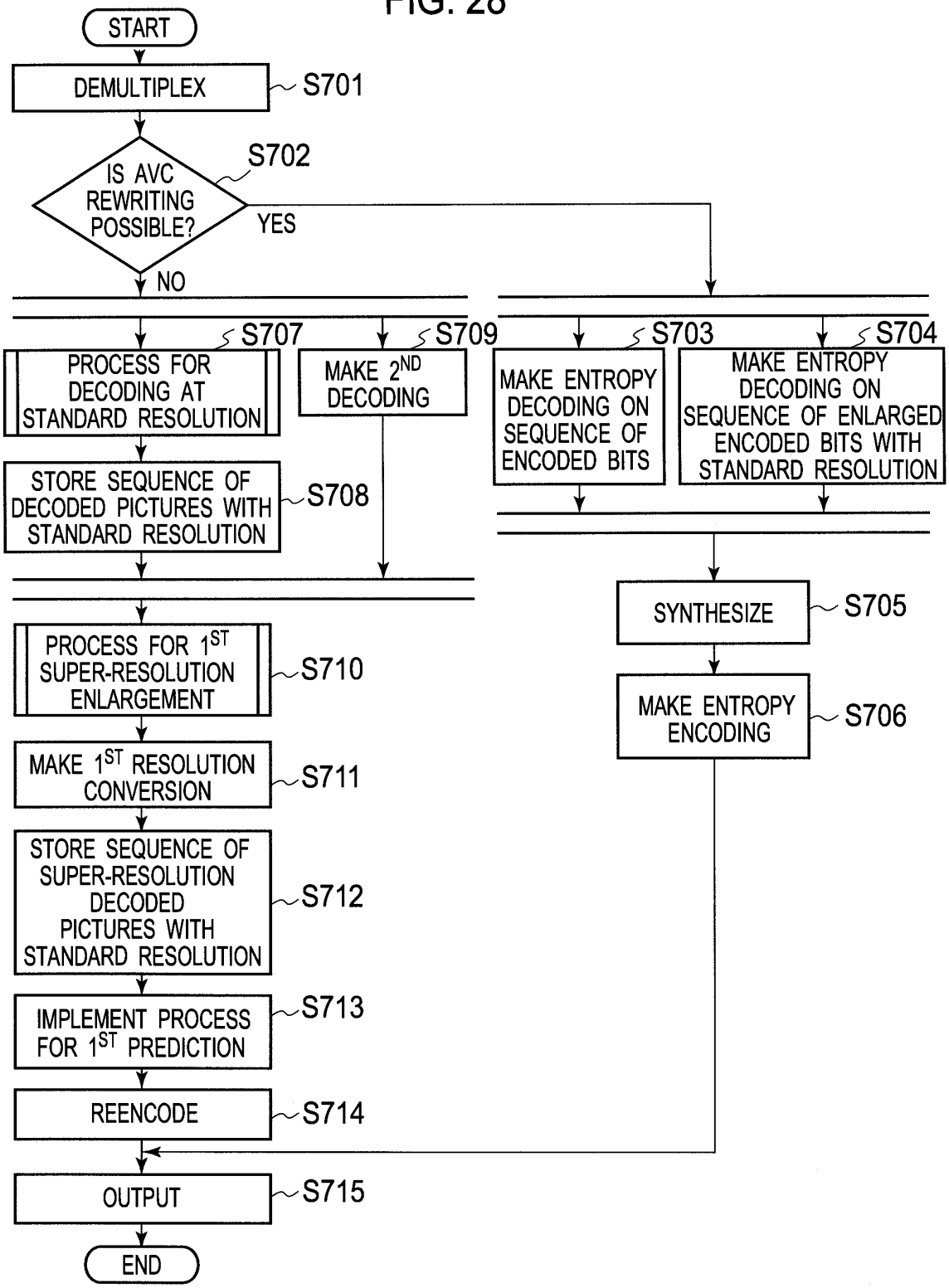

INPUT (ENCODED BIT SEQUENCE)
DEMULTIPLEXER
1801
1ST DECODER
1802
1ST SUPER-RESOLUTION ENLARGER
1803
1ST RESOLUTION CONVERTER
1804
2ND DECODER
1805
REENCODER
1808
MULTIPLEXER
1809
OUTPUT (ENCODED BIT SEQUENCE)

FIG. 28


START
DEMULTIPLEX
S701
IS AVC REWRITING POSSIBLE?
S702
YES
NO
S707
PROCESS FOR DECODING AT STANDARD RESOLUTION
S709
MAKE 2ND DECODING
S703
MAKE ENTROPY DECODING ON SEQUENCE OF ENCODED BITS
S704
MAKE ENTROPY DECODING ON SEQUENCE OF ENLARGED ENCODED BITS WITH STANDARD RESOLUTION
STORE SEQUENCE OF DECODED PICTURES WITH STANDARD RESOLUTION
S708
SYNTHESIZE
S705
PROCESS FOR 1ST SUPER-RESOLUTION ENLARGEMENT
S710
MAKE ENTROPY ENCODING
S706
MAKE 1ST RESOLUTION CONVERSION
S711
STORE SEQUENCE OF SUPER-RESOLUTION DECODED PICTURES WITH STANDARD RESOLUTION
S712
IMPLEMENT PROCESS FOR 1ST PREDICTION
S713
REENCODE
S714
OUTPUT
S715
END

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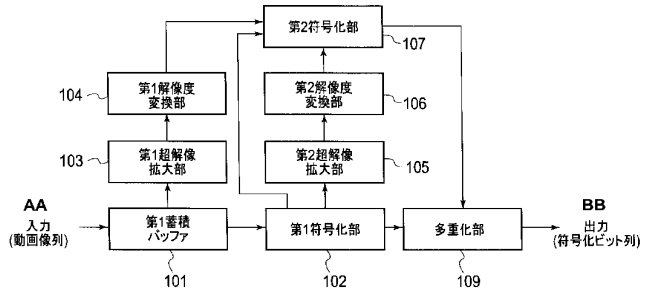
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(54) **Title**: DYNAMIC IMAGE ENCODER, DYNAMIC IMAGE ENCODING METHOD, DYNAMIC IMAGE ENCODING PROGRAM, DYNAMIC IMAGE DECODER, DYNAMIC IMAGE DECODING METHOD, DYNAMIC IMAGE DECODING PROGRAM, DYNAMIC IMAGE RE-ENCODER, DYNAMIC IMAGE RE-ENCODING METHOD, DYNAMIC IMAGE RE-ENCODING PROGRAM

(54) 発明の名称: 動画像符号化装置、動画像符号化方法、動画像符号化プログラム、動画像復号装置、動画像復号方法、動画像復号プログラム、動画像再符号化装置、動画像再符号化方法、動画像再符号化プログラム

[図1]



101 FIRST STORAGE BUFFER
102 FIRST ENCODER
103 FIRST SUPER-RESOLUTION IMAGE ENLARGEMENT UNIT
104 FIRST RESOLUTION CONVERTER
105 SECOND SUPER-RESOLUTION IMAGE ENLARGEMENT UNIT
106 SECOND RESOLUTION CONVERTER
107 SECOND ENCODER
109 MULTIPLEXER
AA INPUT (DYNAMIC IMAGE SEQUENCE)
BB OUTPUT (ENCODED BIT STREAM)

(57) **Abstract**: A first super-resolution image enlargement unit (103) includes frequency component information in the spatial direction and the temporal direction which could not be adequately displayed at the standard resolution although latently included in the input dynamic image by applying a super-resolution enlargement process to an input dynamic image having standard resolution. A first resolution converter (104) returns the signal which has undergone super-resolution image enlargement to the standard resolution. A second encoder (107) encodes the signal which has undergone super-resolution enlargement and which was returned to the standard resolution. A first encoder (102) encodes the input dynamic image having the standard resolution. A multiplexer (109) multiplexes the encoded bit stream from the first encoder (102) and the encoded bit stream from the second encoder (107). The second encoder (107) may use the locally decoded signal at the first encoder (102) or a processed version of that signal as the reference signal.

(57) 要約:

[続葉有]

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第１超解像拡大部１０３は、基準解像度の入力動画像に対し超解像拡大処理を行うことにより、入力動画像中に潜在的に含まれるが基準解像度では十分表現できていなかった空間方向および時間方向の周波数成分情報を含め、第１解像度変換部１０４がその超解像拡大後信号を基準解像度に戻し、第２符号化部１０７はその基準解像度に戻された超解像拡大後信号を符号化する。第１符号化部１０２は基準解像度の入力動画像を符号化し、多重化部１０９は第１符号化部１０２からの符号化ビット列と第２符号化部１０７からの符号化ビット列等とを多重化する。なお、第２符号化部１０７は第１符号化部１０２における局所復号信号またはそれを加工した信号を参照信号として使用しても良い。

明　細　書

発明の名称 ：

動画像符号化装置、動画像符号化方法、動画像符号化プログラム、動画像復号装置、動画像復号方法、動画像復号プログラム、動画像再符号化装置、動画像再符号化方法、動画像再符号化プログラム

技術分野

[0001] 本発明は、動画像列に対し超解像拡大処理等を行う動画像符号化装置、動画像符号化方法、動画像符号化プログラム、動画像復号装置、動画像復号方法、動画像復号プログラム、動画像再符号化装置、動画像再符号化方法、動画像再符号化プログラムに関する。

背景技術

[0002] 映像の空間解像度スケーラビリティを実現する従来技術として、例えば、ベースレイヤとエンハンスメントレイヤの２層の階層符号化装置において、エンハンスメントレイヤと同じ空間解像度の入力映像信号をベースレイヤの空間解像度に縮小（デシメーション）処理した後、ベースレイヤにて符号化し、そのベースレイヤ符号化の際のデコード信号を空間的に補間（インターポレーション）してエンハンスメントレイヤと同じ空間解像度にした信号とエンハンスメントレイヤと同じ空間解像度の入力映像信号との間で相関を利用した予測を行い、その予測誤差信号を符号化して、そこで得た符号化ビットストリームとベースレイヤ符号化で得られたビットストリームを多重化したものを復号装置へ伝送し、復号装置ではその多重化された符号化ビットストリームをその逆に復号するものがある（特許文献１参照。）。

先行技術文献

特許文献

[0003] 特許文献1：特開平７－１６２８７０号公報

発明の概要

発明が解決しようとする課題

[0004] ところで、ISO/IEC SC29 WG11において規格標準化されているMPEG-1、-2、-4/AVC/SVCなどに代表される動画像符号化では、局部復号（ローカルデコード）によって得られる復号ピクチャを参照ピクチャとして利用して動き推定により動きベクトル情報を生成し、動き補償により生成された動きベクトル情報を利用して、符号化対象となっている対象ピクチャに最も近い画像品質を持つような予測ピクチャを生成し、その後、対象ピクチャと予測ピクチャとの残差情報を求め、この残差情報に対して所定の符号化処理を行って、時間方向の相関性の高さを利用して高い符号化効率を実現している。つまり、予測ピクチャの画像品質を向上させ、対象ピクチャとの相関を高めることで、更なる符号化効率の向上が期待できる。しかし、十分な符号量を割り当てることができないと、動きベクトル情報の精度が十分でなくなったり、局部復号結果である参照ピクチャの画像品質が十分得られなくなったりすることによって、予測ピクチャの画像品質が低下し、結果として符号化効率が低下する。

[0005] また、上述の特許文献１やMPEG-4 SVCなどに代表される動画像の階層符号化でも、現在符号化を行おうとしている階層よりも下の階層の参照ピクチャから予測ピクチャもしくは予測ブロックを生成し、現在の階層の対象ピクチャもしくは対象ブロックとの間で階層間予測を行うことにより、異なる空間解像度間の相関性の高さを利用して更なる符号化効率の向上を図っている。しかし、時間方向の相関性の高さを利用する場合と同様に、階層間の相関性の高さを利用する場合も、十分な符号量を割り当てることができないと、予測ピクチャもしくは予測ブロックの画像品質は低下し、結果として符号化効率が低下してしまうという課題が生じる。

[0006] また、符号化対象として入力した動画像に対して所定の解像度変換処理を行って、入力した動画像の持つ空間解像度(以後、基準解像度)よりも低い空間解像度（以後、低解像度）の動画像を生成し、少なくとも2階層の動画像に対して階層間の相関性の高さを利用して階層符号化を行っている。しかし、

このような階層符号化では、仮に可逆の符号化処理を行った場合であっても、入力動画像の基準解像度によって、表現できる空間方向の空間周波数成分情報に帯域制限がかかるとともに、階層符号化を行う際に、階層符号化の局部復号、もしくは階層符号化によって得られる符号化ビットストリームを復号して得られる復号画像が、入力動画像に対して、符号化条件の下で最も入力動画像の画像品質に近くなるように符号化処理を行うことから、階層間の相関性を利用して新たな空間周波数成分情報の推定が可能であっても、基準解像度で表現できる空間周波数成分情報より多くのの空間周波数成分情報を符号化し、伝送することができないという課題が生じる。

[0007] そこで、本発明は、入力動画像の解像度で表現される空間周波数成分情報より多くのの空間周波数成分情報を符号化し、伝送することができる動画像符号化装置、動画像符号化方法、および動画像符号化プログラムを提供することを目的とする。また、本発明の動画像符号化装置、動画像符号化方法、および動画像符号化プログラムによって生成された符号化ビット列を取得して復号することができる動画像復号装置、動画像復号方法、動画像復号プログラムを提供することを目的とする。更に、復号後、再度符号化し、伝送することができる動画像再符号化装置、動画像再符号化方法、および動画像再符号化プログラムを提供することを目的とする。

課題を解決するための手段

[0008] 前記課題を解決するため、本発明の動画像符号化装置は、例えば図９に示すように、基準解像度の動画像列に対し第１の符号化および復号処理を行って前記基準解像度の第１符号化ビット列および基準解像度の復号画像を生成する第１符号化部と、基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像度をもつ超解像拡大・変換画像を生成する第１解像度変換部と、前記第１解像度変換部からの前記超解像拡大・変換画像を符号化対象画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成す

る第２符号化部と、を有する。

[0009] ここで、例えば図７に示すように、前記第２符号化部は、さらに、前記第１符号化部からの前記復号画像を参照画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する、ようにしても良い。

[0010] また、例えば図１および図８に示すように、さらに、前記第１符号化部から前記基準解像度の復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、前記超解像拡大復号画像に対し第２の解像度変換処理を行って基準解像度をもつ超解像拡大・変換復号画像を生成する第２解像度変換部と、を有し、前記第２符号化部は、さらに、前記第２解像度変換部からの前記超解像拡大・変換復号画像を参照画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する、ようにしても良い。

[0011] また、例えば図４の（ａ）に示すように、前記第１の超解像拡大部は、超解像拡大処理を行う際の基準となる基準画像と、少なくとも１枚の観測画像とに基づいて、所望の高解像度の画素位置への位置合わせを行い、不等間隔にサンプリングされた不均一高解像度画像を生成する位置合わせ器と、前記位置合わせ器にて生成された不均一高解像度画像に対し所定の不均一補間処理を行って、所望の高解像度を持つ補間画像を生成する補間器と、前記補間器にて生成された前記補間画像を取得して、所定の復元処理を行い、所望の解像度を持つ推定画像を生成する推定画像生成器と、前記位置合わせ器から前記不均一高解像度画像を取得するとともに、前記推定画像生成器から前記不均一推定画像を取得して、取得したそれぞれの画像を利用して、所定の判定方法に従って超解像拡大処理の繰り返しが必要か否かを判定し、その判定の結果、繰り返しが必要な場合は、前記補間器に対して処理を継続するための制御情報を供給する一方、繰り返しが必要ない場合には、前記推定画像生成器に対して超解像拡大処理結果である高解像度の推定画像を出力するための制御情報を出力する繰り返し判定器と、を有するようにしても良い。

[0012] また、例えば図１等に示すように、さらに、前記第１符号化部からの前記

第１符号化ビット列と、前記第２符号化部からの前記第２符号化ビット列と、前記第１符号化部における符号化および前記第２符号化部における符号化の際に使用した各種符号化パラメータ情報とを、所定の構文構造に基づいて多重化する多重化部、を有するようにしても良い。

[0013] また、例えば図１０に示すように、さらに、前記第１符号化部および前記第１超解像拡大部の前段に設けられ、基準解像度の前記動画像列を蓄積する第１蓄積バッファと、前記第１符号化部と前記第２符号化部の間に設けられ、前記第１符号化部からの前記復号画像を蓄積する第２蓄積バッファと、前記第１蓄積バッファと、前記第２蓄積バッファと、前記第１符号化部と、前記第２符号化部とにおける各バッファ蓄積量を検出し、各バッファ蓄積量を制御する蓄積制御部と、前記蓄積制御部における前記各バッファ蓄積量に基づいて、前記第１符号化部と前記第２符号化部とにおける符号量制御を行う符号量制御部と、を有するようにしても良い。

[0014] また、本発明の動画像符号化装置は、例えば図１３に示すように、基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、前記第１符号化部から前記復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、前記第１符号化部から前記復号画像を取得し、第３の解像度変換処理を行って基準解像度よりも高い解像度をもつ解像度変換拡大復号画像を生成する第３解像度変換部と、前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第２超解像拡大部からの前記超解像拡大復号画像と、前記第３超解像拡大部からの前記解像度変換拡大復号画像とを参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、を有する。

[0015] また、本発明の動画像符号化装置は、例えば図１６に示すように、基準解

像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、前記第１符号化部から前記復号画像を取得し、第３の解像度変換処理を行って基準解像度よりも高い解像度をもつ解像度変換拡大復号画像を生成する第３解像度変換部と、前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第３解像度変換部からの前記解像度変換拡大復号画像を参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、を有する。

[0016] また、本発明の動画像符号化装置は、例えば図１７に示すように、基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、前記第１符号化部から前記復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第２超解像拡大部からの前記超解像拡大復号画像を参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、を有する。

[0017] また、本発明の動画像符号化装置は、例えば図１９に示すように、基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像度をもつ超解像拡大・変換画像を生成する第１解像度変換部と、前記第１符号化部から前記復号画像を

取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、前記第２超解像拡大部からの前記超解像拡大復号画像に対し第２の解像度変換処理を行って基準解像度をもつ超解像拡大・変換復号画像を生成する第２解像度変換部と、前記第１解像度変換部からの前記超解像拡大・変換画像を符号化対象画像として、前記第１符号化部からの前記復号画像と、前記第２解像度変換部からの基準解像度をもつ超解像拡大・変換復号画像とを参照画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する第２符号化部と、前記第１符号化部から前記復号画像を取得し、第３の解像度変換処理を行って基準解像度よりも高い解像度をもつ解像度変換拡大復号画像を生成する第３解像度変換部と、前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第２超解像拡大部からの前記超解像拡大復号画像と、前記第３解像度変換部からの前記解像度変換拡大復号画像とを参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、を有する。

[0018] また、本発明の動画像符号化方法は、基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成するステップと、基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成するステップと、前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像度をもつ超解像拡大・変換画像を生成するステップと、前記超解像拡大・変換画像を符号化対象画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成するステップと、を有する。

[0019] また、本発明の動画像符号化プログラムは、基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成するステップと、基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成するステップと、前記超解像拡大画像に対し第１の解像度変換処理を行

って基準解像度をもつ超解像拡大・変換画像を生成するステップと、前記超解像拡大・変換画像を符号化対象画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成するステップと、をコンピュータに実行させる。

[0020] また、本発明の動画像復号装置は、例えば図２６に示すように、入力される符号化ビット列に対して所定の多重化分離処理を行って基準解像度の符号化ビット列を出力する多重化分離部と、前記多重化分離部によって得られる基準解像度の符号化ビット列を取得して所定の復号処理を行うことにより基準解像度の復号画像列を生成する第１復号部と、前記第１復号部によって生成された基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成する第１超解像拡大部と、前記第１超解像拡大部によって生成された超解像拡大復号画像列を取得して所定の解像度変換処理を行うことにより、基準解像度の超解像復号画像列を生成する第１解像度変換部と、前記多重化分離部によって得られる基準解像度拡張符号化ビット列と、前記第１復号部によって生成された基準解像度の復号画像列と、前記第１解像度変換部によって生成された基準解像度の超解像復号画像列とを取得して所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成する第２復号部と、を有する動画像復号装置である。

[0021] ここで、さらに、例えば図２３に示すように、前記復号部から基準解像度の復号画像列を取得し、所定の解像度変換処理を行うことにより基準解像度よりも高い解像度をもつ高解像度の拡大復号画像列を生成する第２解像度変換部と、前記多重化分離部によって得られた前記高解像度拡張符号化ビット列と、前記超解像拡大部によって生成された超解像拡大復号画像列と、前記第２解像度変換部から高解像度の拡大復号画像列とを取得し、所定の予測処理および所定の復号処理を行うことにより、復号後の超解像拡大画像列を生成する第３復号部と、を有する動画像復号装置でも良い。

[0022] また、本発明の再符号化装置は、例えば図２７に示すように、入力される

符号化ビット列に対して所定の多重化分離処理を行って基準解像度の符号化ビット列を出力する多重化分離部と、前記多重化分離部によって得られる基準解像度の符号化ビット列を取得して所定の復号処理を行うことにより基準解像度の復号画像列を生成する復号部と、前記復号部によって生成された基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成する第１超解像拡大部と、前記第１超解像拡大部によって生成された超解像拡大復号画像列を取得して所定の解像度変換処理を行うことにより、基準解像度の超解像復号画像列を生成する第１解像度変換部と、前記多重化分離部によって得られる基準解像度拡張符号化ビット列と、前記復号部によって生成された基準解像度の復号画像列と、前記第１解像度変換部によって生成された基準解像度の超解像復号画像列とを取得して所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成する第２復号部と、前記復号部から復号途中である直交変換係数情報と、前記第２復号部から復号途中である基準解像度の拡張層における直交変換係数情報とを取得し、それぞれの直交変換係数情報を合成した後に所定のエントロピー符号化処理を行うことにより再符号化後の符号化ビット列を生成する再符号化部と、前記再符号化部によって再符号化された符号化ビット列を取得し、所定の構文構造に基づいて、符号化で利用した各種パラメータ情報や符号化モード情報を特定するための識別情報を挿入しながら多重化処理を行い、多重化後の符号化ビット列を生成する多重化部と、を有する動画像再符号化装置である。

[0023] ここで、前記再符号化部は、更に、前記復号部から基準解像度の復号画像列と、第１解像度変換部からの基準解像度の超解像復号画像列と、前記第２復号部から基準解像度の超解像画像列とを取得し、所定の符号化処理を行うことにより再符号化後の符号化ビット列を生成する、動画像再符号化装置でも良い。

[0024] また、本発明の動画像復号方法は、入力される符号化ビット列に対して所定の多重化分離処理を行って基準解像度の符号化ビット列を出力するステッ

プと、所定の多重化分離処理によって得られた前記基準解像度の符号化ビット列を取得して所定の復号処理を行うことにより基準解像度の復号画像列を生成するステップと、所定の復号処理によって生成された前記基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成するステップと、所定の超解像拡大処理によって生成された前記超解像拡大復号画像列を取得して所定の解像度変換処理を行うことにより、基準解像度の超解像復号画像列を生成するステップと、所定の多重化分離処理によって得られた前記基準解像度拡張符号化ビット列と、所定の復号処理によって生成された前記基準解像度の復号画像列と、所定の解像度変換処理によって生成された基準解像度の超解像復号画像列とを取得して所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成するステップと、を有する動画像復号方法である。

[0025] ここで、さらに、所定の復号処理によって生成された前記基準解像度の復号画像列を取得し、所定の解像度変換処理を行うことにより基準解像度よりも高い解像度をもつ高解像度の拡大復号画像列を生成するステップと、所定の多重化分離処理によって得られた前記高解像度拡張符号化ビット列と、所定の超解像拡大処理によって生成された前記超解像拡大復号画像列と、所定の解像度変換処理によって生成された前記高解像度の拡大復号画像列とを取得し、所定の予測処理および所定の復号処理を行うことにより、復号後の超解像拡大画像列を生成するステップと、を有する動画像復号方法でも良い。

[0026] また、本発明の再符号化方法は、入力される符号化ビット列に対して所定の多重化分離処理を行うステップと、所定の多重化分離処理によって得られた前記基準解像度の符号化ビット列を取得して所定の復号処理を行うことにより基準解像度の復号画像列を生成するステップと、所定の復号処理によって生成された前記基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成するステップと、所定の超解像拡大処理によって生成された前記超解像拡大復号画像列を取得して所定

の解像度変換処理を行うことにより、基準解像度の超解像復号画像列を生成するステップと、所定の多重化分離処理によって得られた前記基準解像度拡張符号化ビット列と、所定の復号処理によって生成された前記基準解像度の復号画像列と、所定の解像度変換処理によって生成された前記基準解像度の超解像復号画像列とを取得して所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成するステップと、所定の復号処理の復号途中である直交変換係数情報と、所定の基準解像度の拡張復号である第２復号処理の復号途中である基準解像度の拡張層における直交変換係数情報とを取得し、それぞれの直交変換係数情報を合成した後に所定のエントロピー符号化処理を行うことにより再符号化後の符号化ビット列を生成するステップと、再符号化後の前記符号化ビット列を取得し、所定の構文構造に基づいて、符号化で利用した各種パラメータ情報や符号化モード情報を特定するための識別情報を挿入しながら多重化処理を行い、多重化後の符号化ビット列を生成するステップと、を有する動画像再符号化方法である。

[0027] また、本発明の動画像復号プログラムは、入力される符号化ビット列に対して所定の多重化分離処理を行って基準解像度の符号化ビット列を出力するステップと、所定の多重化分離処理によって得られた前記基準解像度の符号化ビット列を取得して所定の復号処理を行うことにより基準解像度の復号画像列を生成するステップと、所定の復号処理によって生成された前記基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成するステップと、所定の超解像拡大処理によって生成された前記超解像拡大復号画像列を取得して所定の解像度変換処理を行うことにより、基準解像度の超解像復号画像列を生成するステップと、所定の多重化分離処理によって得られた前記基準解像度拡張符号化ビット列と、所定の復号処理によって生成された前記基準解像度の復号画像列と、所定の解像度変換処理によって生成された基準解像度の超解像復号画像列とを取得して所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号

後の基準解像度の超解像画像列を生成するステップと、をコンピュータに実行させる動画像復号プログラムである。

[0028] また、本発明の動画像再符号化プログラムは、入力される符号化ビット列に対して所定の多重化分離処理を行うステップと、所定の多重化分離処理によって得られた前記基準解像度の符号化ビット列を取得して所定の復号処理を行うことにより基準解像度の復号画像列を生成するステップと、所定の復号処理によって生成された前記基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成するステップと、所定の超解像拡大処理によって生成された前記超解像拡大復号画像列を取得して所定の解像度変換処理を行うことにより、基準解像度の超解像復号画像列を生成するステップと、所定の多重化分離処理によって得られた前記基準解像度拡張符号化ビット列と、所定の復号処理によって生成された前記基準解像度の復号画像列と、所定の解像度変換処理によって生成された前記基準解像度の超解像復号画像列とを取得して所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成するステップと、所定の復号処理の復号途中である直交変換係数情報と、所定の基準解像度の拡張復号である第２復号処理の復号途中である基準解像度の拡張層における直交変換係数情報とを取得し、それぞれの直交変換係数情報を合成した後に所定のエントロピー符号化処理を行うことにより再符号化後の符号化ビット列を生成するステップと、再符号化後の前記符号化ビット列を取得し、所定の構文構造に基づいて、符号化で利用した各種パラメータ情報や符号化モード情報を特定するための識別情報を挿入しながら多重化処理を行い、多重化後の符号化ビット列を生成するステップと、をコンピュータに実行させる動画像再符号化プログラムである。

発明の効果

[0029] 本発明の動画像符号化装置等によれば、第１符号化部が基準解像度の入力動画像を符号化する一方、第１超解像拡大部が基準解像度の入力動画像に対し超解像拡大処理を行うことにより、入力動画像中に潜在的に含まれるが基

準解像度では十分表現できていなかった空間方向および時間方向の周波数成分情報を含め、その後、第１解像度変換部によって所定の解像度変換処理等を行ってから第２符号化部にて符号化するようにしたので、第２符号化部では、基準解像度の入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行えるという効果を生じる。ここで、第２符号化部では、第１符号化部での復号信号やその復号信号を第２超解像拡大処理および第２解像度変換処理等の加工をした信号を参照信号として利用して符号化することもできる。

[0030] また、本発明の動画像符号化装置等によれば、第１符号化部が基準解像度の入力動画像を符号化する一方、第１超解像拡大部が基準解像度の入力動画像に対し超解像拡大処理を行うことにより、入力動画像中に潜在的に含まれるが基準解像度では十分表現できていなかった空間方向および時間方向の周波数成分情報を含め、その後その信号を第３符号化部にて符号化するようにしたので、第３符号化部では、基準解像度の入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行えるという効果を生じる。ここで、第３符号化部では、第１符号化部での復号信号を第２超解像拡大処理や第３解像度変換処理等の加工をして第１超解像拡大信号と同じ解像度に高解像度化した信号を参照信号として符号化することもできる。また、本発明の動画像復号装置等によれば、このように動画像符号化された動画像を入力して復号することができ、さらに、本発明の動画像再符号化装置等によれば、このように動画像符号化された動画像を入力して復号し再符号化することができる。

図面の簡単な説明

[0031] [図1]図１は、本発明の実施の形態１を適用した動画像符号化装置の基本構成の例を示すブロック図である。

[図2]図２は、実施の形態１の動画像符号化装置の動作を示すフローチャートである。

[図3]図３は、実施の形態１の多重化部１０９が生成する多重化ビット列の構

造の一例を示すデータ構造図である。

[図4]図４は、実施の形態１の第１超解像拡大部１０３の詳細構成例を示すブロック図、および第１超解像拡大部１０３で行われる所定の超解像拡大処理の一例を示す概念図である。

[図5]図５は、実施の形態１の第１超解像拡大部１０３の動作を示すフローチャートである。

[図6]図６は、実施の形態１の第１解像度変換部１０４の詳細構成例を示すブロック図、および第１解像度変換部１０４で行われる所定の解像度変換処理の一例を示す概念図である。

[図7]図７は、実施の形態２の動画像符号化装置の構成例を示すブロック図である。

[図8]図８は、実施の形態２の動画像符号化装置の他の構成例を示すブロック図である。

[図9]図９は、実施の形態２の動画像符号化装置のさらに他の構成例を示すブロック図である。

[図10]図１０は、実施の形態３の動画像符号化装置の構成例を示すブロック図である。

[図11]図１１は、実施の形態３における第１符号化器４０３の構成例を示すブロック図である。

[図12]図１２は、実施の形態３における第１復号器４０４の構成例を示すブロック図である。

[図13]図１３は、実施の形態４の動画像符号化装置の構成例を示すブロック図である。

[図14]図１４は、実施の形態４の動画像符号化装置の動作例を示すフローチャートである。

[図15]図１５は、実施の形態４の多重化部１０９が生成する多重化ビット列の構造の一例を示すデータ構造図である。

[図16]図１６は、実施の形態５の動画像符号化装置の構成例を示すブロック

図である。

[図17]図１７は、実施の形態５の動画像符号化装置の他の構成例を示すブロック図である。

[図18]図１８は、実施の形態６の動画像符号化装置の構成例を示すブロック図である。

[図19]図１９は、実施の形態７の動画像符号化装置の構成例を示すブロック図である。

[図20]図２０は、実施の形態７の動画像符号化装置の動作例を示すフローチャートである。

[図21]図２１は、実施の形態７の多重化部１０９が生成する多重化ビット列の構造の一例を示すデータ構造図である。

[図22]図２２は、実施の形態８の動画像符号化装置の構成例を示すブロック図である。

[図23]図２３は、実施の形態９の動画像復号装置の構成例を示すブロック図である。

[図24]図２４は、実施の形態９の動画像復号装置の動作例を示すフローチャートである。

[図25]図２５は、図２４のステップＳ６０２の基準解像度の復号処理の動作手順の一例を示すフローチャートである。

[図26]図２６は、実施の形態１０の動画像復号装置の構成例を示すブロック図である。

[図27]図２７は、実施の形態１１の動画像再符号化装置の構成例を示すブロック図である。

[図28]図２８は、実施の形態１１の動画像再符号化装置の動作例を示すフローチャートである。

発明を実施するための形態

[0032] ［実施の形態１］

図１は、本発明の実施の形態１の動画像符号化装置の構成例を示すブロッ

ク図である。

[0033] 図１において、実施の形態１の動画像符号化装置は、第１蓄積バッファ１０１、第１符号化部１０２、第１超解像拡大部１０３、第１解像度変換部１０４、第２超解像拡大部１０５、第２解像度変換部１０６、第２符号化部１０７、多重化部１０９を有している。

[0034] 第１蓄積バッファ１０１は、入力として入力する動画像に対し、後述される所定の超解像前符号化および第１超解像拡大処理を行う際に必要となる、少なくとも２枚の画像を蓄積し、第１符号化部１０２、第１超解像拡大部１０３等に対し、それぞれにおいて必要とされる画像を供給する機能を有する。

[0035] 第１符号化部１０２は、第１蓄積バッファ１０１から、所定の符号化処理に必要な、基準解像度をもつ画像を取得して、取得した基準解像度をもつ画像に対して所定の符号化処理（以後、超解像前符号化処理と呼ぶ）を行い、第１符号化ビット列を生成し、生成した第１符号化ビット列を多重化部１０９に供給する機能を有する。また、第１符号化部１０２は、所定の復号処理を行い、復号画像を、第２超解像拡大部１０５および第２符号化部１０７に供給する機能を有する。また、第１符号化部１０２は、復号画像を一時的に格納するための機能を有することが望ましい。ここで、所定の復号処理は、生成した第１符号化ビット列に対して復号処理を行って復号画像を生成するように構成しても良い。また、所定の符号化処理に含まれる局部復号処理によって局部復号結果から復号画像を生成するように構成しても良い。

[0036] 第１超解像拡大部１０３は、第１蓄積バッファ１０１から、所定の超解像拡大処理に必要となる、少なくとも２枚の基準解像度をもつ画像を取得して、取得した基準解像度をもつ画像に対し、所定の超解像拡大処理を行い、基準解像度よりも高い解像度をもつ、超解像拡大画像を生成し、生成した超解像拡大画像を第１解像度変換部１０４に供給する機能を有する。ここで、所定の超解像拡大処理を行う際の拡大率は、所定の拡大率情報として設定されるか、外部のユーザ等から設定される拡大率情報を取得する機能を有し、取

得した拡大率情報に基づいて拡大率が特定されて所定の超解像拡大処理を行うように構成しても良い。更に、所定の拡大率情報は、図示しない所定のエントロピー符号化処理を行って拡大率情報ビット列を生成し、多重化部１０９に供給して、復号装置側に伝送するように構成すると更に良い。この点は、第２超解像拡大部１０５も同様である。なお、第１超解像拡大部１０３および第２超解像拡大部１０５の詳細構成例および動作例は、図４において後述する。

[0037] 第１解像度変換部１０４は、第１超解像拡大部１０３から超解像拡大画像を取得して、取得した超解像拡大画像に対して所定の解像度変換処理を行い、基準解像度よりも高い解像度をもつ超解像拡大画像から、例えば、基準解像度等をもつ超解像画像（超解像拡大・変換画像）を生成し、第２符号化部１０７に供給する機能を有する。

[0038] 第２超解像拡大部１０５は、第１符号化部１０２から、所定の超解像拡大処理に必要となる、少なくとも２枚の基準解像度をもつ復号画像を取得して、取得した基準解像度の復号画像に対し、所定の超解像拡大処理を行い、基準解像度よりも高い解像度をもつ、超解像拡大復号画像を生成し、生成した超解像拡大復号画像を第２解像度変換部１０６に供給する機能を有する。ここで、第１超解像拡大部１０３と同様に、所定の超解像拡大処理を行う際の拡大率は、所定の拡大率情報として設定されるか、外部のユーザ等から設定される拡大率情報を取得する機能を有し、取得した拡大率情報に基づいて拡大率が特定されて所定の超解像拡大処理を行うようにしても良い。なお、第２超解像拡大部１０５における拡大後の解像度は、第１超解像拡大部１０３における拡大後の解像度と同じでも、異なっていてもどちらでも良い。

[0039] 第２解像度変換部１０６は、第２超解像拡大部１０５から超解像拡大復号画像を取得して、取得した超解像拡大復号画像に対して所定の解像度変換処理を行って、基準解像度よりも高い解像度をもつ超解像拡大復号画像から、例えば、基準解像度をもつ超解像復号画像（超解像拡大・変換復号画像）を生成し、第２符号化部１０７に供給する機能を有する。ここで、所定の解像

度変換処理を行う際の解像度変換率は、所定の解像度変換率情報として設定されるか、外部のユーザ等から設定される解像度変換率情報を取得する機能を有し、取得した解像度変換率情報に基づいて解像度変換率が特定されて所定の解像度変換処理を行うように構成しても良い。ここで、解像度変換率情報は、図示しない所定のエントロピー符号化処理を行って解像度変換率情報ビット列を生成し、多重化部１０９に供給するように構成すると更に良い構成となる。

[0040] 第２符号化部１０７は、第１解像度変換部１０４から基準解像度の入力画像の超解像拡大・変換信号を符号化対象ピクチャとし、第１符号化部１０２から前記復号画像を第１参照ピクチャとし、第２解像度変換部１０６から基準解像度の復号画像の超解像拡大・変換復号信号を第２参照ピクチャとして、所定の予測処理および第２の符号化処理を行って、第２符号化ビット列を生成し、生成した第２符号化ビット列を多重化部１０９に供給する機能を有する。

[0041] ここで、第２符号化部１０７における所定の予測処理を行う際に利用する参照ピクチャは、復号画像から得られる第１参照ピクチャと、超解像拡大・変換復号画像から得られる第２参照ピクチャとのどちらか一方を利用して予測ピクチャを生成し、対象ピクチャから予測ピクチャを減算することで残差情報を生成するような構成としても良い。

[0042] また、第１参照ピクチャ、および第２参照ピクチャのどちらも利用せず、対象ピクチャを残差情報として生成するような構成を含めても良い。

[0043] 更に、第２符号化部１０７は、各ピクチャ、もしくは所定のピクチャ数ごとに参照ピクチャの選択を制御するために、第１参照ピクチャと第２参照ピクチャのどちらを利用したかを特定するための参照ピクチャ選択情報を生成し、図示しない所定のエントロピー符号化部によってエントロピー符号化処理を行って参照ピクチャ選択情報の符号化ビット列を生成し、多重化部１０９に供給するようにしても良い。なお、後述するように、参照ピクチャ情報の符号化ビット列は、多重化ビット列３００の符号化パラメータ情報ビット

列３１０として多重化される。また、対象ピクチャをそれぞれ所定の大きさをもつ領域ごとに隙間なく分割し、第１参照ピクチャと第２参照ピクチャも同様に所定の大きさをもつ領域ごとに隙間なく分割し、対応する領域ごとに第１参照ピクチャと第２参照ピクチャのどちらを利用するかを特定しながら予測ピクチャを生成し、対象ピクチャから予測ピクチャを減算することで残差情報を生成するようにしても良い。ここで、所定の大きさをもつ領域ごとに、どの参照ピクチャを利用したかを特定するための情報を参照ピクチャ選択情報とし、図示しない所定のエントロピー符号化部によってエントロピー符号化処理を行い、生成された参照ピクチャ選択情報の符号化ビット列を多重化部１０９に供給するようにしても良い。ここで、所定の大きさをもつ領域の形状は、所定の矩形領域、または所定の領域分割によって得られる任意形状領域であることが望ましい。

[0044] また、第２符号化部１０７は、符号化対象ピクチャから第１参照ピクチャを予測ピクチャとして減算して得られる残差情報を第１の残差情報として所定の第２の符号化処理を行って第１の第２符号化ビット列を生成するとともに、符号化対象ピクチャから第２参照ピクチャを予測ピクチャとして減算して得られる残差情報を第２の残差情報として所定の第２の符号化処理を行って第２の第２符号化ビット列を生成し、更に、第１参照ピクチャ、および第２参照ピクチャのどちらも利用せず、対象ピクチャのみから残差情報を生成し、第３の残差情報として所定の第２の符号化処理を行って第３の第２符号化ビット列を生成し、生成した第１から第３の第２符号化ビット列を多重化部１０９に供給する機能を有するようにしても良い。ここで、以上のような各種の参照ピクチャの選択方法および符号化方法を、参照ピクチャ選択モード情報、および第２符号化の符号化モード情報とし、図示しない所定のエントロピー符号化部によってエントロピー符号化処理を行い、多重化部１０９に供給するようにしても良い。

[0045] また、第２符号化部１０７は、例えば、MPEG-4 SVCにおけるCGS(Coarse Grain Scalability)レイヤの符号化を実行し、第１符号化部１０２の基準解像

度の動画像列の空間解像度との間の空間解像度が同一である場合には、MPEGおよびITU-Tとの共同グループであるJVT(Joint Video Team)におけるAVCリライティングにて示される、SVCからAVCに容易に変換できるようにするための抑制条件を満たすような所定の構文構造に基づいて第２符号化を行って第２符号化ビット列を生成するようにしても良い。このようにすれば、第２符号化部１０７にて生成される第２符号化ビット列は、階層符号化であるSVCの符号化形式から単層の符号化であるAVCの符号化形式に、完全な復号と符号化を行うような再符号化を行うことなく変換することができる符号化ビット列を生成することができる。

[0046] 多重化部１０９は、第１符号化部１０２から第１符号化ビット列を取得すると共に、第２符号化部１０７から第２符号化ビット列を取得して、所定の構文構造に基づいて、符号化の際に利用した動きベクトル情報や量子化パラメータ情報、さらには上述の参照ピクチャ選択情報等の各種符号化パラメータや符号化モード等に対して、図示しないエントロピー符号化部を介して得られる各符号化ビット列と、これらを特定するための識別情報を挿入しながら、第１符号化ビット列と、第２符号化ビット列との多重化処理を行い、後述する図３に示すような多重化ビット列を生成する機能を有する。また、多重化部１０９は、第２符号化部１０７が生成した、参照ピクチャ選択モード情報および参照ピクチャ選択情報に対して、図示しない所定のエントロピー符号化された符号化ビット列を更に取得し、同様の多重化処理によって多重化ビット列を生成する機能を有する構成であると良い。

[0047] 以上のような構成を本実施の形態として少なくとも有し、入力される動画像に対して所定の超解像拡大処理および所定の解像度変換処理で生成される基準解像度の入力画像の超解像拡大・変換信号を利用する構成にすることで、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行うことができる。ここで、第１超解像拡大部１０３、第２超解像拡大部１０５が利用する拡大率は、必ずしも同じ拡大率である必要はない。同様に、第１解像度変換部１０４、第２解像度変換部１０６で利用する解像度変換率は

、必ずしも同じ解像度変換率である必要はない。ただし、図１においては、第１解像度変換部１０４および第２解像度変換部１０６による解像度変換処理後の空間解像度は、基準解像度となるような解像度変換率であるものとする。

[0048] 次に、図１に示す実施の形態１の動画像符号化装置の動作を、図２のフローチャートを参照しながら説明する。

[0049] まず、入力される動画像を、第１超解像拡大部１０３における第１超解像拡大処理で必要とされるピクチャ数の画像を、第１蓄積バッファ１０１に格納する（ステップＳ２０１）。

[0050] 第１超解像拡大部１０３は、所定の超解像拡大処理を行う際に必要となる少なくとも２枚の画像を、第１蓄積バッファ１０１から取得し、所定の第１超解像拡大処理を行う（ステップＳ２０２）。これにより、入力される動画像がもつ空間解像度である基準解像度よりも高い解像度をもつ、超解像拡大画像を生成し、第１解像度変換部１０４に供給する。なお、第１超解像拡大部１０３の具体的構成および超解像処理の内容については後述する。

[0051] その後、第１解像度変換部１０４は、第１超解像拡大部１０３から超解像拡大画像を取得し、所定の解像度変換処理を行う（ステップＳ２０３）。これにより、基準解像度の入力画像の超解像拡大・変換信号を生成し、第２符号化部１０７に生成した基準解像度の入力画像の超解像拡大・変換信号を供給する。

[0052] その後、第２符号化部１０７は、第１解像度変換部１０４から基準解像度の入力画像の超解像拡大・変換信号を取得し、一時的に蓄積するための所定のバッファに格納する（ステップＳ２０４）。

[0053] その一方、第１符号化部１０２は、第１蓄積バッファ１０１から所定の超解像前符号化処理を行う際に必要となる基準解像度の動画像列を取得し、基準解像度の符号化、復号処理を行う（ステップＳ２０５）。これにより、符号化処理結果である基準解像度の第１符号化ビット列と、復号結果である基準解像度の復号画像を生成する。その後、第１符号化部１０２は、生成した

第１符号化ビット列を多重化部１０９に供給し、生成した基準解像度の復号画像を第２超解像拡大部１０５および第２符号化部１０７に供給する。

[0054] その後、第２符号化部１０７は、第１符号化部１０２から前記復号画像を取得し、一時的に蓄積するための所定のバッファに格納する（ステップＳ２０６）。

[0055] その後、第２超解像拡大部１０５は、第１超解像拡大部１０３と同様に、第１符号化部１０２から前記復号画像を取得し、所定の超解像拡大処理を行う（ステップＳ２０７）。これにより、基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成し、第２解像度変換部１０６に供給する。

[0056] その後、第２解像度変換部１０６は、第２超解像拡大部１０５から超解像拡大復号画像を取得し、所定の解像度変換処理を行う（ステップＳ２０８）。これにより、基準解像度の復号画像の超解像拡大・変換復号信号を生成し、第２符号化部１０７に供給する。

[0057] その後、第２符号化部１０７は、第２解像度変換部１０６から基準解像度の復号画像の超解像拡大・変換復号信号を取得し、一時的に蓄積するための所定のバッファに格納する（ステップＳ２０９）。

[0058] なお、ステップ２０２～２０４の処理と、ステップ２０５～２０９の処理とは、並列に実行しても良いし、どちらか一方を先に実行しても良い。

[0059] ステップ２０２～２０９の処理が完了すると、第２符号化部１０７は、入力画像を第１超解像拡大部１０３および第１解像度変換部１０４にて第１の超解像拡大および解像度変換した入力画像の超解像拡大・変換信号を符号化対象ピクチャとし、入力画像を第１符号化部１０２にてそのまま符号化および復号した復号画像を第１参照ピクチャとし、その復号画像を第２超解像拡大部１０５および第２解像度変換部１０６にて第２超解像拡大および解像度変換した復号画像の超解像拡大・変換復号信号を第２参照ピクチャとして、所定の第２の予測処理を行う（ステップＳ２１０）。これにより、第２符号化部１０７は、基準解像度の残差情報を生成する。その後、生成した残差情報に対して所定の第２の符号化である第２の符号化処理を行う（ステップＳ

２１１）。これにより、第２符号化ビット列を生成し、多重化部１０９に供給する。

[0060] その後、多重化部１０９は、第１符号化部１０２から第１符号化ビット列、第２符号化部１０７から第２符号化ビット列を取得する。所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化パラメータ情報等に対して、図示しないエントロピー符号化部を介して得られる各符号化ビット列を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、第１符号化ビット列、第２符号化ビット列の多重化処理を行い（ステップＳ２１２）、多重化ビット列を生成する。以上のようなステップを経ることで、本実施の形態の一連の動作が完了する。

[0061] このようなステップを実行することで、本発明の動画像符号化装置を動作させることにより、所望の符号化ビット列を生成することができる。

[0062] 図３は、多重化部１０９が出力する多重化ビット列３００の一例を示している。

[0063] 図３に示す多重化ビット列３００では、少なくとも符号化パラメータ情報ビット列３１０、第１符号化部１０２からの第１符号化ビット列３２０、第２符号化部１０７からの第２符号化ビット列３３０を多重化している。

[0064] ここで、符号化パラメータ情報ビット列３１０には、第１符号化部１０２や第２符号化部１０７がそれぞれの符号化の際に使用した動きベクトル情報や、量子化パラメータ情報、各種符号化モード情報、上述の参照ピクチャ選択モード情報および参照ピクチャ選択情報等の各種符号化パラメータに関する符号化ビット列が格納されている共に、この多重化ビット列３００に第１符号化ビット列３２０と、第２符号化ビット列３３０とが多重化されていることを示す識別情報ビット列３１１とが挿入されている。このような多重化ビット列３００の構成はあくまで一例であり、別の構成としては、符号化全体に渡って必要な情報は、符号化パラメータ情報ビット列３１０の中に格納し、第１符号化部１０２によって使用された、第１符号化部１０２固有の情

報は、第１符号化ビット列３２０の中に格納し、第２符号化部１０７によって使用された、第２符号化部１０７固有の情報は、第２符号化ビット列３３０の中に格納するようにしても良い。

[0065] なお、本実施の形態の動作を複数の並列処理によって説明したが、この並列処理部分を連続的に処理するように、本実施の形態の構成を動作させても勿論よい。

[0066] また、本実施の形態の動作において、第１超解像拡大部１０３、第１解像度変換部１０４を機能させずに、第１蓄積バッファ１０１に格納されている基準解像度の入力画像を、基準解像度の入力画像の超解像拡大・変換信号として第２符号化部１０７に供給し、第２符号化部１０７において、所定の第２符号化処理を行うように、本実施の形態の構成を動作させても勿論よい。

[0067] このように、第１超解像拡大部１０３および第２超解像拡大部１０５を有すると共に、第１解像度変換部１０４および第２解像度変換部１０６を有するので、第１の解像度変換処理により、入力画像と同じ基準解像度であるが、第１超解像拡大処理によって空間方向および時間方向の周波数成分情報が拡大された超解像拡大画像に対して、所望の周波数成分まで周波数帯域を制限することによって基準解像度の入力画像の超解像拡大・変換信号を生成することができる。

[0068] そして、このように生成された基準解像度の入力画像の超解像拡大・変換信号は、入力動画像がもつ周波数成分情報の情報量よりも多くの情報量をもつように生成された超解像拡大画像から、基準解像度の空間周波数で表現できる最大の周波数帯域までの周波数成分情報を、基準解像度の入力画像の超解像拡大・変換信号に含めることができるため、このように入力動画像が持つ周波数成分情報の情報量を拡張した上で動画像符号化処理を行い、基準解像度の第１符号化ビット列および基準解像度の第２符号化ビット列を生成することで、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行うことができる。

[0069] また、入力された基準解像度の動画像に対して所定の符号化および復号処

理によって基準解像度の復号画像を生成することができる。この基準解像度の復号画像に対して、所定の第２超解像拡大処理によって空間方向および時間方向の周波数成分情報が拡大された、基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成し、この生成した超解像拡大復号画像に対して所定の第２の解像度変換処理によって基準解像度の復号画像の超解像拡大・変換復号信号を生成することができる。そして、この生成した基準解像度の復号画像の超解像拡大・変換復号信号を基準解像度の参照ピクチャとし、基準解像度の入力画像の超解像拡大・変換信号との間で所定の予測処理を行った後に、所定の第２の符号化処理を行って、第２符号化ビット列を生成することができる。このように、基準解像度の復号画像の超解像拡大・変換復号信号を参照ピクチャとして利用し、基準解像度の入力画像の超解像拡大・変換信号との間で、同一解像度間における空間解像度の相関性を利用した階層符号化を行って、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行うことができる。

[0070] また、第２符号化部１０７は、予測ピクチャを生成する際に、入力画像を第１符号化部１０２にてそのまま符号化および復号した復号画像を第１参照ピクチャとする一方、その復号画像を第２超解像拡大部１０５および第２解像度変換部１０６にて第２超解像拡大および解像度変換した復号画像の超解像拡大・変換復号信号を第２参照ピクチャとし、第１参照ピクチャと第２参照ピクチャとのどちらか一方を利用して予測ピクチャを生成し、符号化処理を行って、要求に応じて、基準解像度の入力画像の超解像拡大・変換信号と復号画像との間における空間解像度の相関性を利用した場合と、基準解像度の入力画像の超解像拡大・変換信号と超解像拡大・変換復号信号との間における空間解像度の相関性を利用した場合の階層符号化を行うことができ、異なる多重化ビット列を生成し、復号側へ供給、蓄積、または伝送することができる。

[0071] また、予測ピクチャを生成する際に、各ピクチャ、もしくは所定のピクチャ数ごとに参照ピクチャの選択を制御することで、復号画像の画像品質に応

じて適応的に予測ピクチャを生成することが可能となり、結果として符号化効率を向上させることが可能となる。

[0072] 更に、第１および第２参照ピクチャのどちらを利用したかを特定するための参照ピクチャ選択情報を生成し、多重化部１０９に供給して、多重化ビット列３００に多重化するように構成することで、符号化時に利用した参照ピクチャを容易に特定することができる。

[0073] また、符号化対象ピクチャをそれぞれ所定の大きさをもつ領域ごとに隙間なく分割し、第１参照ピクチャと第２参照ピクチャも同様に所定の大きさをもつ領域ごとに隙間なく分割し、対応する領域ごとに第１参照ピクチャと第２参照ピクチャのどちらを利用するかを特定しながら予測ピクチャを生成すれば、復号画像の画像品質に応じてより適応的に予測ピクチャを生成することが可能となり、結果として符号化効率を向上させることが可能となる。

[0074] また、入力された基準解像度の動画像に対して、所定の符号化および復号処理を行って基準解像度の第１符号化ビット列を生成することができるとともに、第２の符号化処理を行って第２符号化ビット列を生成し、これらの符号化ビット列を、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化モード情報等の符号化パラメータ情報に関する符号化ビット列を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、所定の多重化処理を行うことにより多重化ビット列を生成することができる。このような多重化ビット列を生成することにより、本来入力動画像に対する符号化結果と、超解像拡大処理および解像度変換処理によって得られた超解像画像によって拡大された周波数成分情報との予測誤差に対する符号化結果とを単一の符号化ビット列とし、図示されない外部の蓄積装置に伝送した後に所定の記録媒体に記録したり、図示されない外部の通信装置によってネットワーク配信したりすることにより、本実施の形態の動画像符号化装置によって大量の情報量をもつ動画像を効率よく符号化し、蓄積、および伝送することを可能にする。

[0075] また、第１の符号化部１０２からの第１符号化ビット列と、第２符号化部１０７からの第２符号化ビット列とを取得し、符号化モード情報に応じて所定の多重化処理を行って多重化ビット列を生成することで、多様な符号化ビット列を生成できるとともに、復号側で選択的な復号を可能にする。

[0076] また、本実施の形態の動作において、第１超解像拡大部１０３、第１解像度変換部１０４を機能させずに、第１蓄積バッファ１０１に格納されている基準解像度の入力画像を、基準解像度の入力画像の超解像拡大・変換信号として第２符号化部１０７に供給し、第２符号化部１０７において、所定の第２符号化処理を行うように、本実施の形態の構成を動作させることで、入力される基準解像度の動画像を第２符号化部１０７における符号化対象とすることを可能とし、第２符号化部１０７において、一般的な階層間の予測処理よりも効率の良い参照ピクチャを利用して予測ピクチャを生成することで、生成される残差情報の情報量を少なくすることで、第２符号化ビット列の符号化効率を向上させることを可能とし、元の基準解像度の動画像により近づけるような符号化処理を可能にする。

[0077] 次に、本発明および本実施の形態で用いられる所定の超解像拡大処理について説明する。

[0078] 一般に、超解像拡大処理による画像の高解像度化は、単に位置ずれがある等といった、比較的画像間の相関が高い複数の低解像度画像から１枚の高解像度画像を推定することによって行われるものであり、近年数多くの研究で報告されている。例えば、「Sung C.P.Min K.P.共著、Super-Resolution Image Reconstruction: A Technical Overview, IEEE SignalProc. Magazine, 第26巻, 第3号, p.21-36, 2003年」などがある。

[0079] また、「B.C.Tom, A.K.Katsaggelos共著、Reconstruction of a high-resolution image by simultaneous registration, restoration, and interpolation of low-resolution images, Proc. IEEE Int. Conf. Image Processing, 第２巻、p.539-542, 1995年」に開示されているＭＬ（Maximum-likelihood）法というものが提案されている。このＭＬ法では、高解像度画像から推定

された低解像度画像の画素値と実際に観測された画素値の二乗誤差を評価関数とし、評価関数を最小化するような高解像度画像を推定画像としている。この方法は、最尤推定の原理に基づいて超解像処理を行う方法である。

[0080] また、「R.R.Schulz, R.L.Stevenson共著、Extraction of high-resolution frames from video sequences, IEEE Trans. Image Processing, 第５巻, p.996-1011, 1996年」に開示されているＭＡＰ（Maximum A Posterior）法というものが提案されている。ＭＡＰ法では、二乗誤差に高解像度画像の確率情報を付加した評価関数を最小化するような高解像度画像の推定を行う。この方法は、高解像度画像に対する何らかの先見情報を利用して、事後確率を最大化する最適化課題として高解像度画像の推定を行う超解像処理方法である。

[0081] 更に、「H.Stark, P.Oskoui共著、High resolution image recovery from image-plane arrays, using convex projections, J.Opt. Soc. Am. A, 第６巻, p.1715-1726, 1989年」に開示されているＰＯＣＳ（Projection Onto Convex Sets）法というものが提案されている。このＰＯＣＳ法では、高解像度画像と低解像度画像の画素値に関して連立方程式を作成し、その方程式を逐次的に解くことにより、高解像度画像を得る超解像処理方法である。

[0082] 本実施の形態における所定の超解像拡大処理は、例えば、上述のような超解像処理を適用したものである。

[0083] 以下、図４、および図５を参照して、本発明および本実施の形態で用いる超解像拡大処理の基本構成例を説明する。

[0084] 図４の（ａ）は、本発明の実施の形態１における第１超解像拡大部１０３の詳細構成を示すブロック図、図４の（ｂ）は、超解像処理を示す概念図、図５は、超解像処理の動作例を示すフローチャートである。

[0085] 図４の（ａ）において、本実施の形態１の第１超解像拡大部１０３は、位置合わせ器１０３１、補間器１０３２、推定画像生成器１０３３、繰り返し判定器１０３４を有している。なお、第２超解像拡大部１０５も同様の構成を有している。

[0086] 位置合わせ器１０３１は、図４（ｂ）の（I）に示すような、超解像拡大処理を行う際の基準となる基準画像と、少なくとも１枚の観測画像を取得する。ここでは、図４の（ｂ）の（I）に示すような基準画像と、観測画像１と、観測画像２とを取得するものとする。位置合わせ器１０３１は、図４の（ｂ）の（II）に示すように、取得した基準画像と観測画像１，２の解像度よりも高解像度の画素位置への位置合わせを行い、不等間隔にサンプリングされた不均一高解像度画像を生成する機能を有する。また、生成した不均一高解像度画像を補間器１０３２、繰り返し判定器１０３４に供給する機能を有する。ここで、生成される不均一高解像度画像は、例えば図４の（ｂ）の（II）で示すように、基準画像の各画素を基準として観測画像の位置合わせを行い、基準画像との間の相関が最も高くなる位置に配置するようにすることが望ましい。また、位置合わせで適用される解像度は、超解像拡大処理後に得られる解像度よりも高い解像度で位置合わせを行うようにすることが望ましい。なお、図４の（ｃ）については、図６の（ｂ）と対比して後述する。

[0087] 補間器１０３２は、位置合わせ器１０３１にて生成された不均一高解像度画像を取得して、また、取得した不均一高解像度画像から所定の不均一補間処理を行って、所望の高解像度を持つ補間画像を生成し、推定画像生成器１０３３に供給する機能を有する。また、補間器１０３２は、繰り返し判定器１０３４から処理を継続するための制御情報を取得する。ここで、処理を継続するための制御情報には、推定画像生成器１０３３によって生成された不均一推定画像が含まれると良い。また、補間器１０３２は、制御情報に応じて繰り返し処理を行う場合には、所定の更新方法に従って不均一推定画像を利用し、位置合わせ器１０３１から取得した不均一高解像度画像を更新するとともに、それぞれの補間画素を修正しても良い。

[0088] 推定画像生成器１０３３は、補間器１０３２にて生成された補間画像を取得し、所定のカメラモデルから得られる点広がり関数（ＰＳＦ関数）を考慮して所定の復元処理を行い、必要であれば所定のノイズ除去処理を行って、図４の（ｂ）の（III）で示すような所望の解像度を持つ推定画像を生成する

機能を有する。また、推定画像に対してリサンプル処理を行って、不均一高解像度画像の各画素に対応する、不均一推定画像を生成し、繰り返し判定器１０３４に供給する機能を有する。また、繰り返し判定器１０３４から制御情報を取得するとともに、制御情報に応じて、生成した所望の解像度を持つ推定画像を高解像度画像として外部に対して出力する機能を有する。

[0089] 繰り返し判定器１０３４は、位置合わせ器１０３１から不均一高解像度画像を取得するとともに、推定画像生成器１０３３から不均一推定画像を取得して、取得したそれぞれの画像を利用して、所定の判定方法に従って超解像拡大処理の繰り返しが必要か否かを判定し、その判定の結果、繰り返しが必要な場合は、補間器１０３２に対して処理を継続するための制御情報を供給する一方、繰り返しが必要ない場合には、推定画像生成器１０３３に対して超解像拡大処理結果である高解像度の推定画像を出力するための制御情報を供給する機能を有する。

[0090] ここで、更に高速な超解像拡大処理を行う必要がある場合には、例えば、特許第３８３７５７５号で開示されているような、超解像処理の高速化方法を、本発明の画像処理装置に適用するようにすると、更に良い構成を実現することができる。

[0091] 次に、図４の（ａ）に示す超解像拡大部１０３の動作を、図５のフローチャートを参照しながら説明する。

[0092] まず、位置合わせ器１０３１は、超解像拡大処理を行う際の基準となる基準画像と、少なくとも１枚の観測画像とを取得する（Ｓ５００）。その後、所望の解像度よりも高い解像度によって、取得したそれぞれの画像の位置合わせを行う（Ｓ５１０）。その際、基準画像の各画素を対応する位置に配置した後、この基準画像との相関が最も高くなるように観測画像の各画素を配置することで、不等間隔にサンプリングされた不均一高解像度画像を生成する。

[0093] その後、補間器１０３２は、生成された不均一高解像度画像を取得し、所定の不均一補間処理を行って画素の補間を行う（Ｓ５２０）。これにより、

所望の高解像度を持つ補間画像を生成する。

[0094] 次に、推定画像生成器１０３３は、補間画像を取得し、所定の復元処理を行い、必要であれば所定のノイズ除去処理を行って、所望の解像度を持つ推定画像を生成する（Ｓ５３０）。また、推定画像に対してリサンプル処理を行って、不均一解像度画像の各画素に対応する、不均一推定画像を生成する。

[0095] 次に、繰り返し判定器１０３４は、位置合わせ器１０３１から不均一解像度画像を取得するとともに、推定画像生成器１０３３から不均一推定画像を取得する。取得したそれぞれの画像を利用して、所定の判定方法に従って超解像拡大処理の繰り返しが必要か否かを判定する（Ｓ５４０）。

[0096] 超解像拡大処理の繰り返しが必要であると判定された場合（Ｓ５４０　ＹＥＳ）は、補間器１０３２に対して処理を継続するための制御情報を供給する。また、超解像拡大処理の繰り返しが必要でないと判定された場合（Ｓ５４０　ＮＯ）は、推定画像生成器１０３３に対して超解像拡大処理結果である高解像度の推定画像を出力するための制御情報を供給し、推定画像生成器１０３３は制御情報に応じて、生成した所望の解像度を持つ推定画像を、超解像拡大処理によって得られた高解像度画像として出力する（Ｓ５５０）。これにより、本実施の形態１の超解像拡大処理が完了する。

[0097] 次に、第１解像度変換部１０４および第２解像度変換部１０６における所定の解像度変換処理の一例について説明する。

[0098] 図６の（ａ）は、第１解像度変換部１０４の構成例を示すブロック図である。

[0099] 図６の（ａ）において、第１解像度変換部１０４は、画素挿入器１０４１、フィルタリング処理器１０４２、画素間引き器１０４３を有する。なお、第２解像度変換部１０６や後述する他の実施の形態の第３解像度変換部１１０も同様に構成されている。

[0100] 画素挿入器１０４１は、入力された画像の解像度を拡大し、扱うことができる空間周波数帯域を拡張するために、画素間に新たな画素を挿入すること

で入力画像のアップサンプル画像を生成し、フィルタリング処理器１０４２に供給する。

[0101] フィルタリング処理器１０４２は、画素挿入器１０４１からアップサンプル画像を取得し、所定のローパスフィルタを利用してフィルタリング処理を行うことにより帯域制限画像を生成し、画素間引き器１０４３に供給する。ここで、所定のローパスフィルタを利用したフィルタリング処理は、解像度変換部が最終的に出力する画像の空間解像度が表現できる空間周波数帯域の範囲内に、帯域制限および補間ができるローパスフィルタを用いて、アップサンプル画像に対するフィルタリング処理を行えばよく、利用するフィルタは、例えば、sinc関数やLanczos関数に基づいたフィルタ、周波数応答が全帯域にわたって平坦かつ急峻な遮断周波数特性を持つように設計されたFIRおよびIIRフィルタを用いると良い。また、Nearest-neighbor法、Bilinear法、Bicubic法、Spline法、などに基づいたフィルタを用いて処理を軽減させても構わない。

[0102] 画素間引き器１０４３は、フィルタリング処理器１０４２から帯域制限画像を取得し、解像度変換部が最終的に出力する画像の解像度に合わせるために、所定の画素間引き処理を行い、出力画像を生成する。

[0103] 図６の（ｂ）は、第１解像度変換部１０４のような解像度変換部の解像度変換によって画像の拡大処理を行った後に、縮小処理を行った場合に、画像内の信号成分がどのように変化するかを示した概念図である。

[0104] 図６の（ｂ）の（ｉ）に示すように、入力画像に本来含まれる空間周波数成分はｆａまででであるとすると、解像度変換部における解像度変換処理では、仮に扱うことのできる空間周波数成分を拡大するために解像度を高めて画像の拡大処理を行ったとしても、画像の画素数は増大するものの、含まれる空間周波数成分自体を増やすことはできない。よって、図６の（ｂ）の（ｉｉ）のような元のままの空間周波数成分のみを含む状態となり、その後、ローパスフィルタリング処理によってｆｍａｘまで帯域制限し、元の空間解像度をもつ画素数まで画素間引き処理をしても、元のままの空間周波数成分を含む

画像が生成される。

[0105] これに対し、図４の（ｃ）は、第１超解像拡大部１０３のような超解像拡大部の超解像拡大処理を行った後に、縮小処理を行った場合に、画像内の信号成分がどのように変化するかを示した概念図である。

[0106] 図４の（ｃ）の（Ｉ）に示すように、入力画像に本来含まれる空間周波数成分はｆａまででであるとすると、超解像拡大部における超解像拡大処理では、図４の（ｂ）のような処理に基づいて、含まれる空間周波数成分自体が増加する。仮にこのような処理によって図４の（ｃ）の（ＩＩ）に示すように、含まれる空間周波数成分はｆｂまで拡張されたとすると、その後、ローパスフィルタリング処理によってｆｍａｘまで帯域制限を行うと、本来含まれていたｆａまでの空間周波数成分以上の成分を、空間周波数ｆｍａｘまで表現できる画像内に含めた画像が生成される。

[0107] 従って、第１超解像拡大部１０３がこのような超解像拡大処理を行うことにより、同じ解像度の画像であっても、本来含まれるべき画像成分を補った画像を生成して利用できるという点が、第１解像度変換部１０４における解像度変換処理との大きな違いである。このことは、第２超解像拡大部１０５と第３解像度変換部１１０等との関係でも同様である。

[0108] ここで、所定の解像度変換処理を行う際の解像度変換率は、所定の解像度変換率情報として設定されるか、外部のユーザ等から設定される解像度変換率情報を取得する機能を有し、取得した解像度変換率情報に基づいて解像度変換率が特定されて所定の解像度変換処理を行うようにしても良い。

[0109] 例えば、図６の（ａ）に示すように第１解像度変換部１０４や第２解像度変換部１０６を構成すると、基準解像度よりも高い解像度となっている超解像拡大画像から、基準解像度の超解像拡大・変換画像となるように画像の縮小処理を行う場合には、画素挿入器１０４１における画素間に新たな画素を挿入する割合と、画素間引き器１０４３における画素間引きを行う割合を解像度変換率に応じて設定する。

[0110] ここで、解像度変換率は、解像度変換率＝画素挿入率／画素間引き率と表

せ、画素挿入率は、画素挿入率＝入力画素／出力画素、画素間引き率は、画素間引き率＝入力画素／出力画素である。

[0111] 例えば、解像度変換率２で基準解像度から超解像拡大画像が生成されている場合を考えると、基準解像度に戻すための解像度変換率は１／２であることから、画素挿入器１０４１では入力画素：出力画素＝１：１、つまり入力画像をそのままアップサンプル画像としてフィルタリング処理器１０４２に供給するように設定する。画素間引き器１０４３では入力画素：出力画素＝２：１、つまり２画素につき１画素の間引き処理を行って出力画像を生成する。

[0112] また、図６の（ａ）に示す第１解像度変換部１０４の構成を利用して画像の拡大処理を行う場合には、例えば、解像度変換率２＝２／１で基準解像度の２倍の拡大画像を生成する場合を考えると、画素挿入器１０４１では入力画素：出力画素＝１：２、つまり１画素につき１画素の挿入を行ってアップサンプル画像を生成してフィルタリング処理器１０４２に供給するように設定する。画素間引き器１０４３では入力画素：出力画素＝１：１、つまり間引き処理を行わずにそのまま出力画像として出力するように設定する。

[0113] なお、図６の（ａ）に示す第１解像度変換部１０４の構成は、あくまで一例であり、より自由な解像度への画像の拡大・縮小処理が必要な場合には、Spline法などを利用することで、実数の位置精度で自由な位置の画素を、入力画像から生成し、所望の解像度を持つ画像を生成することができるように構成することもできる。

[0114] 従って、本実施の形態１の動画像符号化装置によれば、入力動画像がもつ空間解像度を基準解像度とし、入力動画像中に潜在的に含まれるが基準解像度では十分表現できていなかった空間方向および時間方向の周波数成分情報を、第１超解像拡大部１０３による所定の超解像処理に基づいて復元した上で基準解像度よりも高い解像度で表現し、入力動画像が持つ周波数成分情報の情報量を拡張した超解像拡大画像を生成した上で動画像符号化処理を行って、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を

行えるという効果を生じる。

[0115] また、本実施の形態１の動画像符号化装置では、第１超解像拡大部１０３にて生成した超解像拡大画像に対して、第１解像度変換部１０４にて所定の解像度変換処理を行い、基準解像度で表現された超解像拡大・変換画像を生成するようにしているので、入力動画像中に潜在的に含まれるが基準解像度では十分表現できていなかった空間方向および時間方向の周波数成分情報を生成し、本来含まれていなかった周波数成分情報を、基準解像度で表現できる周波数成分情報の範囲内に制限した上で超解像画像に含ませることにより、入力動画像では表現できていなかった周波数成分情報を超解像画像に反映し、この超解像画像に基づいて動画像符号化処理を行って、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行えるという効果を生じる。

[0116] 更に、本実施の形態１の動画像符号化装置では、第１の符号化部１０２にて符号化および復号されて生成された基準解像度の復号画像に対し、第２超解像拡大部１０５および第２解像度変換部１０６にて所定の超解像処理および解像度変換処理を行って、超解像拡大復号画像および基準解像度の復号画像の超解像拡大・変換復号信号を生成し、第２符号化部１０７は、入力画像を第１超解像拡大部１０３および第１解像度変換部１０４にて第１の超解像拡大および解像度変換した入力画像の超解像拡大・変換信号を符号化対象ピクチャとし、入力画像を第１符号化部１０２にてそのまま符号化および復号した復号画像を第１参照ピクチャとし、その復号画像を第２超解像拡大部１０５および第２解像度変換部１０６にて第２超解像拡大および解像度変換した復号画像の超解像拡大・変換復号信号を第２参照ピクチャとして、所定の第２の予測処理を行って符号化するようにしたので、従来の動画像符号化で得られる予測ピクチャもしくは予測ブロックの画像品質よりも良い画像品質の予測ピクチャもしくは予測ブロックを得ることができ、結果として符号化効率を向上させる効果を生じる。

[0117] ［実施の形態２］

上記実施の形態１では、図１に示すように第２符号化部１０７に２つの参照ピクチャ、すなわち入力画像を第１符号化部１０２にてそのまま符号化および復号した復号画像である第１参照ピクチャと、その復号画像を第２超解像拡大部１０５および第２解像度変換部１０６にて第２超解像拡大および解像度変換した復号画像の超解像拡大・変換復号信号である第２参照ピクチャとを入力して、予測効率の高い参照ピクチャを利用して予測ピクチャを生成するように説明したが、例えば、図７に示すように、第２符号化部１０７に入力画像を第１符号化部１０２にてそのまま符号化および復号した復号画像である第１参照ピクチャのみ入力させるか、あるいは図８に示すように、第２符号化部１０７に第１符号化部１０２からの復号画像を第２超解像拡大部１０５および第２解像度変換部１０６にて第２超解像拡大および解像度変換した復号画像の超解像拡大・変換復号信号である第２参照ピクチャのみ入力させて、第２符号化部１０７は、第１または第２参照ピクチャのみを利用して、第１の超解像拡大および解像度変換した入力画像の超解像拡大・変換信号を符号化対象ピクチャとして予測符号化するようにしても勿論よい。

[0118] また、さらに、図９に示すように、第２符号化部１０７に２つの参照ピクチャ、すなわち入力画像を第１符号化部１０２にてそのまま符号化および復号した復号画像である第１参照ピクチャと、その復号画像を第２超解像拡大部１０５および第２解像度変換部１０６にて第２超解像拡大および解像度変換した復号画像の超解像拡大・変換復号信号である第２参照ピクチャとのいずれも入力させず、第２符号化部１０７は、第１の超解像拡大および解像度変換した入力画像の超解像拡大・変換信号を符号化対象ピクチャとして予測符号

化するようにしても勿論よい。

[0119] ［実施の形態３］

次に、本発明の実施の形態３の動画像符号化装置について説明する。

[0120] 図１０は、実施の形態３の動画像符号化装置の構成例を示すブロック図である。

[0121] 図１０に示す実施の形態３の動画像符号化装置は、図１に示す実施の形態１の動画像符号化装置の構成を更に詳細にし、さらに、蓄積制御部４１２、第２蓄積バッファ４１６、第２参照ピクチャバッファ４１８、符号量制御部４２３を新たに追加したものである。

[0122] また、図１０において、第１符号化部１０２は、第１予測器４０２、第１符号化器４０３、第１復号器４０４、イントラ予測器４０５、第１予測ピクチャバッファ４０６、第１参照ピクチャバッファ４０７、動き推定器４０８、動き補償器４０９、加算器４１０、デブロック器４１１を有している。これにより、一般的な動画像符号化であるISO/IEC SC29 WG11において規格標準化されているMPEG-4 AVCと同等の機能を実現できる。ただし、ここでの第１符号化部１０２の詳細構成は一例であり、第１符号化部１０２の機能を実現できる、別の異なる構成であっても勿論よい。例えば、ディジタル放送などで利用されているMPEG-2であっても構わないし、MPEG-4 AVCのスケーラブル拡張であるMPEG-4 SVCであっても構わない。また、JPEG2000に代表される、ウェーヴレット変換に基づく超解像前符号化器を採用しても構わない。

[0123] また、図１０において、第２符号化部１０７は、第３蓄積バッファ４１５、第２予測器４２０、第２符号化器４２１を有している。

[0124] 次に、図１０に示す実施の形態３の動画像符号化装置について、図１に示す実施の形態１の構成要素とは、異なる機能や新たな機能を有する構成要素について説明する。

[0125] 第１予測器４０２は、第１蓄積バッファ１０１から、所定の符号化処理に必要な、基準解像度をもつ画像を取得するとともに、第１予測ピクチャバッファ４０６から格納された予測ピクチャもしくは予測ブロックを取得して、第１予測器４０２は、取得した画像および予測ピクチャに対して所定の予測処理を行って残差情報を生成し、第１符号化器４０３に供給する機能を有する。ここで、第１予測器４０２における予測処理は、取得した基準解像度をもつ画像の各画像を符号化対象ピクチャとし、取得した予測ピクチャもしくは予測ブロックを対象ピクチャから減算することで、残差情報を生成し、第

１符号化器４０３に供給するような処理であると良い。

[0126] 第１符号化器４０３は、第１予測器４０２から予測処理後の残差情報を取得し、所定の符号化処理によって前記基準解像度の第１符号化ビット列を生成し、第１復号器４０４および多重化部１０９に供給する機能を有する。ここで、第１符号化器４０３は、図１１の（ａ）に示すように第１復号器４０４に対して第１符号化ビット列を供給するようにしても良いし、図１１の（ｂ）に示すように所定の符号化処理の過程で量子化後情報を生成し、第１復号器４０４に供給するようにしても良い。また、第１符号化器４０３は、符号量制御部４２３からの制御情報に基づいて、符号化処理によって生成される第１符号化ビット列の符号量を変動させる機能を有する。

[0127] 第１復号器４０４は、図１１の（ａ），（ｂ）に示す第１符号化器４０３の出力に応じて、図１２の（ａ）に示すように第１符号化器４０３から第１符号化ビット列を取得するか、あるいは図１２の（ｂ）に示すように第１符号化器４０３から量子化後情報を取得して、第１符号化ビット列もしくは量子化後情報に対して所定の復号処理を行って復号残差情報を生成し、加算器４１０に供給する機能を有する。

[0128] イントラ予測器４０５は、所定のイントラ予測処理を行う際に必要となる、復号済みの画像情報を取得し、所定のイントラ予測処理を行ってイントラ予測情報を生成し、第１予測ピクチャバッファ４０６に供給する機能を有する。ここで、イントラ予測器４０５が生成するイントラ予測情報は、予測対象となっているブロックの周囲のブロックで、かつ復号済みのブロックから所定のイントラ予測処理に基づいて生成したイントラ予測ブロックであることが望ましい。

[0129] 第１予測ピクチャバッファ４０６は、イントラ予測器４０５からイントラ予測情報、動き補償器４０９から動き補償予測情報を取得し、予測ピクチャもしくは予測ブロックとして蓄積し、第１予測器４０２および加算器４１０に予測ピクチャもしくは予測ブロックを供給する機能を有する。ここで、第１予測ピクチャバッファ４０６は、蓄積制御部４１２から蓄積制御情報を取

得し、この蓄積制御情報に基づいて予測ピクチャもしくは予測ブロックの取得、蓄積、供給を制御しても良い。

[0130] 第１参照ピクチャバッファ４０７は、デブロック器４１１からデブロック処理後の復号ピクチャもしくは復号ブロック、加算器４１０から復号ピクチャもしくは復号ブロックを取得し、参照ピクチャもしくは参照ブロックとして蓄積し、蓄積した参照ピクチャもしくは参照ブロックを、要求に応じて少なくともイントラ予測器４０５、動き推定器４０８、動き補償器４０９、第２蓄積バッファ４１６に供給する機能を有する。ここで、第１参照ピクチャバッファ４０７は、蓄積制御部４１２から蓄積制御情報を取得し、この蓄積制御情報に基づいて参照ピクチャもしくは参照ブロックの取得、蓄積、供給を制御しても良い。

[0131] 動き推定器４０８は、第１蓄積バッファ１０１から符号化対象ピクチャと、第１参照ピクチャバッファ４０７から参照ピクチャを取得し、所定の動き推定を行って動きベクトル情報を生成する機能を有する。動き推定器４０８は、生成した動きベクトル情報を少なくとも動き補償器４０９に供給する機能を有する。ここで、動き推定器４０８によって生成された動きベクトル情報は、図示されていないエントロピー符号化器によって所定のエントロピー符号化処理が行われ、多重化部１０９に供給されるように構成すると更に良い構成となる。

[0132] 動き補償器４０９は、第１参照ピクチャバッファ４０７から参照ピクチャを取得するとともに、動き推定器４０８から動きベクトル情報を取得して、動き補償器４０９は、取得した参照ピクチャと動きベクトル情報に基づいて所定の動き補償を行って予測ピクチャを生成し、第１予測ピクチャバッファ４０６に供給する機能を有する。

[0133] 加算器４１０は、第１復号器４０４から復号残差情報、第１予測ピクチャバッファ４０６から予測ピクチャまたは予測ブロックを取得して加算することで復号画像を生成し、第１参照ピクチャバッファ４０７およびデブロック器４１１に供給する機能を有する。

[0134] デブロック器４１１は、加算器４１０から復号画像を取得し、所定のデブロック処理を行ってデブロック後の復号画像を生成し、第１参照ピクチャバッファ４０７に供給する機能を有する。

[0135] 図１１の（ａ），（ｂ）は、実施の形態３の第１符号化器４０３の構成例を示している。

[0136] 第１符号化器４０３は、例えば、直交変換器４０３１、量子化器４０３２、エントロピー符号化器４０３３を有している。

[0137] 直交変換器４０３１は、残差情報を取得し、所定の直交変換処理を行って直交変換係数情報を生成して量子化器に供給する機能を有する。

[0138] 量子化器４０３２は、直交変換器４０３１から直交変換係数情報を取得し、所定の量子化処理を行って量子化後情報を生成し、エントロピー符号化器４０３３に供給する機能を有する。ここで、第１復号器４０４において、符号化ビット列に対してエントロピー復号をせずに局部復号結果である量子化後情報を取得して所定の復号処理を行う構成の場合には、図１１の（ｂ）に示すように、量子化器４０３２は、量子化後情報を第１復号器４０４に供給するように構成しても良い。

[0139] エントロピー符号化器４０３３は、量子化器４０３２から量子化後情報を取得し、所定のエントロピー符号化処理を行って第１符号化ビット列を生成し、多重化部１０９に供給する機能を有する。また、第１復号器４０４において、第１符号化ビット列に対してエントロピー復号を行って量子化後情報を取得して所定の復号処理を行う構成の場合には、図１１の（ａ）に示すように、エントロピー符号化器４０３３は、第１符号化ビット列を生成し、第１復号器４０４に供給するように構成しても良い。

[0140] 図１２の（ａ），（ｂ）は、実施の形態３の第１復号器４０４の構成例を示している。

[0141] 第１復号器４０４は、局部復号処理を行うために、少なくとも図１２の（ａ），（ｂ）に示すように逆量子化器４０４２、逆直交変換器４０４３を有している。また、第１符号化ビット列を取得して完全な復号処理を行うよう

な構成であれば、図１２の（ａ）に示すように更にエントロピー復号器４０４１を備えるようにしても良い。

[0142] エントロピー復号器４０４１は、第１符号化器４０３から第１符号化ビット列を取得し、所定のエントロピー復号処理を行って量子化後情報を生成し、逆量子化器４０４２に供給する機能を有する。

[0143] 逆量子化器４０４２は、エントロピー復号器４０４１もしくは量子化器４０３２から量子化後情報を取得し、所定の逆量子化処理を行って、逆量子化後の直交変換係数情報を生成し、逆直交変換器４０４３に供給する機能を有する。

[0144] 逆直交変換器４０４３は、逆量子化器４０４２から逆量子化後の直交変換係数情報を取得し、所定の直交変換処理を行って復号残差情報を生成し、加算器４１０に供給する機能を有する。

[0145] 図１０に戻り、実施の形態３の第２符号化部１０７は、第３蓄積バッファ４１５、第２予測器４２０、第２符号化器４２１を有している。

[0146] 第３蓄積バッファ４１５は、第１解像度変換部１０４から基準解像度の入力画像の超解像拡大・変換信号を取得して蓄積するとともに、第２予測器４２０に供給する機能を有する。また、第３蓄積バッファ４１５は、蓄積制御部４１２から蓄積制御情報を取得し、この蓄積制御情報に基づいて前記基準解像度の入力画像の超解像拡大・変換信号の取得、蓄積、供給を制御する機能を有する。

[0147] 第２予測器４２０は、第３蓄積バッファ４１５から基準解像度の入力画像の超解像拡大・変換信号と、第２蓄積バッファ４１６から基準解像度の復号画像、第２解像度変換部１０６から基準解像度の復号画像の超解像拡大・変換復号信号を取得して、入力画像の超解像拡大・変換信号を符号化対象ピクチャとし、第１符号化部１０２からの復号画像を第１参照ピクチャとし、基準解像度の復号画像の超解像拡大・変換復号信号の各超解像拡大・変換復号画像を第２参照ピクチャとした上で、所定の予測処理を行って予測ピクチャを生成し、対象ピクチャから予測ピクチャを減算することで残差情報を生成

して第２符号化器４２１に供給する機能を有する。

[0148] 第２符号化器４２１は、第２予測器４２０から残差情報を取得し、所定の符号化処理を行って前記第２符号化ビット列を生成し、多重化部１０９に供給すると共に、符号量制御部４２３からの制御情報に基づいて、符号化処理によって生成される第２符号化ビット列の符号量を変動させる機能を有する。

[0149] 蓄積制御部４１２は、各蓄積バッファに対して蓄積制御情報を供給することで、各蓄積バッファの蓄積状態やピクチャの取得や供給のタイミングを制御する機能を有する。

[0150] 第２蓄積バッファ４１６は、第１参照ピクチャバッファ４０７から前記復号画像を取得して、取得した基準解像度の復号画像を第２超解像拡大部１０５および第２予測器４２０に供給する機能を有する。

[0151] また、第２蓄積バッファ４１６は、蓄積制御部４１２から蓄積制御情報を取得し、この蓄積制御情報に基づいて前記復号画像の取得、蓄積、供給を制御する機能を有する。

[0152] 第２参照ピクチャバッファ４１８は、第２超解像拡大部１０５から超解像拡大復号画像を取得して蓄積し、取得した超解像拡大復号画像を第２解像度変換部１０６に供給する機能を有する。その際、第２参照ピクチャバッファ４１８は、蓄積制御部４１２から蓄積制御情報を取得し、この蓄積制御情報に基づいて前記基準解像度の入力画像の超解像拡大・変換信号の取得、蓄積、供給を制御する。

[0153] 符号量制御部４２３は、各符号化器が生成する符号化ビット列の符号量を監視し、所定の範囲の符号量に収まるように、各符号化器の動作を制御すると共に、符号量の状態や、蓄積制御部４１２から得られる各蓄積バッファの状態に応じて、各蓄積バッファの動作を変更するように蓄積制御部４１２を制御する機能を有する。ここで、符号量制御部４２３は、各符号化器の動作を制御して符号量の制御を行う際に、各符号化器の量子化パラメータ情報を変更することで、符号量の制御を行う。また、必要に応じて、各符号化器の

残差情報の信号振幅の状態や、各予測器でどちらの参照ピクチャが利用されたかを特定することができる参照ピクチャ選択情報に基づいて、復号画像に対する超解像拡大処理が有効であったか、有効でなかったかを判定し、有効でなかった場合には、蓄積制御部４１２に第２蓄積バッファ４１６に対して、第２超解像拡大部１０５に対する復号画像の供給を停止するように指示するとともに、超解像拡大処理が有効であった場合に利用していた量子化パラメータ情報とは異なる、第１参照ピクチャに基づいて生成された予測残差情報用の量子化パラメータ情報を利用するように切り替えることで、符号量を制御できるようにすると良い構成となる。

[0154] 従って、本実施の形態３の動画像符号化装置によれば、図１に示す実施の形態１の動画像符号化装置と同様の効果が得られると共に、蓄積制御部４１２と、符号量制御部４２３等とを有し、各バッファにおける蓄積制御や、第１符号化部１０２と第２符号化部１０７とにおける符号量制御を行うようにしたので、第１符号化部１０２と第２符号化部１０７とにおける符号量や、各バッファにおける蓄積量を考慮した符号化を実行することができる。

[0155] なお、本実施の形態３では、図１に示す実施の形態１の動画像符号化装置に対し、蓄積量制御部４１２と符号量制御部４２３等を設け、各バッファにおける蓄積量制御や第１符号化部１０２と第２符号化部１０７とにおける符号量制御を行うように説明したが、図７や、図８、図９に示す実施の形態２の動画像符号化装置に対し、蓄積量制御部４１２と符号量制御部４２３等を設けて同様に蓄積量制御や符号量制御を行うようにしても勿論よい。

[0156] ［実施の形態４］

次に、本発明の実施の形態４の動画像符号化装置について説明する。

[0157] 図１３は、実施の形態４の動画像符号化装置の構成例を示すブロック図である。

[0158] 図１３において、実施の形態４の動画像符号化装置は、第１蓄積バッファ１０１、第１符号化部１０２、第１超解像拡大部１０３、第２超解像拡大部

１０５、第３解像度変換部１１０、第３符号化部１０８、多重化部１０９を有している。

[0159] 第１蓄積バッファ１０１は、図１における実施の形態と同等の機能を有するため、ここでは説明を省略する。

[0160] 第１符号化部１０２は、図１における実施の形態と同等の機能を有する。ここで、実施の形態４では、生成された復号画像は、第２超解像拡大部１０５および第３解像度変換部１１０に供給するように構成する。

[0161] 第１超解像拡大部１０３は、図１における実施の形態と同等の機能を有する。ここで、実施の形態４の第１超解像拡大部１０３は、生成した基準解像度よりも高い解像度をもつ超解像拡大画像を第３符号化部１０８に供給する機能を有する。

[0162] 第２超解像拡大部１０５は、図１における実施の形態と同等の機能を有する。ここで、実施の形態４の第２超解像拡大部１０５は、生成した基準解像度よりも高い解像度をもつ超解像拡大復号画像を、第３符号化部１０８に供給する機能を有する。

[0163] 第３解像度変換部１１０は、第１符号化部１０２から基準解像度の復号画像を取得し、取得した基準解像度の復号画像に対して所定の解像度変換処理を行って、第１超解像拡大部１０３が生成する超解像拡大画像、および第２超解像拡大部１０５が生成する超解像拡大復号画像の空間解像度と同じ解像度をもつ、高解像度の拡大復号画像である解像度変換拡大復号画像を生成し、第３符号化部１０８に供給する機能を有する。ここで、所定の解像度変換処理を行う際の解像度変換率は、所定の解像度変換率情報として設定されるか、外部のユーザ等から設定される解像度変換率情報を取得する機能を有し、取得した解像度変換率情報に基づいて解像度変換率が特定されて所定の解像度変換処理を行うように構成しても良い。

[0164] 第３符号化部１０８は、第１超解像拡大部１０３から超解像拡大画像を取得すると共に、第３解像度変換部１１０からは高解像度の解像度変換拡大復号画像を、第２超解像拡大部１０５からは高解像度の超解像拡大復号画像を

取得して、取得した超解像拡大画像を符号化対象ピクチャとし、第３解像度変換部１１０からの解像度変換拡大復号画像を第１参照ピクチャ、第２超解像拡大部１０５からの超解像拡大復号画像を第２参照ピクチャとして、所定の予測処理および符号化処理を行い、第３符号化ビット列を生成し、生成した第３符号化ビット列を多重化部１０９に供給する機能を有する。

[0165] ここで、第３符号化部１０８における所定の予測処理を行う際に利用する参照ピクチャは、解像度変換拡大復号画像から得られる第１参照ピクチャと、超解像拡大復号画像から得られる第２参照ピクチャとのどちらか一方を利用して予測ピクチャを生成し、対象ピクチャから予測ピクチャを減算することで残差情報を生成する。

[0166] また、第１参照ピクチャ、および第２参照ピクチャのどちらも利用せず、対象ピクチャを残差情報として生成するような構成を含めても良い。

[0167] 更に、第３符号化部１０８は、各ピクチャ、もしくは所定のピクチャ数ごとに参照ピクチャの選択を制御するために、第１参照ピクチャと第２参照ピクチャのどちらを利用したかを特定するための参照ピクチャ選択情報を生成し、図示しない所定のエントロピー符号化部によってエントロピー符号化処理を行って参照ピクチャ選択情報の符号化ビット列を生成し、多重化部１０９に供給するようにしても良い。

[0168] また、対象ピクチャをそれぞれ所定の大きさをもつ領域ごとに隙間なく分割し、第１参照ピクチャと第２参照ピクチャも同様に所定の大きさをもつ領域ごとに隙間なく分割し、対応する領域ごとに第１参照ピクチャと第２参照ピクチャのどちらを利用するかを特定しながら予測ピクチャを生成し、対象ピクチャから予測ピクチャを減算することで残差情報を生成するようにしても良い。ここで、所定の大きさをもつ領域ごとに、どの参照ピクチャを利用したかを特定するための情報を参照ピクチャ選択情報とし、図示しない所定のエントロピー符号化部によってエントロピー符号化処理を行い、生成された参照ピクチャ選択情報の符号化ビット列を多重化部１０９に供給するようにしても良い。ここで、所定の大きさをもつ領域の形状は、所定の矩形領域

、または所定の領域分割によって得られる任意形状領域であることが望ましい。

[0169] また、第３符号化部１０８は、符号化対象ピクチャから第１参照ピクチャを予測ピクチャとして減算して得られる残差情報を、第１の残差情報として所定の第３符号化処理を行って第１の第３符号化ビット列を生成するとともに、対象ピクチャから第２参照ピクチャを予測ピクチャとして減算して得られる残差情報を第２の残差情報として所定の第３符号化処理を行って第２の第３符号化ビット列を生成し、更に、第１参照ピクチャ、および第２参照ピクチャのどちらも利用せず、対象ピクチャのみから残差情報を生成し、第３の残差情報として所定の第３の符号化処理を行って第３の第３符号化ビット列を生成し、生成した第１から第３の第３符号化ビット列を多重化部１０９に供給する機能を有するようにしても良い。ここで、以上のような各種の参照ピクチャの選択方法および符号化方法を、参照ピクチャ選択モード情報、および第３符号化の符号化モード情報とし、図示しない所定のエントロピー符号化部によってエントロピー符号化処理を行い、多重化部１０９に供給するようにしても良い。

[0170] 多重化部１０９は、第１符号化部１０２から第１符号化ビット列を取得すると共に、第３符号化部１０８から第３符号化ビット列を取得して、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化パラメータ情報等に対して、図示しないエントロピー符号化部を介して得られる各符号化ビット列を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、第１符号化ビット列、第３符号化ビット列の多重化処理を行い、出力である多重化ビット列を生成する機能を有する。また、多重化部１０９は、第３符号化部１０８が生成した、参照ピクチャ選択モード情報および参照ピクチャ選択情報に対して、図示しない所定のエントロピー符号化された符号化ビット列を更に取得し、同様の多重化処理によって多重化ビット列を生成する機能を有する構成であると良い。

[0171] また、多重化部１０９は、第１符号化部１０２からの第１符号化ビット列、第３符号化部１０８から第１および第２の第３符号化ビット列を取得するようにしても良い。ここで、多重化部１０９は、取得した基準解像度の第１符号化ビット列を複製し、基準解像度の第１から第３の第１符号化ビット列を生成しても良い。多重化部１０９は、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化パラメータ情報等に対して、図示しないエントロピー符号化部を介して得られる各符号化ビット列を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、基準解像度の第１の第１符号化ビット列と第１の第３符号化ビット列、基準解像度の第２の第１符号化ビット列と第２の第３符号化ビット列、基準解像度の第３の第１符号化ビット列と第３の第３符号化ビット列に対して多重化処理を行い、出力である多重化後の第１から第３の符号化ビット列を生成しても良い。ここで、多重化部１０９は、符号化モード情報などからの要求に応じて選択的に多重化後の第１から第３の符号化ビット列を生成するようにしても構わない。また、ここで利用する符号化モード情報には、少なくとも多重化を制御するための情報が含まれているように構成しても良い。

[0172] 本実施の形態４の動画像符号化装置は、以上のような機能を有し、入力される動画像に対して所定の超解像拡大処理および所定の解像度変換処理で生成される超解像拡大画像や超解像拡大・変換画像を利用することで、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行うことができる。なお、図１３の構成において、第１超解像拡大部１０３、第２超解像拡大部１０５が利用する拡大率は、同一の拡大率であることが望ましいが、同一の拡大率でなくても良い。また、第３解像度変換部１１０で利用する解像度変換率は、第１超解像拡大部１０３が生成する超解像拡大画像、および第２超解像拡大部１０５が生成する超解像拡大復号画像がもつ空間解像度と同じ解像度となるような解像度変換率であることが望ましいが、同一の拡大率でなくても良い。

[0173] 次に、図１３に示す実施の形態４の動画像符号化装置の動作を、図１４のフローチャートを参照しながら説明する。

[0174] 図１４は、実施の形態４の動画像符号化装置の動作を示すフローチャートである。

[0175] まず、図１３に示す実施の形態４の動画像符号化装置では、入力される動画像から第１超解像拡大部１０３における第１超解像拡大処理で必要とされるピクチャ数の画像を、第１蓄積バッファ１０１に格納する（Ｓ１４０１）。

[0176] 第１超解像拡大部１０３は、所定の超解像拡大処理を行う際に必要となる少なくとも２枚の画像を、第１蓄積バッファ１０１から取得し、所定の第１超解像拡大処理を行う（Ｓ１４０２）。これにより、入力される動画像がもつ空間解像度である基準解像度よりも高い解像度をもつ、超解像拡大画像を生成し、第３符号化部１０８に供給する。

[0177] 第３符号化部１０８は、第１超解像拡大部１０３から超解像拡大画像を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１４０３）。

[0178] その一方、第１符号化部１０２は、第１蓄積バッファ１０１から所定の超解像前符号化処理を行う際に必要となる基準解像度の動画像列を取得し、基準解像度の符号化、復号処理を行う（Ｓ１４０４）。これにより、符号化処理結果である基準解像度の第１符号化ビット列と、復号結果である基準解像度の復号画像を生成する。

[0179] その後、第１符号化部１０２は、生成した第１符号化ビット列を多重化部１０９に供給し、生成した基準解像度の復号画像を、一時的に蓄積するための所定のバッファに格納する（Ｓ１４０５）。

[0180] 第２超解像拡大部１０５は、第１符号化部１０２から前記復号画像を取得し、所定の超解像拡大処理を行う（Ｓ１４０６）。これにより、基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成し、第３符号化部１０８に供給する。

[0181] その後、第３符号化部１０８は、第２超解像拡大部１０５から超解像拡大

復号画像を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１４０７）。

[0182] また、第３解像度変換部１１０は、第１符号化部１０２から前記復号画像を取得し、所定の解像度変換処理を行う（Ｓ１４０８）。これにより、基準解像度よりも高い解像度をもつ高解像度の拡大復号画像である解像度変換拡大復号画像を生成し、第３符号化部１０８に供給する。

[0183] その後、第３符号化部１０８は、第３解像度変換部１１０から高解像度の解像度変換拡大復号画像を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１４０９）。

[0184] なお、Ｓ１４０２～Ｓ１４０２の処理と、Ｓ１４０４～Ｓ１４０７の処理と、Ｓ１４０２～Ｓ１４０２の処理は、並列処理でも、順番に処理しても良い。

[0185] 以上の処理が完了すると、第３符号化部１０８は、第１超解像拡大部１０３から取得した超解像拡大画像を符号化対象ピクチャとし、第３解像度変換部１１０から取得した解像度変換拡大復号画像を第１参照ピクチャとし、第２超解像拡大部１０５から取得した超解像拡大復号画像を第２参照ピクチャとして、所定の第３の予測処理を行う（Ｓ１４１０）。これにより、高解像度の残差情報を生成する。その後、生成した残差情報に対して所定の第３の符号化である第３符号化処理を行う（Ｓ１４１１）。これにより、第３符号化ビット列を生成し、多重化部１０９に供給する。

[0186] その後、多重化部１０９は、第１符号化部１０２から第１符号化ビット列、第３符号化部１０８から第３符号化ビット列を取得し、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化パラメータ情報等に対して、図示しないエントロピー符号化部を介して得られる各符号化ビット列を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら多重化処理を行い（Ｓ１４１２）、図１５に示すような多重化ビット列を生成する。以上のようなステップを経ることで、本実施の形態の一連の動作が完了する。

[0187] 図１５は、実施の形態４の多重化部１０９が生成する多重化ビット列３００の構造の一例を示すデータ構造図である。

[0188] 多重化ビット列３００に、符号化パラメータ情報ビット列３１０と、第１符号化部１０２からの第１符号化ビット列３２０と、第３符号化部１０８からの第３符号化ビット列３４０とが多重化される。

[0189] なお、本実施の形態４の動作を複数の並列処理によって説明したが、この並列処理部分を連続的に処理するように、本実施の形態の構成を動作させても勿論よい。

[0190] 従って、本実施の形態４の動画像符号化装置によれば、上記実施の形態１等と同様に、第１超解像拡大部１０３および第２超解像拡大部１０５により、第１および第２超解像拡大処理を行うような構成とすることで、入力動画像がもつ空間解像度を基準解像度とし、第１超解像拡大処理により、基準解像度よりも高い解像度をもつ超解像拡大画像を生成することができる。

[0191] その結果、この第１超解像拡大処理により、入力動画像から、入力動画像中に潜在的に含まれるが基準解像度では十分表現できていなかった空間方向および時間方向の周波数成分情報を、所定の超解像処理に基づいて復元した上で基準解像度よりも高い解像度で表現することができる。このように入力動画像が持つ周波数成分情報の情報量を拡張した上で動画像符号化処理を行って、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行うことができる。

[0192] また、入力された基準解像度の動画像に対して、所定の符号化および復号処理を行って基準解像度の復号画像を生成し、この復号画像に対して所定の第２超解像拡大処理によって空間方向および時間方向の周波数成分情報が拡大された、基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成し、この生成された超解像拡大復号画像を、高解像度の参照ピクチャとし、超解像拡大画像との間で所定の予測処理を行った後に、所定の第３符号化処理を行って、第３符号化ビット列を生成することができる。このように、超解像拡大復号画像を参照ピクチャとして利用し、超解像拡大画像との間で、空

間解像度の相関性を利用した階層符号化を行って、入力された動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行うことができる。

[0193] つまり、本実施の形態４では、上記実施の形態１等と同様に、入力された本来の基準解像度の空間解像度で表現できる範囲内でしか表現できなかった画像の周波数成分情報を、画像自体に潜在的に含まれる相関性を利用して復元するために、所定の超解像拡大処理を行い、新たに生み出された、基準解像度よりも高い空間解像度でしか表現できない周波数成分情報を、超解像拡大画像として反映させ、このようにして生成された、新たな最終的な符号化対象である、超解像拡大画像と、本来の基準解像度の動画像列のそれぞれに含まれる空間解像度の周波数成分情報の違いを、本発明により符号化および伝送することが可能となる点が重要である。仮に、第２超解像拡大処理のみを行い、超解像拡大復号画像を生成して外部の表示装置に出力するような動画像復号装置があったとしても、復号対象となる基準解像度の第１符号化ビット列に対して所定の復号処理を行って生成された基準解像度の復号画像には、少なからず符号化時の劣化が含まれており、この復号画像に対して所定の第２超解像拡大処理を行ったとしても、符号化劣化を含んだ状態の基準解像度の復号画像に対して超解像拡大処理を行うため、一定の効果を得られるものの、必ずしも正しい超解像拡大処理を行うことができるとは限らない。このように必ずしも十分ではない超解像拡大復号画像に対して、本来あるべき超解像拡大画像に含まれる周波数成分情報との違いを、所定の拡張符号化処理によって符号化、および伝送することで、本発明では、超解像拡大画像に含まれる周波数成分情報を、より多く正確に、復号側に供給できるような構成となっている。

[0194] また、本実施の形態４では、予測ピクチャを生成する際に、第３解像度変換部１１０からの第１参照ピクチャと、第２超解像拡大部１０５からの第２参照ピクチャとのどちらか一方を利用して第３の符号化である第３符号化処理を行って、要求に応じて、超解像拡大画像と第１参照ピクチャである解像度変換拡大復号画像との間における空間解像度の相関性を利用した場合と、

超解像拡大画像と第２参照ピクチャである超解像拡大復号画像との間における空間解像度の相関性を利用した場合の階層符号化を行うことができ、異なる多重化ビット列を生成し、復号側へ供給、蓄積、または伝送することができる。

[0195] また、本実施の形態４では、予測ピクチャを生成する際に、各ピクチャ、もしくは所定のピクチャ数ごとに参照ピクチャの選択を制御することで、復号画像の画像品質に応じて適応的に予測ピクチャを生成することが可能となり、結果として符号化効率を向上させることが可能となる。

[0196] 更に、本実施の形態４では、第１および第２参照ピクチャのどちらを利用したかを特定するための参照ピクチャ選択情報を生成し、多重化部１０９に供給するように構成することで、本発明の符号化時に利用した参照ピクチャを容易に特定することができるようになる。

[0197] また、本実施の形態４では、符号化対象ピクチャをそれぞれ所定の大きさをもつ領域ごとに隙間なく分割し、第１参照ピクチャと第２参照ピクチャも同様に所定の大きさをもつ領域ごとに隙間なく分割し、対応する領域ごとに第１参照ピクチャと第２参照ピクチャのどちらを利用するかを特定しながら予測ピクチャを生成することで、復号画像の画像品質に応じてより適応的に予測ピクチャを生成することが可能となり、結果として符号化効率を向上させることが可能となる。

[0198] また、入力された基準解像度の動画像に対して、所定の符号化および復号処理を行って基準解像度の第１符号化ビット列を生成するとともに、第３符号化処理を行って高解像度の第３符号化ビット列を生成し、これらの符号化ビット列を所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化パラメータ情報等に対して、図示しないエントロピー符号化部を介して得られる各符号化ビット列を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、所定の多重化処理を行うことにより多重化ビット列を生成することができる。このような多重化ビット列を生成することにより、本来入力

動画像に対する符号化結果と、超解像拡大処理によって得られた超解像拡大画像によって拡大された周波数成分情報との予測誤差に対する符号化結果とを単一の符号化ビット列とし、図示されない外部の蓄積装置に伝送した後に所定の記録媒体に記録したり、図示されない外部の通信装置によってネットワーク配信したりすることにより、本実施の形態の動画像符号化装置によって大量の情報量をもつ動画像を効率よく符号化し、蓄積、および伝送することを可能にする。

[0199] また、第１、第２の第３符号化ビット列を取得し、符号化モード情報に応じて多重化する符号化ビット列の組み合わせを特定し、特定された複数の符号化ビット列に対して所定の多重化処理を行って多重化ビット列を生成することで、多様な符号化ビット列を生成できるとともに、復号側で選択的な復号を可能にする。

[0200] ［実施の形態５］

上記実施の形態４では、図１３に示すように第３符号化部１０８では、２つの参照ピクチャ、すなわち第１符号化部１０２からの復号画像を第３解像度変換部１１０にて第３解像度変換処理をした解像度変換拡大復号画像を第１参照ピクチャ、第１符号化部１０２からの復号画像を第２超解像拡大部１０５にて第２超解像拡大処理をした超解像拡大復号画像を第２参照ピクチャとして入力し、予測効率の高い参照ピクチャを予測ピクチャとして利用するように説明したが、例えば、図１６に示すように、第３解像度変換部１１０からの解像度変換拡大復号画像のみが参照ピクチャとして入力するか、あるいは、例えば、図１７に示すように、第２超解像拡大部１０５からの超解像拡大復号画像のみが参照ピクチャとして入力し、第１超解像拡大部１０３からの超解像拡大画像を符号化対象ピクチャとして予測符号化するようにしても勿論よい。

[0201] ［実施の形態６］

次に、本発明の実施の形態６の動画像符号化装置について説明する。

[0202] 図１８は、実施の形態６の動画像符号化装置の構成例を示すブロック図で

ある。

[0203] 図１８に示す実施の形態６の動画像符号化装置は、図１３に示す実施の形態４の動画像符号化装置の構成を更に詳細にし、さらに、蓄積制御部４１２、第２蓄積バッファ４１６、第２参照ピクチャバッファ４１８、符号量制御部４２３を新たに追加したものである。

[0204] 以下に、図１８において、図１３に示す実施の形態４の構成要素とは異なる機能や新たな機能を有する構成要素について説明する。

[0205] 第４蓄積バッファ５０１は、第１超解像拡大部１０３から超解像拡大画像を取得して蓄積し、蓄積した超解像拡大画像を第３予測器５０２に供給する機能を有する。なお、第４蓄積バッファ５０１は、蓄積制御部４１２から蓄積制御情報を取得し、この蓄積制御情報に基づいて超解像拡大画像の取得、蓄積、供給を制御しても良い。

[0206] 第３予測器５０２は、第４蓄積バッファ５０１から超解像拡大画像、第２参照ピクチャバッファ４１８から超解像拡大復号画像、第３解像度変換部１１０から解像度変換拡大復号画像を取得して、第３予測器５０２は、取得した超解像拡大画像の各超解像拡大画像を符号化対象ピクチャとし、解像度変換拡大復号画像から得られる各解像度変換拡大復号画像を解像度変換拡大復号画像から得られる第１参照ピクチャとし、超解像拡大復号画像の各超解像拡大復号画像を、超解像拡大復号画像から得られる第２参照ピクチャとした上で、所定の予測処理を行って予測ピクチャを生成し、符号化対象ピクチャから予測ピクチャを減算することで残差情報を生成して第３符号化器５０３に供給する機能を有すると更に良い構成となる。

[0207] 第３符号化器５０３は、第３予測器５０２から残差情報を取得し、所定の符号化処理を行って第３符号化ビット列を生成し、多重化部１０９に供給する機能を有する。また、第３符号化器５０３は、符号量制御部４２３からの制御情報に基づいて、符号化処理によって生成する第３符号化ビット列の符号量を変動させる機能を有することが望ましい。

[0208] 第３解像度変換部１１０は、第２蓄積バッファ４１６から前記復号画像を

取得し、所定の解像度変換処理を行って、高解像度の拡大復号画像である解像度変換拡大復号画像を生成し、第３予測器５０２に供給する機能を有する。ここで、高解像度の解像度変換拡大復号画像は、第１超解像拡大部１０３が生成する超解像拡大画像、および第２超解像拡大部１０５が生成する超解像拡大復号画像がもつ空間解像度と同じ解像度となるように、第３解像度変換部１１０において所定の解像度変換処理が行われるようにしても良い。

[0209] また、以下に、蓄積制御部４１２、第２蓄積バッファ４１６、第２参照ピクチャバッファ４１８、符号量制御部４２３に関して説明する。

[0210] 蓄積制御部４１２が備える機能は、図１０における実施の形態３の蓄積制御部４１２が備える機能と同等であれば良いことから、ここでは説明を省略する。

[0211] 第２蓄積バッファ４１６が備える機能は、図１０における実施の形態３の第２蓄積バッファ４１６が備える機能と同等であれば良いことから、ここでは説明を省略する。

[0212] 第２参照ピクチャバッファ４１８は、更に、第２超解像拡大部１０５から取得した超解像拡大復号画像を第３予測器５０２に供給する機能を有する。

[0213] 符号量制御部４２３が備える機能も、図１０における実施の形態３の符号量制御部４２３が備える機能と同等である。

[0214] このように、図１８に示す本実施の形態６の動作は、図１０に示す実施の形態４の動作と同様であるため、ここでは説明を省略する。

[0215] 従って、本実施の形態６の動画像符号化装置によれば、図１３に示す実施の形態４の動画像符号化装置と同様の効果が得られると共に、図１０に示す実施の形態３と同様に、さらに、蓄積量制御部４１２と符号量制御部４２３等とを有し、各バッファにおける蓄積量制御や、第１符号化部１０２と第３符号化部１０８とにおける符号量制御を行うようにしたので、第１符号化部１０２と第３符号化部１０８とにおける符号量や、各バッファにおける蓄積量を考慮した符号化を実行することができる。

[0216] なお、本実施の形態６では、図１３に示す実施の形態４の動画像符号化装

置に対し、蓄積量制御部４１２と符号量制御部４２３等を設け、各バッファにおける蓄積量制御や第１符号化部１０２と第３符号化部１０８とにおける符号量制御を行うように説明したが、図１６や図１７に示す実施の形態５の動画像符号化装置に対し、蓄積量制御部４１２と符号量制御部４２３等を設けて、同様に蓄積量制御や符号量制御を行うようにしても勿論よい。

[0217] ［実施の形態７］

次に、本発明の実施の形態７の動画像符号化装置について説明する。

[0218] 図１９は、実施の形態７の動画像符号化装置の構成例を示すブロック図である。

[0219] 図１９に示す実施の形態７の動画像符号化装置は、図１に示す実施の形態１の動画像符号化装置と、図１３に示す実施の形態４の動画像符号化装置とを統合した構成となっており、各構成要素の基本的な機能において、同一であるものに関しては説明を省略し、異なる部分に関して以下に説明する。

[0220] 多重化部１０９は、更に、第１符号化部１０２からの第１符号化ビット列を取得すると共に、第２符号化部１０７から第２符号化ビット列を、第３符号化部１０８から第３符号化ビット列を取得して、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択モード情報および参照ピクチャ選択情報、符号化パラメータ情報等に対して、図示しないエントロピー符号化部を介して得られる各符号化ビット列を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、第１符号化ビット列、第２符号化ビット列、第３符号化ビット列の多重化処理を行い、多重化ビット列を生成する機能を有する。ここで、多重化部１０９は、第１符号化部１０２から取得した基準解像度の第１符号化ビット列を複製して第１の第１符号化ビット列と第２の第１符号化ビット列として、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択モード情報および参照ピクチャ選択情報、符号化パラメータ情報等に対して、図示しないエントロピー符号化部を介して得られる各符号化ビット列を、後に続く符号化ビット列の

組を識別するための識別情報等を挿入しながら、複製した基準解像度の第１の第１符号化ビット列と、取得した第２符号化ビット列の多重化処理を行い、出力である多重化後の符号化ビット列を生成しても良い。また、多重化部１０９は、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択モード情報および参照ピクチャ選択情報、符号化パラメータ情報等に対して、図示しないエントロピー符号化部を介して得られる各符号化ビット列を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、複製した基準解像度の第２の第１符号化ビット列と、取得した第３符号化ビット列の多重化処理を行い、出力である多重化後の第２の符号化ビット列を生成しても良い。

[0221] また、多重化部１０９は、更に、第２符号化部１０７から第１および第２の第２符号化ビット列を取得し、第３符号化部１０８から第１および第２の第３符号化ビット列を取得しても良い。その上で、多重化部１０９は、取得した基準解像度の第１符号化ビット列を複製して、基準解像度の第１から第６の第１符号化ビット列を生成し、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択モード情報および参照ピクチャ選択情報、符号化パラメータ情報等に対して、図示しないエントロピー符号化部を介して得られる各符号化ビット列を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、基準解像度の第１の第１符号化ビット列と第１の第２符号化ビット列、基準解像度の第２の第１符号化ビット列と第２の第２符号化ビット列、基準解像度の第３の第１符号化ビット列と第３の第２符号化ビット列、基準解像度の第４の第１符号化ビット列と第１の第３符号化ビット列、基準解像度の第５の第１符号化ビット列と第２の第３符号化ビット列、基準解像度の第６の第１符号化ビット列と第３の第３符号化ビット列との多重化処理を行って、多重化後の第１から第６の符号化ビット列を生成し、要求に応じて出力する機能を有すると更に良い構成となる。ここで、多重化部１０９は、要求に応じて選択的に多重化後の第１から第６の符号化ビット列を生成するようにしても

構わない。

[0222] 以上のような機能を本実施の形態７は少なくとも有し、入力される動画像に対して所定の超解像拡大処理および所定の解像度変換処理で生成される基準解像度の入力画像の超解像拡大信号や超解像拡大・変換信号を利用する構成にすることで、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行うことができる。ここで、図１９において、第１超解像拡大部１０３、第２超解像拡大部１０５が利用する拡大率は、同一の拡大率であることが望ましいが、異なる拡大率でもかまわない。また、第１解像度変換部１０４、第２解像度変換部１０６で利用する解像度変換率は、同一の解像度変換率であり、解像度変換処理後の空間解像度は、基準解像度となるような解像度変換率であることが望ましいが、異なる拡大率でもかまわない。更に、第３解像度変換部１１０で利用する解像度変換率は、第１超解像拡大部１０３が生成する超解像拡大画像、および第２超解像拡大部１０５が生成する超解像拡大復号画像がもつ空間解像度と同じ解像度となるような解像度変換率であることが望ましいが、異なる拡大率でもかまわない。

[0223] 次に、図１９に示す実施の形態７の動作を、図２０のフロ―チャ―トを参照しながら説明する。

[0224] まず、入力される動画像を、第１超解像拡大部１０３における第１超解像拡大処理で必要とされるピクチャ数の画像を、第１蓄積バッファ１０１に格納する（Ｓ１９０１）。

[0225] 第１超解像拡大部１０３は、所定の超解像拡大処理を行う際に必要となる少なくとも２枚の画像を、第１蓄積バッファ１０１から取得し、所定の第１超解像拡大処理を行う（Ｓ１９０２）。これにより、入力される動画像がもつ空間解像度である基準解像度よりも高い解像度をもつ、超解像拡大画像を生成し、第１解像度変換部１０４および第３符号化部１０８に供給する。

[0226] その後、第３符号化部１０８は、第１超解像拡大部１０３から超解像拡大画像を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１９０３）。

[0227] その後、第１解像度変換部１０４は、第１超解像拡大部１０３から超解像拡大画像を取得し、所定の解像度変換処理を行う（Ｓ１９０４）。これにより、基準解像度の入力画像の超解像拡大・変換信号を生成し、第２符号化部１０７に生成した基準解像度の入力画像の超解像拡大・変換信号を供給する。

[0228] その後、第２符号化部１０７は、第１解像度変換部１０４から基準解像度の入力画像の超解像拡大・変換信号を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１９０５）。

[0229] 一方、第１符号化部１０２は、第１蓄積バッファ１０１から所定の超解像前符号化処理を行う際に必要となる基準解像度の動画像列を取得し、基準解像度の符号化、復号処理を行う（Ｓ１９０６）。これにより、符号化処理結果である基準解像度の第１符号化ビット列と、復号結果である基準解像度の復号画像を生成する。その後、第１符号化部１０２は、生成した第１符号化ビット列を多重化部１０９に供給し、生成した基準解像度の復号画像を第２超解像拡大部１０５、第２符号化部１０７、および第３解像度変換部１１０に供給する。

[0230] 次に、第２符号化部１０７は、第１符号化部１０２から前記復号画像を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１９０７）。

[0231] また、第２超解像拡大部１０５は、第１符号化部１０２から基準解像度の復号画像を取得し、所定の超解像拡大処理を行う（Ｓ１９０８）。これにより、基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成し、第２解像度変換部１０６、および第３符号化部１０８に供給する。

[0232] すると、第３符号化部１０８は、第２超解像拡大部１０５から超解像拡大復号画像を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１９０９）。

[0233] また、第２解像度変換部１０６は、第２超解像拡大部１０５から超解像拡大復号画像を取得し、所定の解像度変換処理を行う（Ｓ１９１０）。これにより、基準解像度の超解像拡大・変換復号信号を生成し、第２符号化部１０

７に供給する。

[0234] そして、第２符号化部１０７は、第２解像度変換部１０６から基準解像度の超解像拡大・変換復号信号を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１９１１）。

[0235] また、第３解像度変換部１１０は、第１符号化部１０２から前記復号画像を取得し、所定の解像度変換処理を行う（Ｓ１９１２）。これにより、高解像度の拡大復号画像である解像度変換拡大復号画像を生成し、第３符号化部１０８に供給する。

[0236] その後、第３符号化部１０８は、第３解像度変換部１１０から高解像度の解像度変換拡大復号画像を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１９１３）。

[0237] なお、Ｓ１９０２～Ｓ１９０５との処理と、Ｓ１９０６～Ｓ１９１１の処理と、Ｓ１９１２～Ｓ１９１３の処理は、並列処理しても、順番に処理してもどちらでも良い。

[0238] そして、以上の処理が完了すると、第２符号化部１０７は、第１解像度変換部１０４から取得した入力画像の超解像拡大・変換画像を符号化対象ピクチャとし、第１符号化部１０２から取得した復号画像を第１参照ピクチャとし、第２解像度変換部１０６から取得した超解像拡大・変換復号画像を第２参照ピクチャとして、所定の第２の予測処理を行って基準解像度の残差情報を生成し（Ｓ１９１４）、生成した残差情報に対して所定の第２の符号化である第２の符号化処理を行う（Ｓ１９１５）。これにより、第２符号化ビット列を生成し、多重化部１０９に供給する。

[0239] また、第３符号化部１０８は、第１超解像拡大部１０３から取得した入力画像の超解像拡大画像を符号化対象ピクチャとし、第３解像度変換部１１０から取得した解像度変換拡大復号画像を第１参照ピクチャとし、第２超解像拡大部１０５から取得した超解像拡大復号画像を第２参照ピクチャとして、所定の第３の予測処理を行って高解像度の残差情報を生成し（Ｓ１９１６）、生成した残差情報に対して所定の第３の符号化である第３符号化処理を行

う（Ｓ１９１７）。これにより、第３符号化ビット列を生成し、多重化部１０９に供給する。その後、他の並列処理が完了するまで待機する。

[0240] そして、多重化部１０９は、第１符号化部１０２から第１符号化ビット列、第２符号化部１０７から第２符号化ビット列、および第３符号化部１０８から第３符号化ビット列を取得し、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化パラメータ情報等に対して、図示しないエントロピー符号化部を介して得られる各符号化ビット列を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、第１符号化ビット列、第２符号化ビット列および第３符号化ビット列の多重化処理を行い（Ｓ１９１８）、多重化ビット列を生成する。以上のようなステップを経ることで、本実施の形態の一連の動作が完了する。

[0241] 図２１は、実施の形態７の多重化部１０９が生成する多重化ビット列３００の構造の一例を示すデータ構造図である。

[0242] 多重化ビット列３００に、符号化パラメータ情報ビット列３１０と、第１符号化部１０２からの第１符号化ビット列３２０と、第２符号化部１０７からの第２符号化ビット列３３０と、第３符号化部１０８からの第３符号化ビット列３４０とが多重化される。

[0243] なお、本実施の形態の動作を複数の並列処理によって説明したが、この並列処理部分を連続的に処理するように、本実施の形態の構成を動作させても勿論よい。

[0244] 従って、本実施の形態７では、図１９に示すような構成とすることによって、図１に示す実施の形態１と、図１２に示す実施の形態４の構成によって得られるそれぞれの効果を同時に得ることができる。

[0245] また、本実施の形態７では、第１符号化部１０２が入力された基準解像度の動画像に対して、所定の符号化および復号処理を行って基準解像度の第１符号化ビット列を生成し、第２符号化部１０７が第２の符号化処理を行って基準解像度の第２符号化ビット列を生成するとともに、第３符号化部１０８

が第３符号化処理を行って高解像度の第３符号化ビット列を生成し、これら第１～第３の符号化ビット列を所定の多重化処理を行うことにより多重化ビット列を生成することにより、本来入力動画像に対する符号化結果と、超解像拡大処理および解像度変換処理によって得られた超解像拡大画像や超解像拡大・変換画像によって拡大された周波数成分情報との予測誤差に対する符号化結果とを単一の符号化ビットストリームによって効率よく蓄積もしくは伝送することができるとともに、復号側で選択的な復号を可能にする。

[0246] また、本実施の形態７では、第２符号化部１０７が所定の予測処理を行う際に利用する参照ピクチャとして、基準解像度の復号画像から得られる第１参照ピクチャと、基準解像度の復号画像の超解像拡大・変換復号信号から得られる第２参照ピクチャとのどちらか一方を利用して予測ピクチャを生成し、基準解像度の入力画像の超解像拡大・変換信号から得られる符号化対象ピクチャから予測ピクチャを減算することで残差情報を生成し、この残差情報に対して所定の符号化処理を行って第２符号化ビット列を生成するとともに、第３符号化部１０８は、所定の予測処理を行う際に利用する参照ピクチャとして、高解像度の解像度変換拡大復号画像から得られる第１参照ピクチャと、超解像拡大復号画像から得られる第２参照ピクチャとのどちらか一方を利用して予測ピクチャを生成し、超解像拡大画像から得られる符号化対象ピクチャから予測ピクチャを減算することで残差情報を生成し、この残差情報に対して所定の符号化処理を行って第３符号化ビット列を生成するように構成することで、要求に応じて、基準解像度の入力画像の超解像拡大・変換信号と復号画像との間における空間解像度の相関性を利用した場合と、基準解像度の入力画像の超解像拡大・変換信号と超解像拡大・変換復号信号との間における空間解像度の相関性を利用した場合の階層符号化を行うことができるとともに、超解像拡大画像と解像度変換拡大復号画像との間における空間解像度の相関性を利用した場合と、超解像拡大画像と超解像拡大復号画像との間における空間解像度の相関性を利用した場合の階層符号化を行うことができ、異なる多重化ビット列を生成し、復号側へ供給、蓄積、または伝送す

ることができる。

[0247] 更に、第１および第２参照ピクチャのどちらを利用したかを特定するための参照ピクチャ選択情報、および参照ピクチャ選択情報を生成し、多重化部１０９に供給するように構成することで、本実施の形態７の符号化時に利用した参照ピクチャを容易に特定することができるようになる。

[0248] また、本実施の形態７では、第１符号化部１０２から得られる基準解像度の第１符号化ビット列、第２符号化部１０７から得られる第１から第３の第２符号化ビット列、第３符号化部１０８から得られる第１から第３の第３符号化ビット列に対して多重化処理を行い、多重化後の第１から第６の符号化ビット列を要求に応じて生成することで多様な符号化ビット列の生成を可能にする。また、図示されない外部の蓄積装置に伝送した後に所定の記録媒体に記録したり、図示されない外部の通信装置によってネットワーク配信したりすることにより、本実施の形態の動画像符号化装置によって大量の情報量をもつ動画像を効率よく符号化し、蓄積、および伝送することを可能にするとともに、復号側で選択的な復号を可能にする。

[0249] なお、図１９に示す実施の形態７の動画像符号化装置では、図１に示す実施の形態１の動画像符号化装置と、図１３に示す実施の形態４の動画像符号化装置とを統合した構成としているが、図７、図８、図９に示す実施の形態２の動画像符号化装置と、図１６、図１７に示す実施の形態５の動画像符号化装置とを統合したり、さらには図１に示す実施の形態１の動画像符号化装置と、図１６、図１７に示す実施の形態５の動画像符号化装置とを統合したり、図７、図８、図９に示す実施の形態２の動画像符号化装置と、図１３に示す実施の形態４の動画像符号化装置とを統合しても勿論よい。

[0250] ［実施の形態８］

次に、本発明の実施の形態８の動画像符号化装置について説明する。

[0251] 図２２は、実施の形態８の動画像符号化装置の構成例を示すブロック図である。

[0252] 図２２に示す実施の形態８における構成要素は、図１３に示す実施の形態

４と、図１８に示す実施の形態６とを統合したものである。従って、実施の形態８の動作も、実施の形態４との動作と、実施の形態６の動作とを組み合わせたものになるので、省略する。

[0253] 従って、本実施の形態８の動画像符号化装置によれば、図１９に示す実施の形態７の動画像符号化装置と同様の効果が得られると共に、図１０に示す実施の形態３や、図１８に示す実施の形態６と同様に、さらに、蓄積量制御部４１２と符号量制御部４２３等とを有し、各バッファにおける蓄積量制御や、第１符号化部１０２と第３符号化部１０８とにおける符号量制御を行うようにしたので、第１符号化部１０２と第３符号化部１０８とにおける符号量や、各バッファにおける蓄積量を考慮した符号化を実行することができる。

[0254] なお、上記実施の形態１～８の説明では、動画像符号化装置をブロック図により図示してハードウエアにより構成したものとして説明したが、本発明では、これに限らず、ＣＰＵと、メモリやＨＤＤに格納された動画像符号化プログラムにより、上記実施の形態１～８の機能をソフトウェア処理により達成するようにしても勿論よい。また、本発明の動画像符号化装置、動画像符号化方法、および動画像符号化プログラムの適用される範囲は、動画像を符号化するような装置、方法、プログラム、システム等であれば、特に限定されるものではない。本発明は、例えば、ＴＶに代表される放送装置、携帯電話、テレビ会議装置、監視装置、ＤＶＤ－Ｒ／ＲＷやＢＤ－Ｒ／ＲＷ、ＨＤＤ、ＳＤ（商標または登録商標）、ホログラフィックメモリなどの追記および書き換え可能な記録媒体を利用した録画再生装置、およびカムコーダといった撮像記録再生装置、オーサリングなどの記録編集装置、動画像の配信装置などに適用しても構わない。

[0255] ［実施の形態９］

次に、実施の形態９以降により、本発明の動画像復号装置の実施形態について説明する。

[0256] 図２３は、実施の形態９の動画像復号装置の構成例を示すブロック図であ

る。

[0257] 図２３において、実施の形態９の動画像復号装置は、少なくとも多重化分離部１８０１、第１復号部１８０２、第１超解像拡大部１８０３、第１解像度変換部１８０４、第２復号部１８０５、第２解像度変換部１８０６、第３復号部１８０７を有している。

[0258] 多重化分離部１８０１は、入力として入力する多重化後の符号化ビット列を取得し、所定の構文構造に基づいて符号化で利用した各種パラメータ情報や符号化モード情報を特定するための識別情報を特定しながら多重化分離を行うことで、多重化後の符号化ビット列から、第１復号部１８０２で復号される第１符号化ビット列、第２復号部１８０５で復号される第２符号化ビット列、第３復号部１８０７で復号される第３符号化ビット列を取得する機能を有する。また、多重化分離部１８０１は、多重化後の符号化ビット列から取得が可能であれば、拡大率情報ビット列、解像度変換率情報ビット列、第２復号処理で利用するための参照ピクチャ選択モード情報、および参照ピクチャ選択情報の符号化ビット列、第３復号処理で利用するための参照ピクチャ選択モード情報、および参照ピクチャ選択情報の符号化ビット列、を更に取得し、供給することができる機能を有する構成であると良い。多重化分離部１８０１は、少なくとも、取得した第１符号化ビット列を第１復号部１８０２、第２符号化ビット列を第２復号部１８０５、第３符号化ビット列を第３復号部１８０７にそれぞれ供給する機能を有する。更に、多重化分離部１８０１は、多重化後の符号化ビット列から取得が可能であれば、動きベクトル情報の符号化ビット列を取得し、第１復号部１８０２に供給する機能を有する構成であると良い。

[0259] 第１復号部１８０２は、多重化分離部１８０１から基準解像度の第１符号化ビット列を取得し、所定の第１復号処理を行うことにより、基準解像度の復号画像列を生成する機能を有する。また、第１復号部１８０２は、取得が可能であれば、図示しないエントロピー復号部を介し、所定のエントロピー復号処理が行われることで得られる動きベクトル情報を取得し、所定の復号

処理を行う機能を有すると良い。第１復号部１８０２は、生成された基準解像度の復号画像列を第１超解像拡大部１８０３、第２復号部１８０５、第２解像度変換部１８０６に供給する機能を有する。また、第１復号部１８０２は、復号画像列を一時的に格納するための機能を有することが望ましい。更に、第１復号部１８０２は、生成された基準解像度の復号画像列を要求に応じて外部の図示されていない表示装置に供給する機能を有することで、基準解像度の復号画像列を出力表示できるような構成であると良い。

[0260] 第１超解像拡大部１８０３は、第１復号部１８０２から基準解像度の復号画像列を取得し、所定の超解像拡大処理に必要となる、少なくとも２枚の基準解像度をもつ復号画像列を取得し、取得した基準解像度の復号画像列に対し、所定の超解像拡大処理を行い、基準解像度よりも高い解像度をもつ、超解像拡大復号画像列を生成し出力する機能を有する。ここで、所定の超解像拡大処理を行う際の拡大率は、所定の拡大率情報として設定されるか、多重化分離部１８０１で取得され、図示しないエントロピー復号部を介し、所定のエントロピー復号処理が行われることで得られる拡大率情報を取得する機能を有し、取得した拡大率情報に基づいて拡大率が特定されて所定の超解像拡大処理を行うように構成すると良い。また、第１超解像拡大部１８０３は、生成した超解像拡大復号画像列を第１解像度変換部１８０４に供給する機能を有する。更に、第１超解像拡大部１８０３は、生成された超解像拡大復号画像列を要求に応じて外部の図示されていない表示装置に供給する機能を有することで、基準解像度よりも高い解像度をもつ超解像拡大復号画像列を出力表示できるような構成であると良い。

[0261] 第１解像度変換部１８０４は、第１超解像拡大部１８０３から超解像拡大復号画像列を取得し、取得した超解像拡大復号画像列に対して所定の解像度変換処理を行うことにより、基準解像度よりも高い解像度をもつ超解像拡大復号画像列から、基準解像度をもつ超解像復号画像列を生成し、第２復号部１８０５に供給する機能を有する。ここで、所定の解像度変換処理を行う際の解像度変換率は、所定の解像度変換率情報として設定されるか、多重化分

離部１８０１から図示しないエントロピー復号部を介し、所定のエントロピー復号処理が行われることで得られる解像度変換率情報を取得できる場合には、この取得した解像度変換率情報に基づいて解像度変換率が特定されて所定の解像度変換処理を行う機能を有するように構成すると良い。更に、第１解像度変換部１８０４は、生成された基準解像度の超解像復号画像列を要求に応じて外部の図示されていない表示装置に供給する機能を有することで、基準解像度の超解像復号画像列を出力表示できるような構成であると良い。

[0262] 第２復号部１８０５は、多重化分離部１８０１から基準解像度の第２符号化ビット列、第１復号部１８０２から基準解像度の復号画像列、第１解像度変換部１８０４から基準解像度の超解像復号画像列を取得し、取得した第２符号化ビット列に対して所定の基準解像度の拡張復号である第２復号処理を行うことにより、基準解像度の復号残差情報を生成する機能を有する。ここで、第２復号部１８０５は、取得した画像列を一時的に蓄積する機能を有することが望ましい。

[0263] また、第２復号部１８０５は、復号画像列における各復号画像を第１の参照ピクチャとし、超解像復号画像列における各超解像復号画像を第２の参照ピクチャとして、所定の予測処理を行うことにより、基準解像度の予測ピクチャを生成する機能を有する。ここで、第２復号部１８０５は、多重化分離部１８０１から図示しないエントロピー復号部を介し、所定のエントロピー復号処理が行われることで得られる参照ピクチャ選択モード情報、および参照ピクチャ選択情報を取得できる場合には、この参照ピクチャ選択モード情報、および参照ピクチャ選択情報に基づいて所定の予測処理を行い、基準解像度の予測ピクチャを生成する機能を有すると更に良い構成となる。ここで、所定の予測処理は、取得した参照ピクチャ選択モード情報および参照ピクチャ選択情報に従って、復号対象となっている第２符号化ビット列が、どのような符号化モードの下で、どのような参照ピクチャを利用して予測ピクチャを作成したかを特定し、符号化時と同等の予測ピクチャを作成するように構成すると良い。例えば、第２復号部１８０５は、参照ピクチャ選択モード

情報から、第１参照ピクチャと第２参照ピクチャのどちらか一方を利用して予測処理を行う符号化モードであることを特定すると、特定された参照ピクチャを利用して所定の予測処理を行い、予測ピクチャを生成する。また、例えば、第２復号部１８０５は、参照ピクチャ選択モード情報から、第１参照ピクチャと第２参照ピクチャのどちらも利用しないで予測処理を行う符号化モードであることを特定すると、どちらの参照ピクチャも利用せずに所定の予測処理を行い、予測ピクチャを生成する。また、例えば、第２復号部１８０５は、参照ピクチャ選択モード情報から、各ピクチャ、もしくは所定のピクチャ数ごとに参照ピクチャの選択を制御して予測処理を行う符号化モードであることを特定すると、参照ピクチャ選択情報を利用して順次、第１参照ピクチャと第２参照ピクチャのどちらを利用したかを特定し、特定された参照ピクチャを利用して所定の予測処理を行い、予測ピクチャを生成する。また、例えば、第２復号部１８０５は、参照ピクチャ選択モード情報から、対象ピクチャをそれぞれ所定の大きさをもつ領域ごとに隙間なく分割し、第１参照ピクチャと第２参照ピクチャも同様に所定の大きさをもつ領域ごとに隙間なく分割し、対応する領域ごとに第１参照ピクチャと第２参照ピクチャのどちらを利用するかを制御して予測処理を行う符号化モードであることを特定すると、参照ピクチャ選択情報を利用して順次、対応する領域ごとに第１参照ピクチャと第２参照ピクチャのどちらを利用したかを特定し、特定された各領域の参照ピクチャを利用して所定の予測処理を行い、予測ピクチャを生成する。

[0264] そして、第２復号部１８０５は、生成した基準解像度の復号残差情報と、基準解像度の予測ピクチャとを加算することで、復号後の基準解像度の超解像画像列を生成する機能を有する。更に、第２復号部１８０５は、生成された復号後の基準解像度の超解像画像列を要求に応じて外部の図示されていない表示装置に供給する機能を有することで、基準解像度の超解像画像列を出力表示できるような構成であると良い。

[0265] 第２解像度変換部１８０６は、第１復号部１８０２から基準解像度の復号

画像列を取得し、取得した基準解像度の復号画像列に対して所定の解像度変換処理を行うことにより、第１超解像拡大部１８０３が生成する超解像拡大復号画像列の空間解像度と同じ解像度をもつ、高解像度の拡大復号画像列を生成し、第３符号化部１８０７に供給する機能を有する。ここで、所定の解像度変換処理を行う際の解像度変換率は、所定の解像度変換率情報として設定されるか、多重化分離部１８０１から図示しないエントロピー復号部を介し、所定のエントロピー復号処理が行われることで得られる解像度変換率情報を取得できる場合には、この取得した解像度変換率情報に基づいて解像度変換率が特定されて所定の解像度変換処理を行う機能を有するように構成すると良い。更に、第２解像度変換部１８０６は、生成された高解像度の拡大復号画像列を要求に応じて外部の図示されていない表示装置に供給する機能を有することで、高解像度の拡大復号画像列を出力表示できるような構成であると良い。

[0266] 第３復号部１８０７は、多重化分離部１８０１から高解像度の第３符号化ビット列、第２解像度変換部１８０６から高解像度の拡大復号画像列、第１超解像拡大部１８０３から高解像度の超解像拡大復号画像列を取得し、取得した第３符号化ビット列に対して所定の高解像度の拡張復号である第３復号処理を行うことにより、高解像度の復号残差情報を生成する機能を有する。ここで、第３復号部１８０７は、取得した画像列を一時的に蓄積する機能を有することが望ましい。

[0267] また、第３復号部１８０７は、拡大復号画像列における各拡大復号画像を拡大復号画像列から得られる第１の参照ピクチャとし、超解像拡大復号画像列における各超解像拡大復号画像を第２の参照ピクチャとして、所定の予測処理を行うことにより、高解像度の予測ピクチャを生成する機能を有する。ここで、第３復号部１８０７は、多重化分離部１８０１から図示しないエントロピー復号部を介し、所定のエントロピー復号処理が行われることで得られる参照ピクチャ選択モード情報、および参照ピクチャ選択情報を取得できる場合には、この参照ピクチャ選択モード情報、および参照ピクチャ選択情

報に基づいて所定の予測処理を行い、高解像度の予測ピクチャを生成する機能を有すると更に良い構成となる。ここで、所定の予測処理は、取得した参照ピクチャ選択モード情報および参照ピクチャ選択情報に従って、復号対象となっている第３符号化ビット列が、どのような符号化モードの下で、どのような参照ピクチャを利用して予測ピクチャを作成したかを特定し、符号化時と同等の予測ピクチャを作成するように構成すると良い。例えば、第３復号部１８０７は、参照ピクチャ選択モード情報から、第１参照ピクチャと第２参照ピクチャのどちらか一方を利用して予測処理を行う符号化モードであることを特定すると、特定された参照ピクチャを利用して所定の予測処理を行い、予測ピクチャを生成する。また、例えば、第３復号部１８０７は、参照ピクチャ選択モード情報から、第１参照ピクチャと第２参照ピクチャのどちらも利用しないで予測処理を行う符号化モードであることを特定すると、どちらの参照ピクチャも利用せずに所定の予測処理を行い、予測ピクチャを生成する。また、例えば、第３復号部１８０７は、参照ピクチャ選択モード情報から、各ピクチャ、もしくは所定のピクチャ数ごとに参照ピクチャの選択を制御して予測処理を行う符号化モードであることを特定すると、参照ピクチャ選択情報を利用して順次、第１参照ピクチャと第２参照ピクチャのどちらを利用したかを特定し、特定された参照ピクチャを利用して所定の予測処理を行い、予測ピクチャを生成する。また、例えば、第３復号部１８０７は、参照ピクチャ選択モード情報から、対象ピクチャをそれぞれ所定の大きさをもつ領域ごとに隙間なく分割し、第１参照ピクチャと第２参照ピクチャも同様に所定の大きさをもつ領域ごとに隙間なく分割し、対応する領域ごとに第１参照ピクチャと第２参照ピクチャのどちらを利用するかを制御して予測処理を行う符号化モードであることを特定すると、参照ピクチャ選択情報を利用して順次、対応する領域ごとに第１参照ピクチャと第２参照ピクチャのどちらを利用したかを特定し、特定された各領域の参照ピクチャを利用して所定の予測処理を行い、予測ピクチャを生成する。

[0268] そして、第３復号部１８０７は、生成した高解像度の復号残差情報と、高

解像度の予測ピクチャとを加算することで、復号後の高解像度の超解像拡大画像列を生成する機能を有する。例えば、生成した復号後の高解像度の超解像拡大画像列を、要求に応じて外部の図示されていない表示装置に供給する機能を有することで、高解像度の超解像拡大画像列を出力表示できるような構成であると良い。

[0269] 以上のように動画像復号装置を構成することにより、上記実施の形態１～８の動画像符号化装置等によって生成された多重化後の符号化ビット列を入力し、符号化の手順とは逆に復号することで、基準解像度の復号画像列、拡大復号画像列、超解像拡大復号画像列、超解像復号画像列、復号後の超解像画像列、復号後の超解像拡大画像列といった、従来よりも高品質で多様な空間解像度や周波数成分を持った復号画像列を得ることができる。また、これらの多様な復号画像列を図示されていない表示装置に対して、要求に応じた選択的な出力に対応するように構成することが可能である。例えば、ユーザが携帯端末表示装置などのような、高い解像度を表示できない表示装置を利用している場合には、基準解像度の復号画像列、基準解像度の超解像復号画像列、復号後の基準解像度の超解像画像列を、出力として選択的に要求し、視聴することができる。また、例えば、ユーザが高精細テレビなどのような、高い解像度を表示できる表示装置を利用している場合には、高解像度の拡大復号画像列、高解像度の超解像拡大復号画像列、復号後の超解像拡大画像列を、出力として選択的に要求し、視聴することができる。

[0270] 次に、図２３に示す実施の形態９の動画像復号装置の動作を、図２４のフローチャートを参照して説明する。

[0271] まず、多重化分離部１８０１は、入力される多重化後の符号化ビット列を取得し、所定の構文構造に基づいて符号化で利用した各種パラメータ情報や符号化モード情報を特定するための識別情報を特定しながら多重化分離を行う（ステップＳ６０１）ことで、基準解像度の第１符号化ビット列、基準解像度の第２符号化ビット列、高解像度の第３符号化ビット列を取得し、第１符号化ビット列を第１復号部１８０２、第２符号化ビット列を第２復号部１

８０５、第３符号化ビット列を第３復号部１８０７に供給する。また、多重化分離部１８０１は、多重化後の符号化ビット列から取得が可能であれば、動きベクトル情報を取得し、第１復号部１８０２に供給する。

[0272] その後、第１の並列処理（ステップＳ６０２，Ｓ６０３）、第２の並列処理（ステップＳ６０４）、および第３の並列処理（ステップＳ６０５）に分岐し、並行して動作を行う。

[0273] つまり、第１の並列処理では、第１復号部１８０２は、多重化分離部１８０１から第１符号化ビット列と、取得が可能であれば、動きベクトル情報を取得し、基準解像度の第１復号処理を行う（ステップＳ６０２）ことで基準解像度の復号画像列を生成し、第２復号部１８０５に供給する。

[0274] その後、第２復号部１８０５は、第１復号部１８０２によって生成された基準解像度の復号画像列を取得し、一時的に蓄積するための所定のバッファに格納する（ステップＳ６０３）。その後、他の並列処理が完了するまで待機する。

[0275] 第２の並列処理では、第２復号部１８０５は、多重化分離部１８０１から基準解像度の第２符号化ビット列を取得し、所定の第２復号処理を行う（ステップＳ６０４）ことで、基準解像度の復号残差情報を生成する。その後、他の並列処理が完了するまで待機する。

[0276] 第３の並列処理では、第３復号部１８０７は、多重化分離部１８０１から高解像度の第３符号化ビット列を取得し、所定の第３復号処理を行う（ステップＳ６０５）ことで、高解像度の復号残差情報を生成する。その後、他の並列処理が完了するまで待機する。

[0277] 第１～第３の並列処理が完了すると、第４の並列処理（ステップＳ６０６，Ｓ６０７，Ｓ６０８，Ｓ６０９）、第５の並列処理（ステップＳ６１０，Ｓ６１１）に分岐し、並列して動作を行う。

[0278] 第４の並列処理では、第１超解像拡大部１８０３は、第１復号部１８０２から基準解像度の復号画像列を取得し、所定の超解像拡大処理を行う（ステップＳ６０６）ことで、基準解像度よりも高い解像度をもつ高解像度の超解

像拡大復号画像列を生成し、第１解像度変換部１８０４、および第３復号部１８０７に供給する。

[0279] その後、第３復号部１８０７は、第１超解像拡大部１８０３によって生成された高解像度の超解像拡大復号画像列を取得し、一時的に蓄積するための所定のバッファに格納する（ステップＳ６０７）。

[0280] その後、第１解像度変換部１８０４は、第１超解像拡大部１８０３から高解像度の超解像拡大復号画像列を取得し、所定の解像度変換処理を行う（ステップＳ６０８）ことで、基準解像度よりも高い解像度をもつ超解像拡大復号画像列から、基準解像度をもつ超解像復号画像列を生成し、第２復号部１８０５に供給する。

[0281] その後、第２復号部１８０５は、第１解像度変換部１８０４によって生成された基準解像度の超解像復号画像列を取得し、一時的に蓄積するための所定のバッファに格納する（ステップＳ６０９）。その後、他の並列処理が完了するまで待機する。

[0282] 第５の並列処理では、第２解像度変換部１８０６は、第１復号部１８０２から基準解像度の復号画像列を取得し、所定の解像度変換処理を行う（ステップＳ６１０）ことで高解像度の拡大復号画像列を生成し、第３号化部１８０７に供給する。

[0283] その後、第３復号部１８０７は、第２解像度変換部１８０６によって生成された高解像度の拡大復号画像列を取得し、一時的に蓄積するための所定のバッファに格納する（ステップＳ６１１）。その後、他の並列処理が完了するまで待機する。

[0284] 以上の並列処理が完了すると、第６の並列処理（ステップＳ６１２）、第７の並列処理（ステップＳ６１３）に分岐し、並列して動作を行う。

[0285] 第６の並列処理では、第２復号部１８０５は、所定の予測処理を行う（ステップＳ６１２）ことで、基準解像度の予測ピクチャを生成し、生成した基準解像度の復号残差情報と、基準解像度の予測ピクチャとを加算することで、復号後の基準解像度の超解像画像列を生成する。その後、他の並列処理が

完了するまで待機する。

[0286] 第７の並列処理では、第３復号部１８０７は、所定の予測処理を行う（ステップＳ６１３）ことで、高解像度の予測ピクチャを生成し、生成した高解像度の復号残差情報と、高解像度の予測ピクチャとを加算することで、復号後の高解像度の超解像拡大画像列を生成する。その後、他の並列処理が完了するまで待機する。

[0287] 並列処理が完了すると、第１復号部１８０２、第１超解像拡大部１８０３、第１解像度変換部１８０４、第２復号部１８０５、第２解像度変換部１８０６、第３復号部１８０７は、生成された復号後の各解像度の画像列を要求に応じて外部の図示されていない表示装置等に供給することで、多様な復号結果を要求に応じて出力表示する（ステップＳ６１４）。以上のようなステップを経ることで、本実施形態の一連の動作が完了する。

[0288] このようなステップを実行することで、実施の形態９の動画像復号装置を動作させることにより、所望の復号後の画像列を生成することができる。

[0289] なお、本実施形態９の動作を複数の並列処理によって説明したが、この並列処理部分を連続的に処理するように、本実施形態の構成を動作させても良いことに注意する。

[0290] 図２５は、図２４のステップＳ６０２の基準解像度の復号処理の動作手順の一例を示すフローチャートである。

[0291] 図２５において、第１復号部１８０２は、所定のエントロピー復号部、逆量子化部、逆直交変換部、イントラ予測部、動き補償部に基づいて所定の復号処理を行う。

[0292] まず、第１復号部１８０２は、現在の復号対象領域の復号を行うために、多重化分離部１８０２から基準解像度の第１符号化ビット列を取得すると、エントロピー復号部により所定のエントロピー復号処理を行って復号後の量子化後情報を生成し、量子化後情報に対して逆量子化部により所定の逆量子化処理を行って復号後の直交変換係数情報を生成し、直交変換係数情報に対して逆直交変換部により所定の逆直交変換処理を行って復号残差情報を生成

することにより、第１の復号を行う（ステップＳ７０１）。

[0293] 次に、イントラ予測部は、現在の復号対象領域における予測情報を生成するために、現在の復号対象領域に隣接する復号済み領域の情報に基づいて、所定のイントラ予測処理を行う（ステップＳ７０２）ことで予測情報を生成し、生成された復号対象領域の復号残差情報と予測情報とを加算することで、復号対象領域の復号情報を生成する。

[0294] その後、面内の各領域の復号情報が全て生成されて復号画像が得られたかを判別どうかをイントラ復号が完了しかたどうかを判定する（ステップＳ７０３）。

[0295] イントラ復号が完了した場合（ステップＳ７０３：ＹＥＳ）、復号すべき符号化ビット列が存在する場合には処理を継続し、ステップＳ７０４に進む。復号すべき符号化ビット列が存在しない場合には、一連の復号処理を終了する。

[0296] イントラ復号が完了していない場合（ステップＳ７０３：ＮＯ）、次の復号対象領域を特定し、ステップＳ７０１に戻ることで処理を継続する。

[0297] イントラ復号が完了すると、次にインター復号を行うために、第１復号部１８０２は、イントラ復号と同様に、第１の復号を行う（ステップＳ７０４）ことで、復号残差情報を生成する。

[0298] また、動き補償部は、生成された復号画像を参照ピクチャとし、多重化分離部１８０１から動きベクトル情報を取得し、動きベクトル情報に基づいて参照ピクチャを利用しながら所定の動き補償を行う（ステップＳ７０５）ことで予測ピクチャを生成し、生成した復号残差情報と予測ピクチャとを加算することで、復号画像を生成する。

[0299] その後、インター復号が完了したかどうかを符号化モード情報などから判定する（ステップＳ７０６）。

[0300] 次の復号もインター復号である場合（ステップＳ７０６　ＮＯ）、インター復号を継続するためにステップＳ７０４に戻ることで処理を継続する。

[0301] 次の復号がインター復号ではない場合（ステップＳ７０６　ＹＥＳ）、イ

ンター復号処理を終了する。ここで、復号すべき符号化ビット列が存在し、次の復号がイントラ復号である場合には、ステップＳ７０１に戻ることで、一連の復号処理が繰り返される。また、復号すべき符号化ビット列が存在しない場合には、一連の復号処理を終了する。

[0302] なお、本実施の形態９も、ブロック図によりハードウエア的に構成して説明したが、上記実施の形態１～８と同様に、図２３に示す動画像復号装置の機能を、ＣＰＵとプログラムとによりソフトウエア的に実行するようにしても勿論よい。

[0303] ［実施の形態１０］

次に、実施の形態１０の動画像復号装置の実施形態について説明する。

[0304] 図２６は、実施の形態１０の動画像復号装置の構成例を示すブロック図である。

[0305] 図２６に示す実施の形態１０の動画像復号装置は、図２３に示す本発明の動画像復号装置から第２解像度変換部１８０６、第３復号部１８０７を省略ないしは機能させないように構成したもので、図２６の各構成要素の機能は、図２３に示すものと同等であり、重複を避けるため説明を省略する。

[0306] このような動画像復号装置を構成することにより、本発明と対になる動画像符号化装置、動画像符号化方法、動画像符号化プログラム、動画像再符号化装置、動画像再符号化方法、動画像再符号化プログラムによって生成された多重化後の符号化ビット列を取得し、本発明の動画像復号装置によって正しく復号することで、基準解像度の復号画像列、超解像拡大復号画像列、超解像復号画像列、復号後の超解像画像列といった、従来よりも高品質で多様な空間解像度や周波数成分を持った復号画像列を得ることができる。また、これらの多様な復号画像列を図示されていない表示装置に対して、要求に応じた選択的な出力に対応するように構成することが可能である。

なお、本実施の形態１０も、ブロック図によりハードウエア的に構成して説明したが、上記実施の形態１～９と同様に、図２６に示す動画像復号装置の機能を、ＣＰＵとプログラムとによりソフトウエア的に実行するようにし

ても勿論よい。

[0307] ［実施の形態１１］

次に、本発明の実施の形態１１である、再符号化装置について説明する。

[0308] 図２７は、実施の形態である、再符号化装置の構成例を示すブロック図である。

[0309] 図２７に示す実施の形態１１の再符号化装置は、図２６に示す実施の形態１０の動画像復号装置に対し、新たに再符号化部１８０８および多重化部１８０９を追加することで、ある特定の符号化形式から別の異なる符号化形式に変換する再符号化処理（トランスコーディング）を行うような構成としている。

[0310] 図２７に示す実施の形態１１における再符号化処理を、例えば、ＡＶＣリライティング(またはＡＶＣトランスコーディング)、つまりＡＶＣの符号化形式に再符号化するような処理に基づく構成とすることもできる。なお、図２３に示す実施の形態９の動画像復号装置に対し、新たに再符号化部１８０８および多重化部１８０９を追加するように構成しても勿論よい。

[0311] ここで、本実施の形態１１では、多重化分離部１８０１によって得られる基準解像度の第２符号化ビット列は、例えば、MPEG-4 SVCにおけるCGS(Coarse Grain Scalability)レイヤの構成であると良い。これは、さらに、基本階層となる基準解像度の画像列と、基本階層を参照する拡張階層となる基準解像度の超解像画像列との間の空間解像度が同一であるように符号化されている場合には、MPEGおよびITU-Tとの共同グループであるJVT(Joint Video Team)におけるＡＶＣリライティングに関する奇書（AVC Rewritingに関する文献ファイルJVT-U043、http://ftp3.itu.ch/av-arch/jvt-site/2006_10_Hangzhou/ JVT- U043.zip、およびJVT-V035、http://ftp3.itu.ch/av-arch/jvt-site/2007_01_Marrakech/ JVT-V035.zip）中に示す、SVCからＡＶＣに容易に変換できるようにするための抑制条件を満たすような所定の構文構造に基づいて符号化を行って符号化ビット列が生成されていると良い。本実施の形態１１では、このように生成された符号化ビット列を取得し、本発明のCGSレイヤで

構成された拡張階層を扱う符号化形式から単層の符号化であるＡＶＣの符号化形式に、完全な復号と符号化を行うような再符号化を行うことなく、変換することができるような符号化ビット列を生成できるような構成であると良い。

[0312] また、このようなＡＶＣリライティングに適した符号化が行われていない符号化ビット列に対しては、基準解像度の符号化ビット列、および基準解像度の第２符号化ビット列を復号することによって得られる超解像画像列と、基準解像度の符号化ビット列を復号した際に得られる各種の符号化モード情報や動きベクトル情報などを利用しながら、単一階層のＡＶＣの符号化形式に基づいて再符号化を行うことで、符号化ビット列を生成できるような構成であると良い。

[0313] したがって、図２７に示す本実施の形態１１の再符号化装置を構成する各要素は、更に以下に示すような機能を備えると良い。

[0314] つまり、第１復号部１８０２は、更に、所定のエントロピー復号処理および逆量子化処理を行うことにより、取得した基準解像度の符号化ビット列に対して、完全に復号せずに、基準解像度の基本層における直交変換係数情報の状態まで復号するための機能を有する。また、第１復号部１８０２は、ＡＶＣリライティングが可能であると判断された場合には復号途中である直交変換係数情報を、再符号化が必要であると判断された場合には基準解像度の復号画像列を再符号化部１８０８に供給する機能を有する。また、第１復号部１８０２は、復号時に得られる各種パラメータ情報および符号化モード情報を再符号化部１８０８に供給する機能を有すると良い。

[0315] 第１解像度変換部１８０４は、更に、再符号化が必要であると判断された場合には、基準解像度の超解像復号画像列を再符号化部１８０８に供給する機能を有する。

[0316] 第２復号部１８０５は、更に、所定のエントロピー復号処理および逆量子化処理を行うことにより、取得した基準解像度拡張符号化ビット列に対して、完全に復号せずに、基準解像度の拡張層における直交変換係数情報の状態

まで復号するための機能を有し、ＡＶＣリライティングが可能であると判断した場合には、復号途中である基準解像度の拡張層における直交変換係数情報を、再符号化が必要であると判断された場合には復号後における基準解像度の超解像画像列を再符号化部１８０８に供給する機能を有する。

[0317] 再符号化部１８０８は、ＡＶＣリライティングが可能であると判断された場合には第１復号部１８０２から復号途中である直交変換係数情報、および第２復号部１８０５から復号途中である基準解像度の拡張層における直交変換係数情報を取得し、それぞれの直交変換係数情報を合成した後に所定のエントロピー符号化処理を行うことにより再符号化後の符号化ビット列を生成し、多重化部１８０９に供給する機能を有する。また、再符号化部１８０８は、再符号化が必要であると判断された場合には第１復号部１８０２から基準解像度の復号画像列、第１解像度変換部１８０４から基準解像度の超解像復号画像列、および第２復号部１８０５から基準解像度の超解像画像列を必要に応じて取得し、所定の符号化処理を行うことにより再符号化後の符号化ビット列を生成し、多重化部１８０９に供給する機能を有する。

[0318] 多重化部１８０９は、取得した再符号化後の符号化ビット列を取得し、所定の構文構造に基づいて、符号化で利用した各種パラメータ情報や符号化モード情報を特定するための識別情報を挿入しながら多重化処理を行い、出力である多重化後の符号化ビット列を生成する機能を有する。

[0319] このように動画像再符号化装置を構成することにより、上記実施の形態１～８の動画像符号化装置等によって生成された多重化後の符号化ビット列を取得し、本発明の動画像再符号化装置によって、第１復号部１８０２から復号途中である直交変換係数情報、および第２復号部１８０５から復号途中である基準解像度の拡張層における直交変換係数情報を取得し、それぞれの直交変換係数情報を合成し、再度エントロピー符号化処理および多重化処理を行うことにより、再符号化後の符号化ビット列を生成できることから、従来よりも高品質で多様な空間解像度や周波数成分を持った復号成分を、完全に復号して復号画像列を生成することなく、多くの演算量を費やすことなく容

易に再符号化することができる。

[0320] また、再符号化後の符号化ビット列を生成することで異なる符号化形式に変換し、対象となる符号化形式に適合した符号化ビット列を生成することができるように構成することが可能である。

[0321] 基準解像度の復号画像列、超解像復号画像列、復号後の超解像画像列といった、従来よりも高品質で多様な空間解像度や周波数成分を持った復号画像列を得ることができる。また、これらの多様な復号画像列に対して再符号化を行うことで、単一階層の符号化ビット列を生成することができる。

[0322] したがって、例えば、携帯端末表示装置などのように、搭載されている動画像復号装置が、演算量や消費電力などの制約により、より低い演算量や消費電力、低い符号化伝送レートで復号できるような符号化形式にのみ対応しているような場合には、本発明の動画像再符号化装置によって再符号化を行うことで、対象となる符号化形式に適合した符号化ビット列を生成することができるように構成することが可能である。

[0323] また、このように動画像再符号化装置を構成することにより、上記実施の形態１～８の動画像符号化装置等によって生成された多重化後の符号化ビット列を取得し、本発明の動画像再符号化装置によって正しく復号することで、基準解像度の復号画像列、超解像復号画像列、復号後の超解像画像列といった、従来よりも高品質で多様な空間解像度や周波数成分を持った復号画像列を得ることができる。

[0324] また、これらの多様な復号画像列に対して再符号化を行うことで、単一階層の符号化ビット列を生成することができる。したがって、例えば、携帯端末表示装置などのように、搭載されている動画像復号装置が、演算量や消費電力などの制約により、より低い演算量や消費電力、低い符号化伝送レートで復号できるような符号化形式にのみ対応しているような場合には、本発明の動画像再符号化装置によって再符号化を行うことで、異なる符号化形式に変換し、対象となる符号化形式に適合した符号化ビット列を生成することができるように構成することが可能である。

[0325] 次に、図２８のフローチャートを参照して、図２７に示す再符号化装置の動作について説明する。

[0326] まず、多重化分離部１８０１は、入力として入力する多重化後の符号化ビット列を取得し、所定の構文構造に基づいて符号化で利用した各種パラメータ情報や符号化モード情報を特定するための識別情報を特定しながら多重化分離を行う（ステップＳ７０１）ことで、多重化後の符号化ビット列から、基準解像度の第１符号化ビット列、基準解像度の第２符号化ビット列を取得する一方、多重化後の符号化ビット列から取得が可能であれば、拡大率情報ビット列、解像度変換率情報ビット列、基準解像度拡張予測情報の符号化ビット列を更に取得する。その後、多重化分離部１８０１は、取得した第１符号化ビット列を第１復号部１８０２、第２符号化ビット列を第２復号部１８０５にそれぞれ供給し、更に、多重化後の符号化ビット列から取得が可能であれば、動きベクトル情報を取得し、第１復号部１８０２に供給する。

[0327] その後、多重化分離部１８０１は、ＡＶＣリライティングが可能であるか、可能でないかを判定する（ステップＳ７０２）。この判定は、多重化後の符号化ビット列内に含まれる、ＡＶＣリライティングが可能であるか、可能でないかを判定するための判定情報に基づいて行うと良い。

[0328] ＡＶＣリライティングが可能である場合（ステップＳ７０２　ＹＥＳ）、本装置では、第１の並列処理（ステップＳ７０３）、第２の並列処理（ステップＳ７０４）に分岐して、並行してその後の動作を行う。

[0329] これに対し、ＡＶＣリライティングが可能でない場合（ステップＳ７０２　ＮＯ）、本装置では、再符号化が必要であるとして、第３の並列処理（ステップＳ７０７、ステップＳ７０８）、第４の並列処理（ステップＳ７０９）に分岐し、並行してその後の動作を行う。

[0330] ＡＶＣリライティングが可能である場合は、以下の処理を行う。

[0331] つまり、第１の並列処理では、第１復号部１８０２は、第１符号化ビット列を取得し、所定のエントロピー復号処理（ステップＳ７０３）および逆量子化処理を行うことにより、復号途中である基本層の直交変換係数情報を生

成し、再符号化部１８０８に供給する。その後、第２の並列処理が完了するまで待機する。

[0332] 第２の並列処理では、第２復号部１８０５は、第２符号化ビット列を取得し、所定のエントロピー復号処理（ステップＳ７０４）および逆量子化処理を行うことにより、復号途中である拡張層の直交変換係数情報を生成し、再符号化部１８０８に供給する。その後、第１の並列処理が完了するまで待機する。

[0333] 第１および第２の並列処理が完了すると、再符号化部１８０８は、第１復号部１８０２から復号途中である基本層の直交変換係数情報、第２復号部１８０５から復号途中である拡張層の直交変換係数情報を取得した上で、所定の合成処理に基づいて合成し（ステップＳ７０５）、合成結果に対して所定のエントロピー符号化を行う（ステップＳ７０６）ことで、再符号化後の符号化ビット列を生成し、多重化部１８０９に供給する。ここまでの処理が、ＡＶＣリライティングが可能である場合の処理となる。

[0334] 次に、ＡＶＣリライティングが可能でない場合、つまり再符号化が必要である場合には、以下の処理を行う。

[0335] 第３の並列処理では、第１復号部１８０２は、多重化分離部１８０１から基準解像度の符号化ビット列と、取得が可能であれば、動きベクトル情報を取得し、基準解像度の復号処理を行う（ステップＳ７０７）ことで基準解像度の復号画像列を生成し、第２復号部１８０５、および必要に応じて再符号化部１８０８に供給する。

[0336] その後、第２復号部１８０５は、第１復号部１８０２によって生成された基準解像度の復号画像列を取得し、一時的に蓄積するための所定のバッファに格納する（ステップＳ７０８）。その後、第４の並列処理が完了するまで待機する。

[0337] 第４の並列処理において、第２復号部１８０５は、多重化分離部１８０１から第２符号化ビット列を取得し、所定の復号処理を行う（ステップＳ７０９）ことで、基準解像度の復号残差情報を生成する。その後、第３の並列処

理が完了するまで待機する。

[0338] 第３および第４の並列処理が完了すると、第１超解像拡大部１８０３は、第１復号部１８０２から基準解像度の復号画像列を取得し、所定の超解像拡大処理を行う（ステップＳ７１０）ことで、基準解像度よりも高い解像度をもつ高解像度の超解像拡大復号画像列を生成し、第１解像度変換部１８０４に供給する。

[0339] その後、第１解像度変換部１８０４は、第１超解像拡大部１８０３から高解像度の超解像拡大復号画像列を取得し、所定の解像度変換処理を行う（ステップＳ７１１）ことで、基準解像度よりも高い解像度をもつ超解像拡大復号画像列から、基準解像度をもつ超解像復号画像列を生成し、第２復号部１８０５、および必要に応じて再符号化部１８０８に供給する。

[0340] その後、第２復号部１８０５は、第１解像度変換部１８０４によって生成された基準解像度の超解像復号画像列を取得し、一時的に蓄積するための所定のバッファに格納する（ステップＳ７１２）。

[0341] 第２復号部１８０５は、所定の予測処理を行う（ステップＳ７１３）ことで、基準解像度の予測ピクチャを生成し、生成した基準解像度の復号残差情報と、基準解像度の予測ピクチャとを加算することで、復号後の基準解像度の超解像画像列を生成し、必要に応じて再符号化部１８０８に供給する。

[0342] 再符号化部１８０８は、第１復号部１８０２から基準解像度の復号画像列、第１解像度変換部１８０４から基準解像度の超解像復号画像列、および第２復号部１８０５から基準解像度の超解像画像列を必要に応じて取得し、所定の符号化処理によって再符号化を行う（ステップＳ７１４）ことで符号化ビット列を生成し、多重化部１８０９に供給する。

[0343] 多重化部１８０９は、取得した再符号化後の符号化ビット列を取得し、所定の構文構造に基づいて、符号化で利用した各種パラメータ情報や符号化モード情報を特定するための識別情報を挿入しながら多重化処理を行い、出力である多重化後の符号化ビット列を生成し、出力する（ステップＳ７１５）。以上のようなステップを経ることで、本実施形態の一連の動作が完了する

。

[0344] このようなステップを実行することで、本実施の形態の動画像再符号化装置を動作させることにより、再符号化後の符号化ビット列を生成することができる。なお、本実施の形態の動作を複数の並列処理によって説明したが、この並列処理部分を連続的に処理するように、本実施の形態の構成を動作させても良いことに注意する。

[0345] なお、本実施の形態１１も、ブロック図によりハードウエア的に構成して説明したが、上記実施の形態１～１０と同様に、図２７に示す再符号化装置の機能を、ＣＰＵとプログラムとによりソフトウエア的に実行するようにしても勿論よい。

[0346] なお、本発明の動画像復号装置、動画像復号方法、および動画像復号プログラム、そして、本発明の動画像再符号化装置、動画像再符号化方法、および動画像再符号化プログラムの適用される範囲は、動画像を符号化し、復号するような装置、方法、プログラム、システム等であれば、特に限定されるものではない。例えば、本発明を、ＴＶに代表される受像装置、携帯電話、テレビ会議装置、監視装置、ＣＤ、ＤＶＤ、Ｂｌｕ－ｒａｙ　Ｄｉｓｃ（登録商標）などの記録媒体を利用した再生装置、ＤＶＤ－Ｒ／ＲＷやＢＤ－Ｒ／ＲＷ、ＨＤＤ、ＳＤなどの追記および書き換え可能な記録媒体を利用した録画再生装置、およびカムコーダといった撮像記録再生装置、オーサリングなどの記録編集装置、動画像の配信装置などに適用しても良い。

産業上の利用可能性

[0347] 本発明の動画像符号化装置等によれば、第１符号化部が基準解像度の入力動画像を符号化する一方、第１超解像拡大部が基準解像度の入力動画像に対し超解像拡大処理を行うことにより、入力動画像中に潜在的に含まれるが基準解像度では十分表現できていなかった空間方向および時間方向の周波数成分情報を含め、その後、第１解像度変換部によって所定の解像度変換処理等を行ってから第２符号化部にて符号化するようにしたので、第２符号化部では、基準解像度の入力動画像がもつ情報量よりも多くの情報量に基づいた動

画像符号化を行えるという効果を生じる。ここで、第２符号化部では、第１符号化部での復号信号やその復号信号を第２超解像拡大処理および第２解像度変換処理等の加工をした信号を参照信号として利用して符号化することもできる。

[0348] また、本発明の動画像符号化装置等によれば、第１符号化部が基準解像度の入力動画像を符号化する一方、第１超解像拡大部が基準解像度の入力動画像に対し超解像拡大処理を行うことにより、入力動画像中に潜在的に含まれるが基準解像度では十分表現できていなかった空間方向および時間方向の周波数成分情報を含め、その後その信号を第３符号化部にて符号化するようにしたので、第３符号化部では、基準解像度の入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行えるという効果を生じる。ここで、第３符号化部では、第１符号化部での復号信号を第２超解像拡大処理や第３解像度変換処理等の加工をして第１超解像拡大信号と同じ解像度に高解像度化した信号を参照信号として符号化することもできる。また、本発明の動画像復号装置等によれば、このように動画像符号化された動画像を入力して復号することができ、さらに、本発明の動画像再符号化装置等によれば、このように動画像符号化された動画像を入力して復号し再符号化することができる。

符号の説明

[0349] １０１ 第１蓄積バッファ

１０２ 第１符号化部

１０３ 第１超解像拡大部

１０４ 第１解像度変換部

１０５ 第２超解像拡大部

１０６ 第２解像度変換部

１０７ 第２符号化部

１０８ 第３符号化部

１０９ 多重化部

１１０　第３解像度変換部

１８０１　多重化分離部

１８０２　第１復号部

１８０３　第１超解像拡大部

１８０４　第１解像度変換部

１８０５　第２復号部

１８０６　第２解像度変換部

１８０７　第３復号部

１８０８　再符号化部

１８０９　多重化部

請求の範囲

[請求項1] 基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、

基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、

前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像度をもつ超解像拡大・変換画像を生成する第１解像度変換部と、

前記第１解像度変換部からの前記超解像拡大・変換画像を符号化対象画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する第２符号化部と、

を有する動画像符号化装置。

[請求項2] 請求項１記載の動画像符号化装置において、

前記第２符号化部は、さらに、

前記第１符号化部からの前記復号画像を参照画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する、動画像符号化装置。

[請求項3] 請求項１または請求項２記載の動画像符号化装置において、さらに、

前記第１符号化部から基準解像度の前記復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、

前記超解像拡大復号画像に対し第２の解像度変換処理を行って基準解像度をもつ超解像拡大・変換復号画像を生成する第２解像度変換部と、を有し、

前記第２符号化部は、さらに、

前記第２解像度変換部からの前記超解像拡大・変換復号画像を参照

画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する、動画像符号化装置。

[請求項4] 請求項１～請求項３の記載の動画像符号化装置において、

前記第１の超解像拡大部は、

超解像拡大処理を行う際の基準となる基準画像と、少なくとも１枚の観測画像とに基づいて、所望の高解像度の画素位置への位置合わせを行い、不等間隔にサンプリングされた不均一高解像度画像を生成する位置合わせ器と、

前記位置合わせ器にて生成された不均一高解像度画像に対し所定の不均一補間処理を行って、所望の高解像度を持つ補間画像を生成する補間器と、

前記補間器にて生成された前記補間画像を取得して、所定の復元処理を行い、所望の解像度を持つ推定画像を生成する推定画像生成器と、

前記位置合わせ器から前記不均一高解像度画像を取得するとともに、前記推定画像生成器から前記不均一推定画像を取得して、取得したそれぞれの画像を利用して、所定の判定方法に従って超解像拡大処理の繰り返しが必要か否かを判定し、その判定の結果、繰り返しが必要な場合は、前記補間器に対して処理を継続するための制御情報を供給する一方、

繰り返しが必要ない場合には、前記推定画像生成器に対して超解像度拡大結果である高解像度の推定画像を出力するための制御情報を出力する繰り返し判定器と、

を有する動画像符号化装置。

[請求項5] 請求項１～請求項４のいずれか一の請求項に記載された動画像符号化装置において、

さらに、

前記第１符号化部からの前記第１符号化ビット列と、前記第２符号

化部からの前記第２符号化ビット列と、前記第１符号化部における符号化および前記第２符号化部における符号化の際に使用した各種符号化パラメータ情報とを、所定の構文構造に基づいて多重化する多重化部、

を有する動画像符号化装置。

[請求項6] 請求項２～請求項５のいずれか一の請求項に記載された動画像符号化装置において、

さらに、

前記第１符号化部および前記第１超解像拡大部の前段に設けられ、基準解像度の前記動画像列を蓄積する第１蓄積バッファと、

前記第１符号化部と前記第２符号化部の間に設けられ、前記第１符号化部からの前記復号画像を蓄積する第２蓄積バッファと、

前記第１蓄積バッファと、前記第２蓄積バッファと、前記第１符号化部と、前記第２符号化部とにおける各バッファ蓄積量を検出し、各バッファ蓄積量を制御する蓄積制御部と、

前記蓄積制御部における前記各バッファ蓄積量に基づいて、前記第１符号化部と前記第２符号化部とにおける符号量制御を行う符号量制御部と、

を有する動画像符号化装置。

[請求項7] 基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、

基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、

前記第１符号化部から前記復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、

前記第１符号化部から前記復号画像を取得し、第３の解像度変換処理を行って基準解像度よりも高い解像度をもつ解像度変換拡大復号画像を生成する第３解像度変換部と、

前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第２超解像拡大部からの前記超解像拡大復号画像と、前記第３超解像拡大部からの前記解像度変換拡大復号画像とを参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、

を有する動画像符号化装置。

[請求項8] 基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、

基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、

前記第１符号化部から前記復号画像を取得し、第３の解像度変換処理を行って基準解像度よりも高い解像度をもつ解像度変換拡大復号画像を生成する第３解像度変換部と、

前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第３解像度変換部からの前記解像度変換拡大復号画像を参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、

を有する動画像符号化装置。

[請求項9] 基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、

基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像

拡大部と、

前記第１符号化部から前記復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、

前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第２超解像拡大部からの前記超解像拡大復号画像を参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、

を有する動画像符号化装置。

[請求項10] 基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、

基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、

前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像度をもつ超解像拡大・変換画像を生成する第１解像度変換部と、

前記第１符号化部から前記復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、

前記第２超解像拡大部からの前記超解像拡大復号画像に対し第２の解像度変換処理を行って基準解像度をもつ超解像拡大・変換復号画像を生成する第２解像度変換部と、

前記第１解像度変換部からの前記超解像拡大・変換画像を符号化対象画像として、前記第１符号化部からの前記復号画像と、前記第２解像度変換部からの基準解像度をもつ超解像拡大・変換復号画像とを参照画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する第２符号化部と、

前記第１符号化部から前記復号画像を取得し、第３の解像度変換処理を行って基準解像度よりも高い解像度をもつ解像度変換拡大復号画像を生成する第３解像度変換部と、

前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第２超解像拡大部からの前記超解像拡大復号画像と、前記第３解像度変換部からの前記解像度変換拡大復号画像をと参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、

を有する動画像符号化装置。

[請求項11] 基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成するステップと、

基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成するステップと、

前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像度をもつ超解像拡大・変換画像を生成するステップと、

前記超解像拡大・変換画像を符号化対象画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成するステップと、

を有する動画像符号化方法。

[請求項12] 基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成するステップと、

基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成するステップと、

前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像

度をもつ超解像拡大・変換画像を生成するステップと、

前記超解像拡大・変換画像を符号化対象画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成するステップと、

をコンピュータに実行させる動画像符号化プログラム。

[請求項13] 入力される符号化ビット列に対して所定の多重化分離処理を行って少なくとも第１および第２の符号化ビット列を出力する多重化分離部と、

前記多重化分離部によって得られる基準解像度の第１符号化ビット列を取得して所定の第１復号処理を行うことにより基準解像度の復号画像列を生成する第１復号部と、

前記第１復号部によって生成された基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成する第１超解像拡大部と、

前記第１超解像拡大部によって生成された超解像拡大復号画像列を取得して所定の解像度変換処理を行うことにより、基準解像度の超解像復号画像列を生成する第１解像度変換部と、

前記多重化分離部によって得られる基準解像度の第２符号化ビット列と、前記第１復号部によって生成された基準解像度の復号画像列と、前記第１解像度変換部によって生成された基準解像度の超解像復号画像列とを取得し、所定の予測処理および所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成する第２復号部と、

を有する動画像復号装置。

[請求項14] 請求項１３に記載の動画像復号装置において、さらに、

前記多重化分離部は、入力される符号化ビット列に対して所定の多重化分離処理を行って、さらに第３の符号化ビット列を出力し、

前記第１復号部から基準解像度の復号画像列を取得し、所定の解像

度変換処理を行うことにより基準解像度よりも高い解像度をもつ高解像度の拡大復号画像列を生成する第２解像度変換部と、

前記多重化分離部によって得られる高解像度の第３符号化ビット列と、前記第１超解像拡大部によって生成された超解像拡大復号画像列と、前記第２解像度変換部から高解像度の拡大復号画像列とを取得し、所定の予測処理および所定の高解像度の拡張復号である第３復号処理を行うことにより、復号後の超解像拡大画像列を生成する第３復号部と、

を有する動画像復号装置。

[請求項15] 入力される符号化ビット列に対して所定の多重化分離処理を行って少なくとも第１および第２の符号化ビット列を出力する多重化分離部と、

前記多重化分離部によって得られる基準解像度の第１符号化ビット列を取得して所定の第１復号処理を行うことにより基準解像度の復号画像列を生成する第１復号部と、

前記第１復号部によって生成された基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成する第１超解像拡大部と、

前記第１超解像拡大部によって生成された超解像拡大復号画像列を取得して所定の解像度変換処理を行うことにより、基準解像度の超解像復号画像列を生成する第１解像度変換部と、

前記多重化分離部によって得られる基準解像度の第２符号化ビット列と、前記第１復号部によって生成された基準解像度の復号画像列と、前記第１解像度変換部によって生成された基準解像度の超解像復号画像列とを取得して所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成する第２復号部と、

前記第１復号部から復号途中である直交変換係数情報と、前記第２

復号部から復号途中である基準解像度の拡張層における直交変換係数情報とを取得し、それぞれの直交変換係数情報を合成した後に所定のエントロピー符号化処理を行うことにより再符号化後の符号化ビット列を生成する再符号化部と、

前記再符号化部によって再符号化された符号化ビット列を取得し、所定の構文構造に基づいて、符号化で利用した各種パラメータ情報や符号化モード情報を特定するための識別情報を挿入しながら多重化処理を行い、多重化後の符号化ビット列を生成する多重化部と、

を有する動画像再符号化装置。

[請求項16] 請求項１５に記載の動画像再符号化装置において、

前記再符号化部は、更に、前記第１復号部から基準解像度の復号画像列と、第１解像度変換部からの基準解像度の超解像復号画像列と、前記第２復号部から基準解像度の超解像画像列とを取得し、所定の符号化処理を行うことにより再符号化後の符号化ビット列を生成する、動画像再符号化装置。

[請求項17] 入力される符号化ビット列に対して所定の多重化分離処理を行って少なくとも第１および第２の符号化ビット列を出力するステップと、

所定の多重化分離処理によって得られた前記基準解像度の第１符号化ビット列を取得して所定の第１復号処理を行うことにより基準解像度の復号画像列を生成するステップと、

所定の第１復号処理によって生成された前記基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成するステップと、

所定の超解像拡大処理によって生成された前記超解像拡大復号画像列を取得して所定の解像度変換処理を行うことにより、基準解像度の超解像復号画像列を生成するステップと、

所定の多重化分離処理によって得られた前記基準解像度の第２符号化ビット列と、所定の第１復号処理によって生成された前記基準解像

度の復号画像列と、所定の解像度変換処理によって生成された基準解像度の超解像復号画像列とを取得し、所定の予測処理および所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成するステップと、

を有する動画像復号方法。

[請求項18] 請求項１７に記載の動画像復号方法において、さらに、

入力される符号化ビット列に対して所定の多重化分離処理を行って第３の符号化ビット列を出力するステップと、

所定の第１復号処理によって生成された前記基準解像度の復号画像列を取得し、所定の解像度変換処理を行うことにより基準解像度よりも高い解像度をもつ高解像度の拡大復号画像列を生成するステップと、

所定の多重化分離処理によって得られる高解像度の第３符号化ビット列と、所定の超解像拡大処理によって生成された前記超解像拡大復号画像列と、所定の解像度変換処理によって生成された前記高解像度の拡大復号画像列とを取得し、所定の予測処理および所定の高解像度の拡張復号である第３復号処理を行うことにより、復号後の超解像拡大画像列を生成するステップと、

を有する動画像復号方法。

[請求項19] 入力される符号化ビット列に対して所定の多重化分離処理を行うステップと、

所定の多重化分離処理によって得られた前記基準解像度の第１符号化ビット列を取得して所定の第１復号処理を行うことにより基準解像度の復号画像列を生成するステップと、

所定の第１復号処理によって生成された前記基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成するステップと、

所定の超解像拡大処理によって生成された前記超解像拡大復号画像

列を取得して所定の解像度変換処理を行うことにより、基準解像度の超解像復号画像列を生成するステップと、

所定の多重化分離処理によって得られた基準解像度の第２符号化ビット列と、所定の第１復号処理によって生成された前記基準解像度の復号画像列と、所定の第１解像度変換処理によって生成された前記基準解像度の超解像復号画像列とを取得して所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成するステップと、

所定の第１復号処理の復号途中である直交変換係数情報と、所定の基準解像度の拡張復号である第２復号処理の復号途中である基準解像度の拡張層における直交変換係数情報とを取得し、それぞれの直交変換係数情報を合成した後に所定のエントロピー符号化処理を行うことにより再符号化後の符号化ビット列を生成するステップと、

再符号化後の前記符号化ビット列を取得し、所定の構文構造に基づいて、符号化で利用した各種パラメータ情報や符号化モード情報を特定するための識別情報を挿入しながら多重化処理を行い、多重化後の符号化ビット列を生成するステップと、

を有する動画像再符号化方法。

[請求項20] 入力される符号化ビット列に対して所定の多重化分離処理を行って少なくとも第１および第２の符号化ビット列を出力するステップと、

所定の多重化分離処理によって得られた前記基準解像度の第１符号化ビット列を取得して所定の第１復号処理を行うことにより基準解像度の復号画像列を生成するステップと、

所定の第１復号処理によって生成された前記基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成するステップと、

所定の超解像拡大処理によって生成された前記超解像拡大復号画像列を取得して所定の解像度変換処理を行うことにより、基準解像度の

超解像復号画像列を生成するステップと、

所定の多重化分離処理によって得られた前記基準解像度の第２符号化ビット列と、所定の第１復号処理によって生成された前記基準解像度の復号画像列と、所定の解像度変換処理によって生成された基準解像度の超解像復号画像列とを取得し、所定の予測処理および所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成するステップと、

をコンピュータに実行させる動画像復号プログラム。

[請求項21] 入力される符号化ビット列に対して所定の多重化分離処理を行うステップと、

所定の多重化分離処理によって得られた前記基準解像度の第１符号化ビット列を取得して所定の第１復号処理を行うことにより基準解像度の復号画像列を生成するステップと、

所定の第１復号処理によって生成された前記基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成するステップと、

所定の超解像拡大処理によって生成された前記超解像拡大復号画像列を取得して所定の解像度変換処理を行うことにより、基準解像度の超解像復号画像列を生成するステップと、

所定の多重化分離処理によって得られた基準解像度の第２符号化ビット列と、所定の第１復号処理によって生成された前記基準解像度の復号画像列と、所定の第１解像度変換処理によって生成された前記基準解像度の超解像復号画像列とを取得して所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成するステップと、

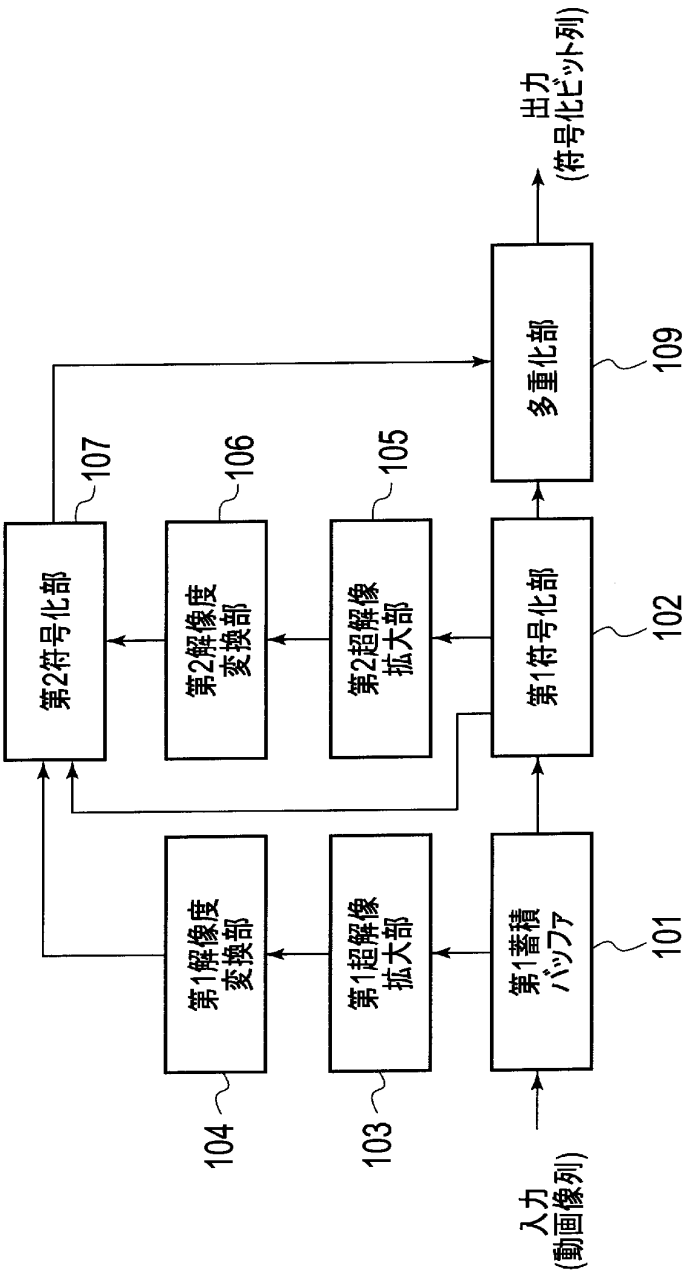
所定の第１復号処理の復号途中である直交変換係数情報と、所定の基準解像度の拡張復号である第２復号処理の復号途中である基準解像度の拡張層における直交変換係数情報とを取得し、それぞれの直交変

換係数情報を合成した後に所定のエントロピー符号化処理を行うことにより再符号化後の符号化ビット列を生成するステップと、

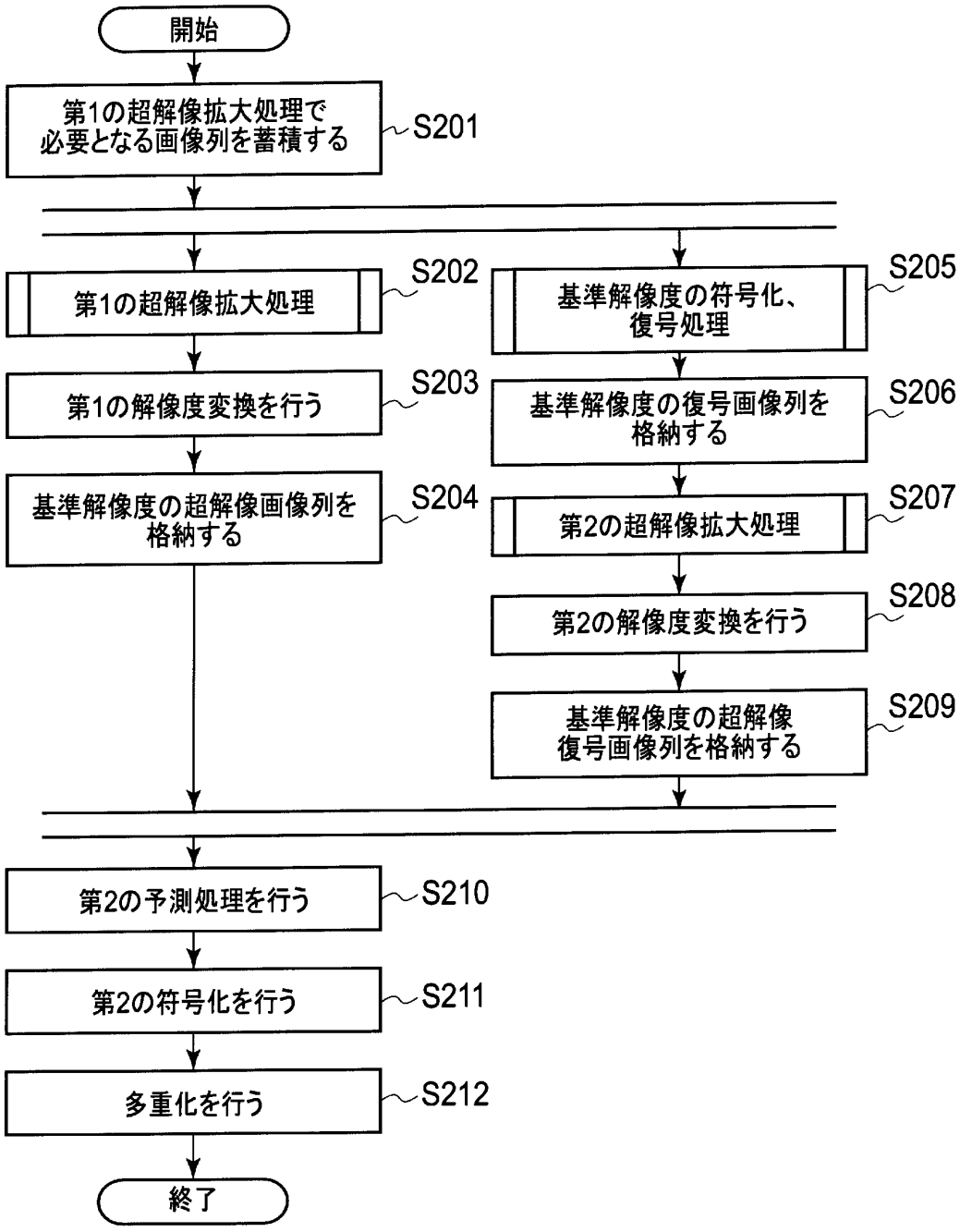
再符号化後の前記符号化ビット列を取得し、所定の構文構造に基づいて、符号化で利用した各種パラメータ情報や符号化モード情報を特定するための識別情報を挿入しながら多重化処理を行い、多重化後の符号化ビット列を生成するステップと、

をコンピュータに実行させる動画像再符号化プログラム。

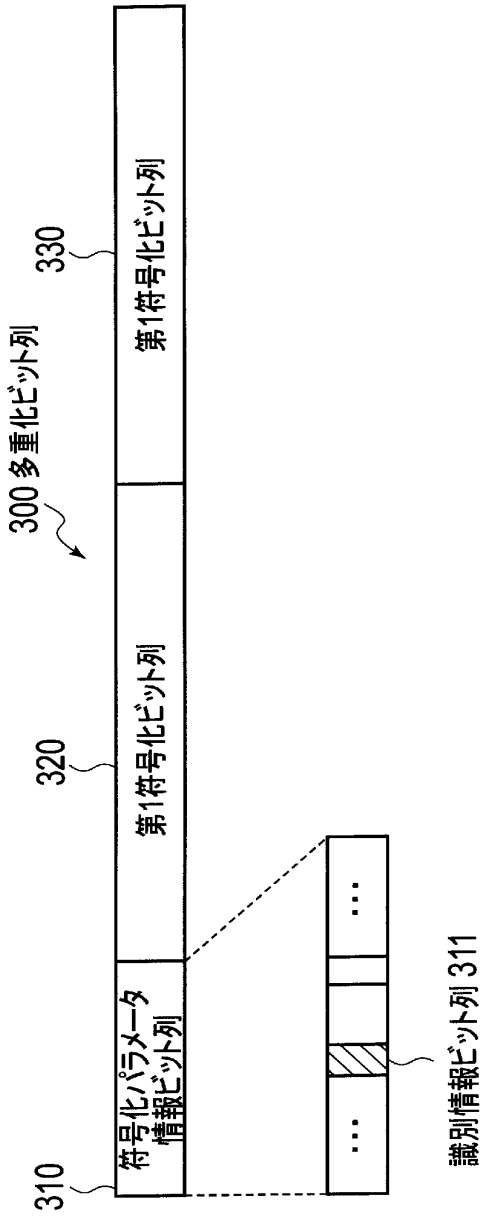
[図1]


入力
(動画像列)
第1蓄積
バッファ
101
第1超解像
拡大部
103
第1解像度
変換部
104
第1符号化部
102
第2超解像
拡大部
105
第2解像度
変換部
106
第2符号化部
107
多重化部
109
出力
(符号化ビット列)

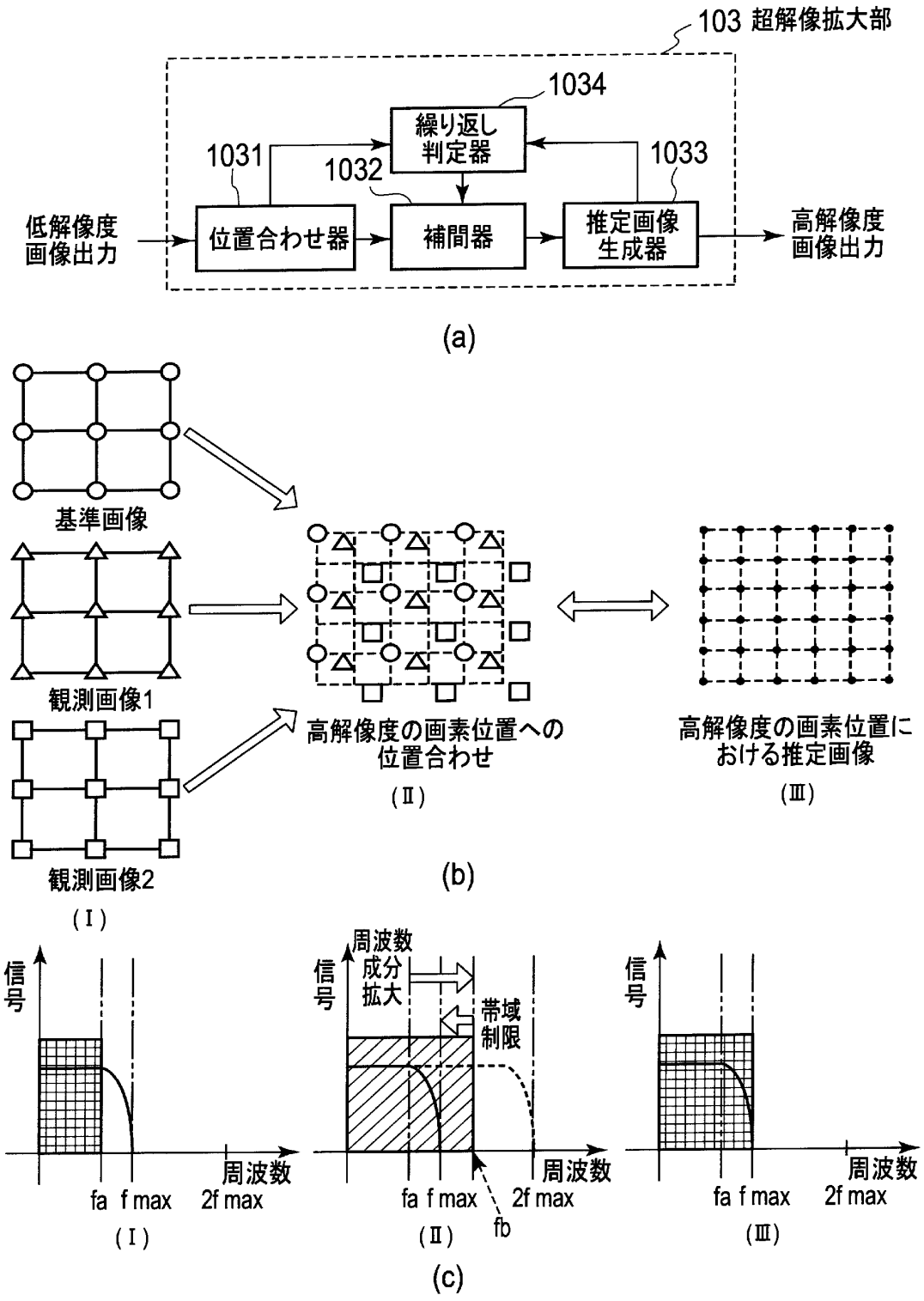
[図2]


開始
第1の超解像拡大処理で必要となる画像列を蓄積する
S201
第1の超解像拡大処理
S202
第1の解像度変換を行う
S203
基準解像度の超解像画像列を格納する
S204
基準解像度の符号化、復号処理
S205
基準解像度の復号画像列を格納する
S206
第2の超解像拡大処理
S207
第2の解像度変換を行う
S208
基準解像度の超解像復号画像列を格納する
S209
第2の予測処理を行う
S210
第2の符号化を行う
S211
多重化を行う
S212
終了

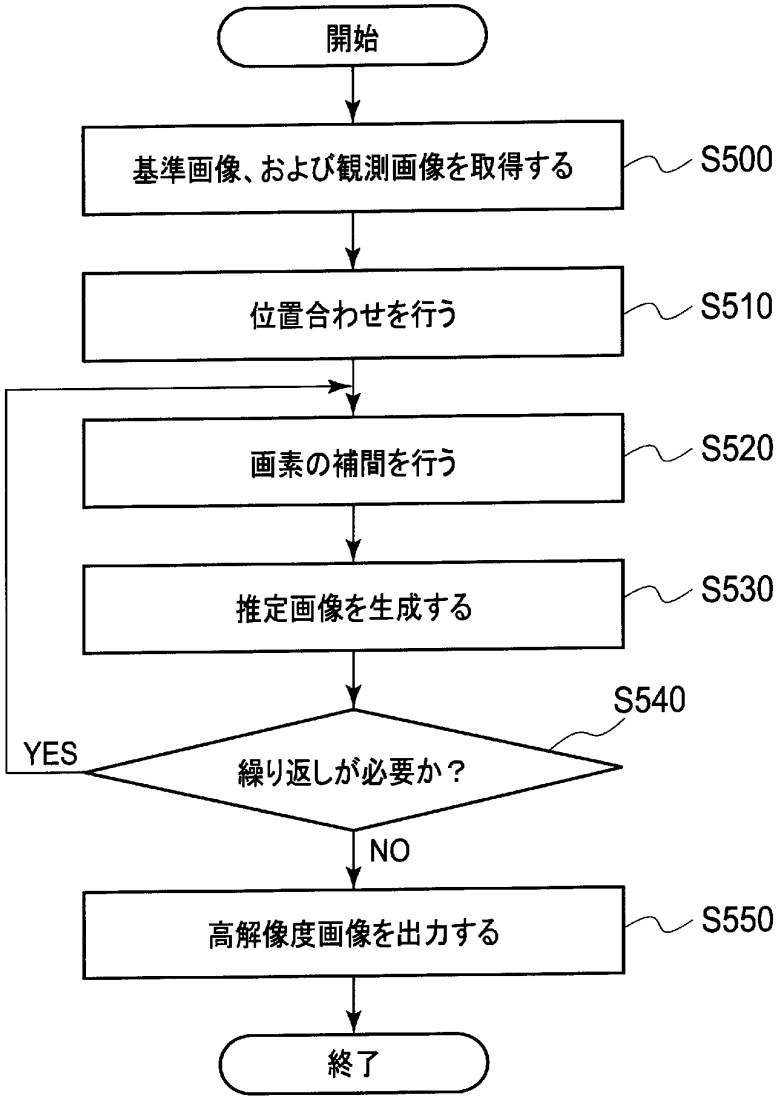
[図3]


300 多重化ビット列
310
符号化パラメータ情報ビット列
320
第1符号化ビット列
330
第1符号化ビット列
識別情報ビット列 311

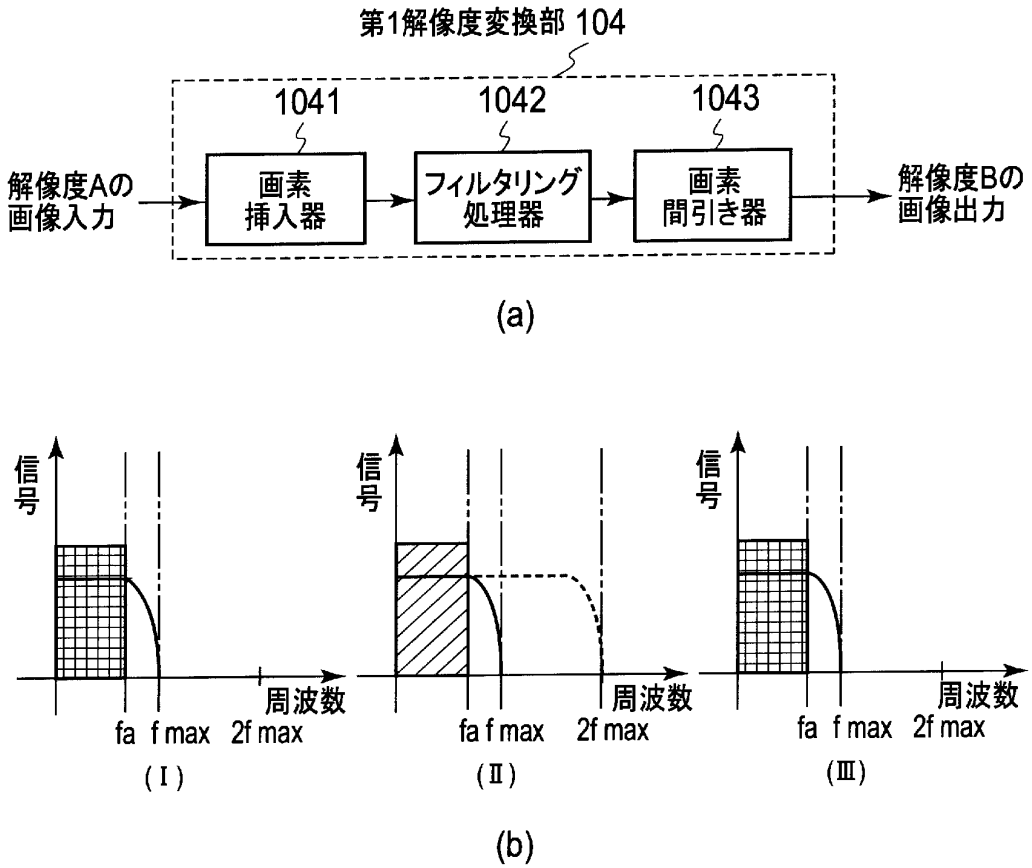
[図4]


103 超解像拡大部
1034
繰り返し判定器
1031
1032
1033
低解像度画像出力
位置合わせ器
補間器
推定画像生成器
高解像度画像出力
(a)
基準画像
観測画像1
観測画像2
(I)
高解像度の画素位置への位置合わせ
(II)
高解像度の画素位置における推定画像
(III)
(b)
信号
周波数
fa f max 2f max
(I)
成分拡大
帯域制限
fb
(II)
(III)
(c)

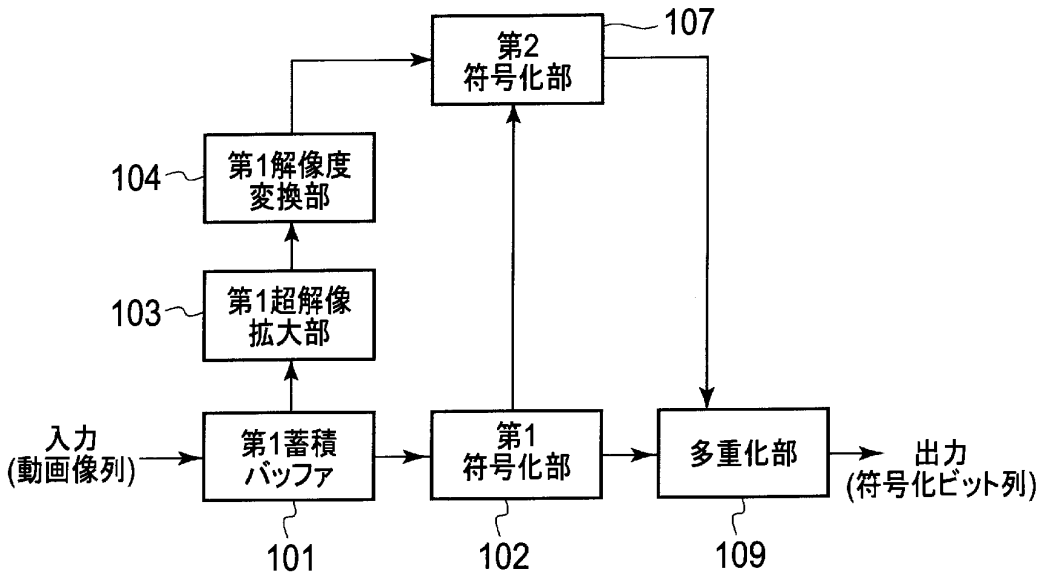
[図5]


開始
基準画像、および観測画像を取得する
S500
位置合わせを行う
S510
画素の補間を行う
S520
推定画像を生成する
S530
S540
YES
繰り返しが必要か？
NO
高解像度画像を出力する
S550
終了

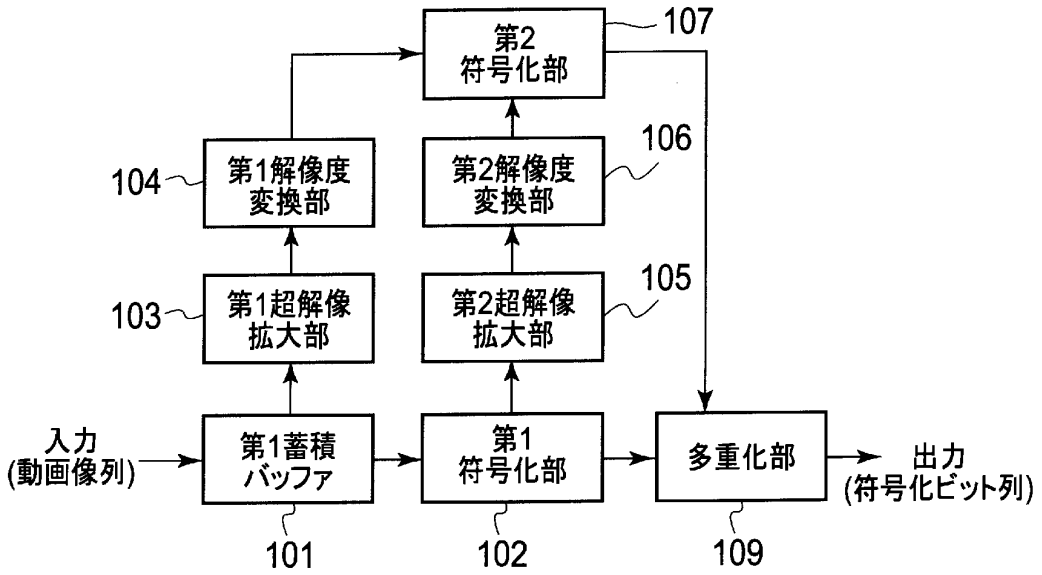
[図6]


第1解像度変換部 104
1041
1042
1043
解像度Aの
画像入力
画素
挿入器
フィルタリング
処理器
画素
間引き器
解像度Bの
画像出力
(a)
信号
周波数
fa f max 2f max
(Ⅰ)
信号
周波数
fa f max 2f max
(Ⅱ)
信号
周波数
fa f max 2f max
(Ⅲ)
(b)

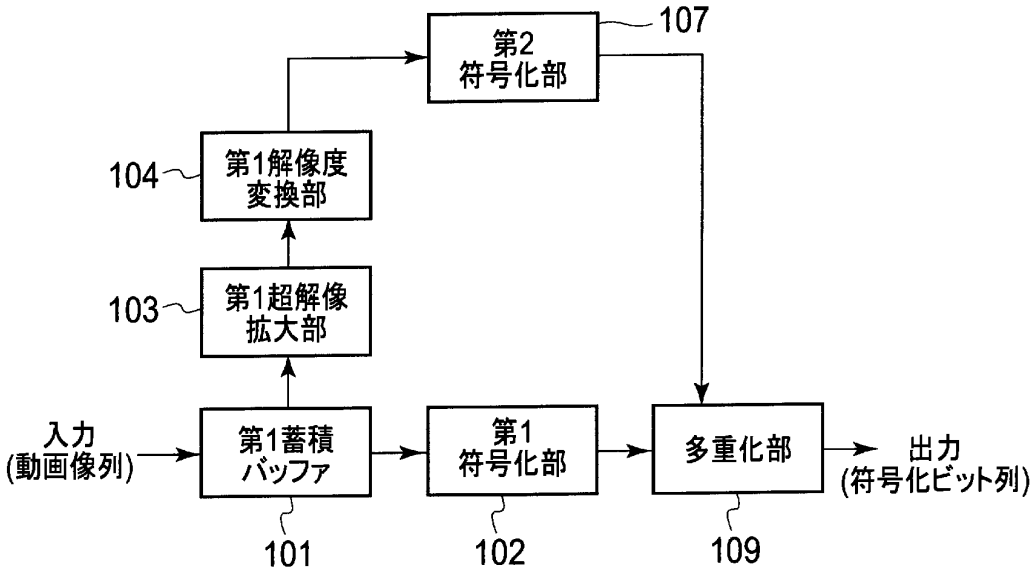
[図7]


第2
符号化部
107
第1解像度
変換部
104
第1超解像
拡大部
103
入力
(動画像列)
第1蓄積
バッファ
第1
符号化部
多重化部
出力
(符号化ビット列)
101
102
109

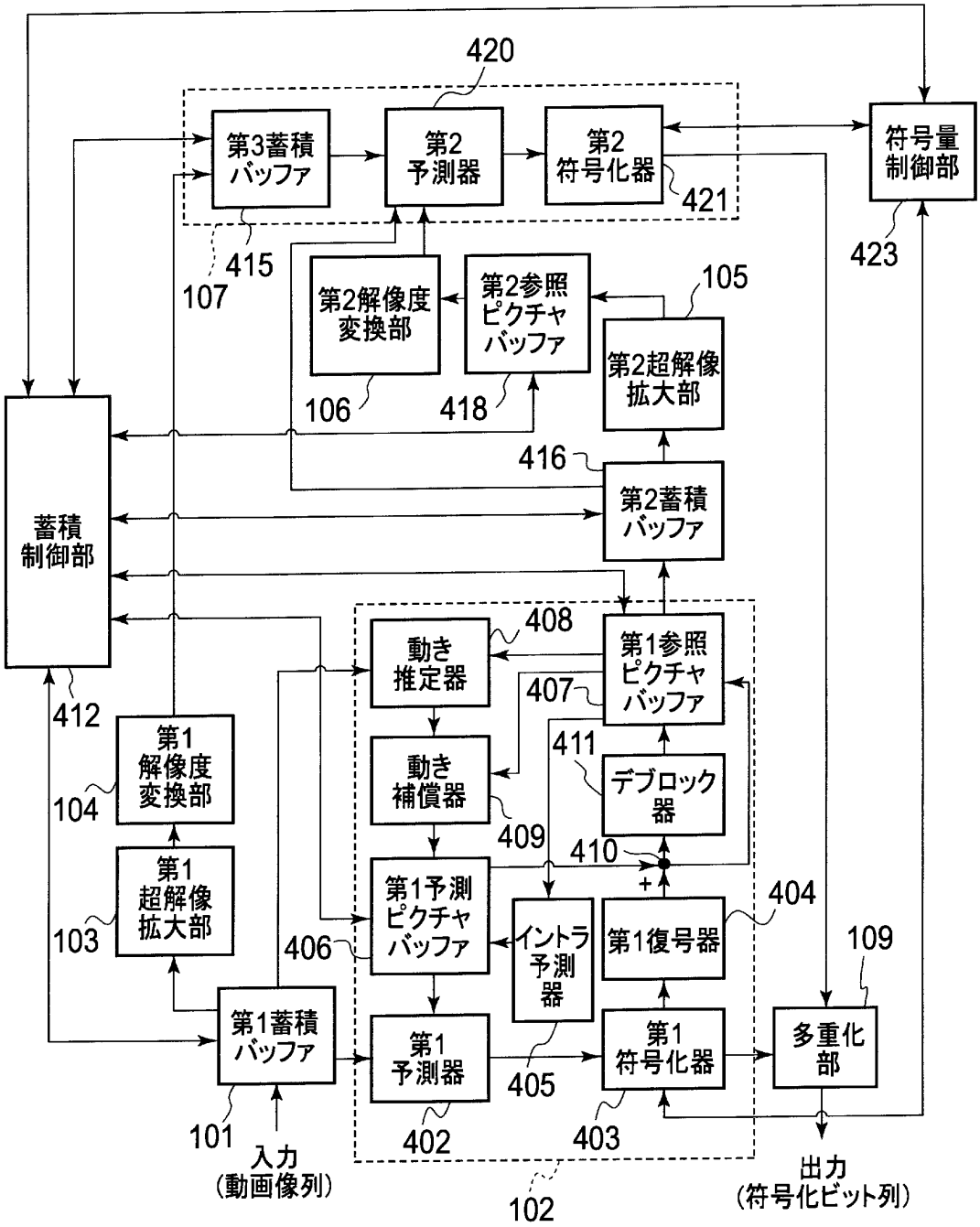
[図8]


第2
符号化部
107
第1解像度
変換部
104
第2解像度
変換部
106
第1超解像
拡大部
103
第2超解像
拡大部
105
入力
(動画像列)
第1蓄積
バッファ
第1
符号化部
多重化部
出力
(符号化ビット列)
101
102
109

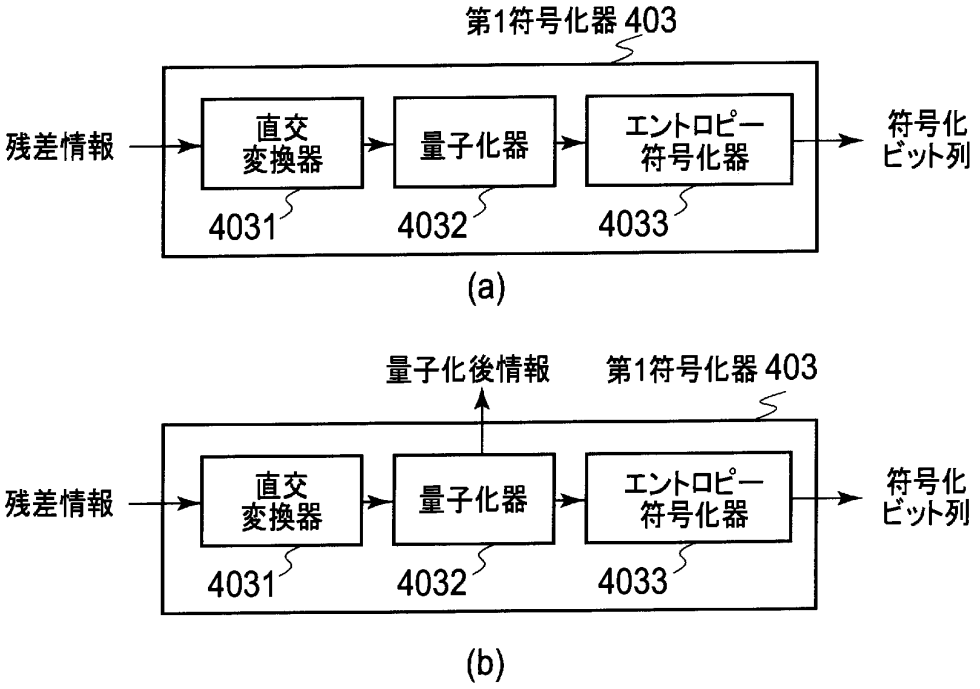
[図9]


第2
符号化部
107
第1解像度
変換部
104
第1超解像
拡大部
103
入力
(動画像列)
第1蓄積
バッファ
101
第1
符号化部
102
多重化部
109
出力
(符号化ビット列)

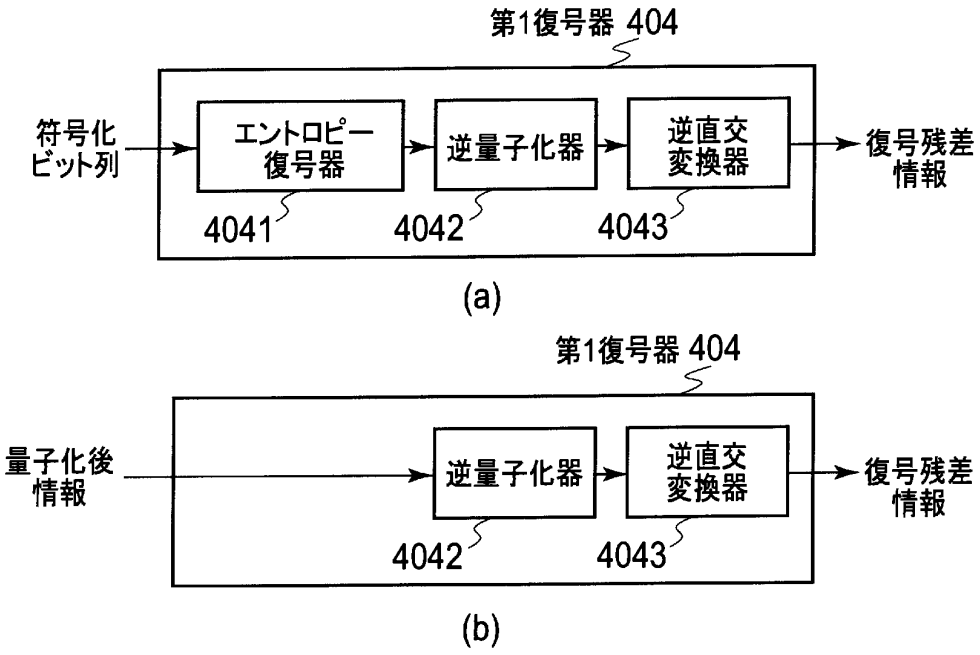
[図10]


420
第3蓄積バッファ
第2予測器
第2符号化器
421
符号量制御部
423
415
107
第2解像度変換部
第2参照ピクチャバッファ
105
第2超解像拡大部
106
418
416
蓄積制御部
第2蓄積バッファ
408
動き推定器
第1参照ピクチャバッファ
407
412
第1解像度変換部
411
デブロック器
動き補償器
104
409
410
第1超解像拡大部
404
第1予測ピクチャバッファ
イントラ予測器
第1復号器
103
406
109
第1蓄積バッファ
第1予測器
第1符号化器
多重化部
405
101
402
403
入力
(動画像列)
102
出力
(符号化ビット列)

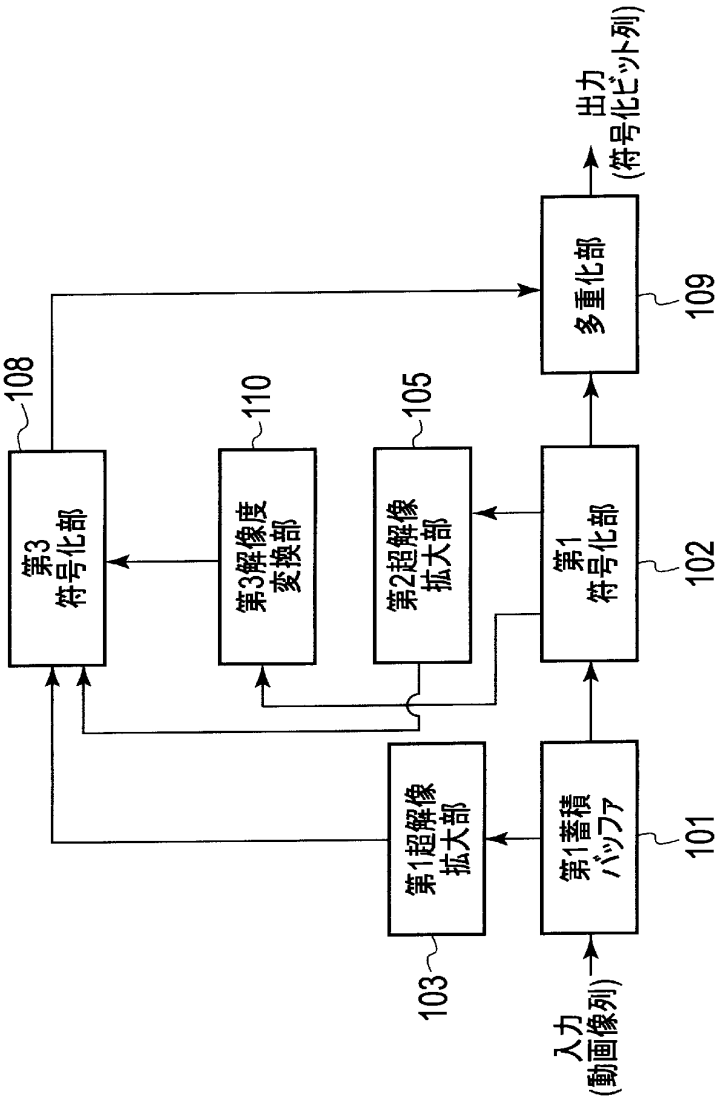
[図11]


第1符号化器 403
残差情報
直交
変換器
量子化器
エントロピー
符号化器
符号化
ビット列
4031
4032
4033
(a)
量子化後情報
第1符号化器 403
残差情報
直交
変換器
量子化器
エントロピー
符号化器
符号化
ビット列
4031
4032
4033
(b)

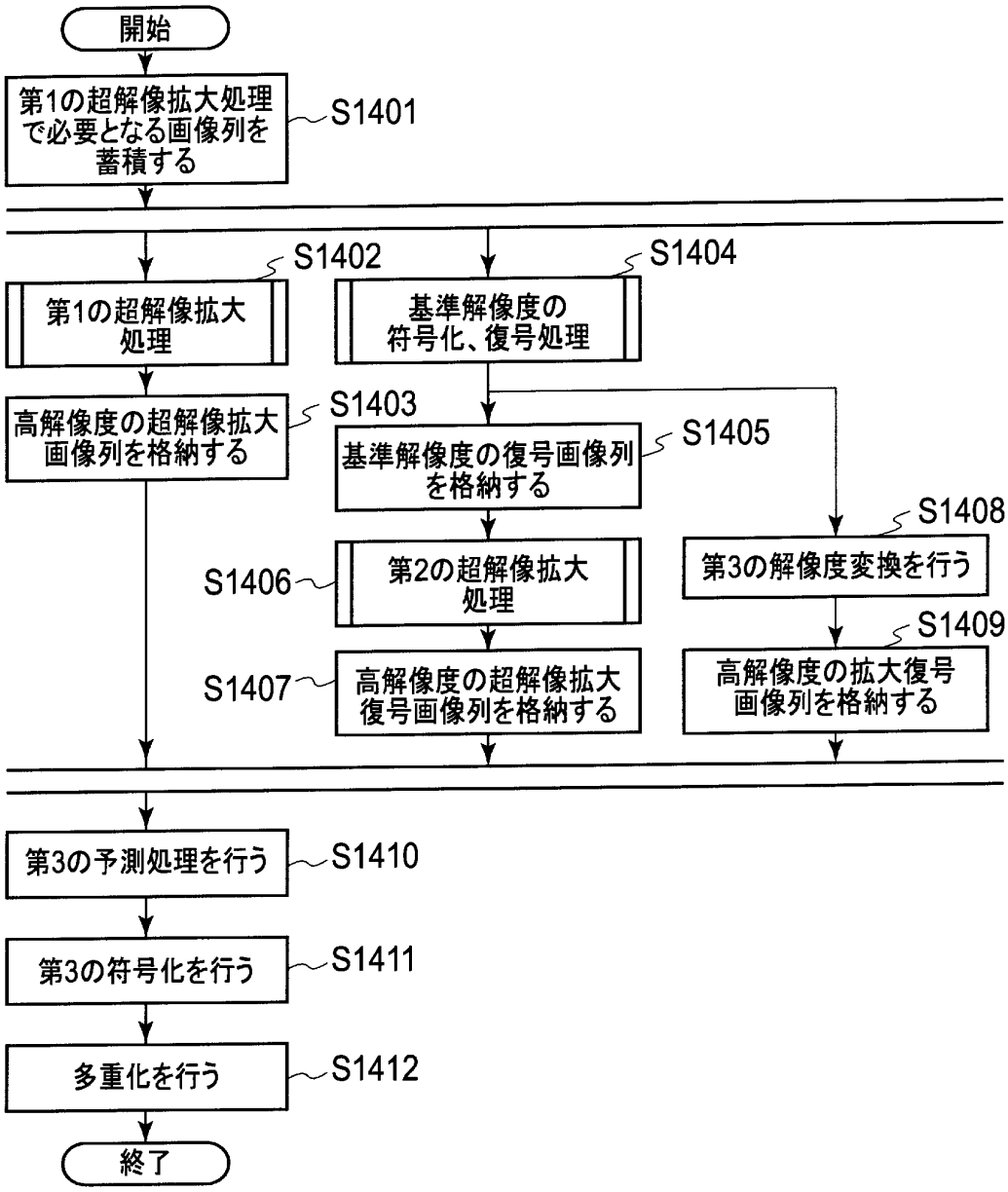
[図12]


第1復号器 404
符号化
ビット列
エントロピー
復号器
逆量子化器
逆直交
変換器
復号残差
情報
4041
4042
4043
(a)
第1復号器 404
量子化後
情報
逆量子化器
逆直交
変換器
復号残差
情報
4042
4043
(b)

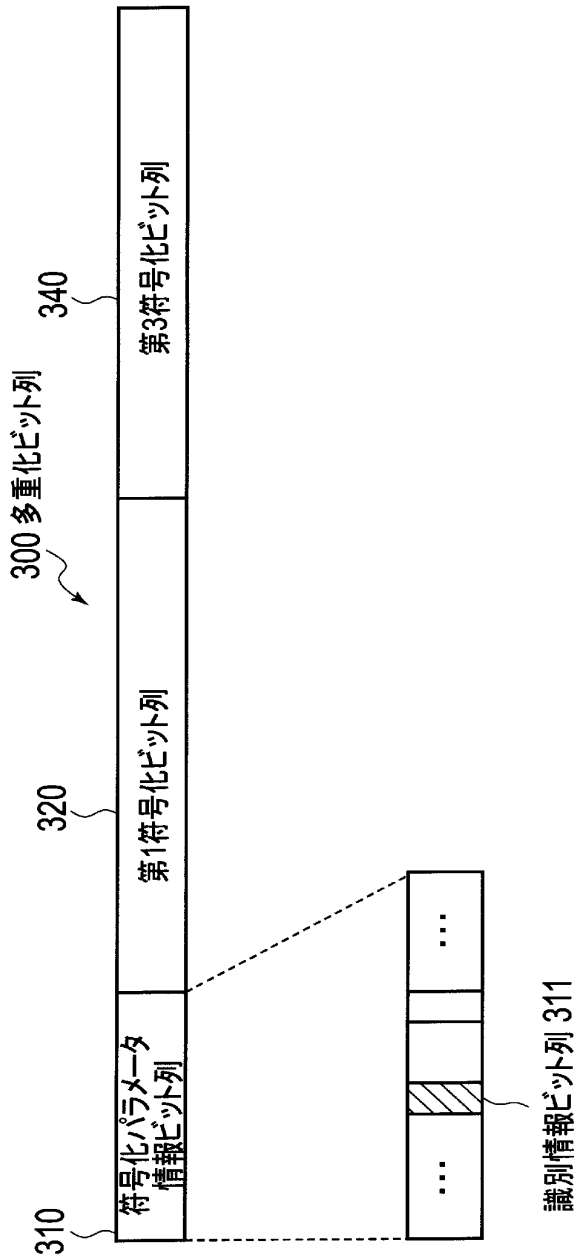
[図13]


入力
(動画像列)
103
第1超解像
拡大部
第1蓄積
バッファ
101
第3
符号化部
108
第3解像度
変換部
110
第2超解像
拡大部
105
第1
符号化部
102
多重化部
109
出力
(符号化ビット列)

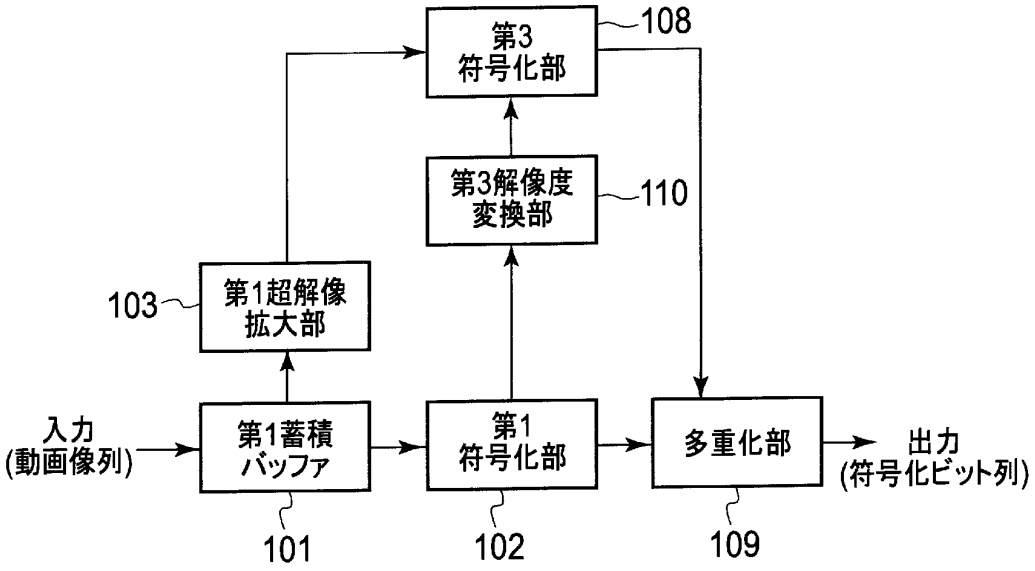
[図14]


開始
第1の超解像拡大処理で必要となる画像列を蓄積する
S1401
S1402
第1の超解像拡大処理
S1404
基準解像度の符号化、復号処理
S1403
高解像度の超解像拡大画像列を格納する
S1405
基準解像度の復号画像列を格納する
S1408
第3の解像度変換を行う
S1406
第2の超解像拡大処理
S1409
高解像度の拡大復号画像列を格納する
S1407
高解像度の超解像拡大復号画像列を格納する
第3の予測処理を行う
S1410
第3の符号化を行う
S1411
多重化を行う
S1412
終了

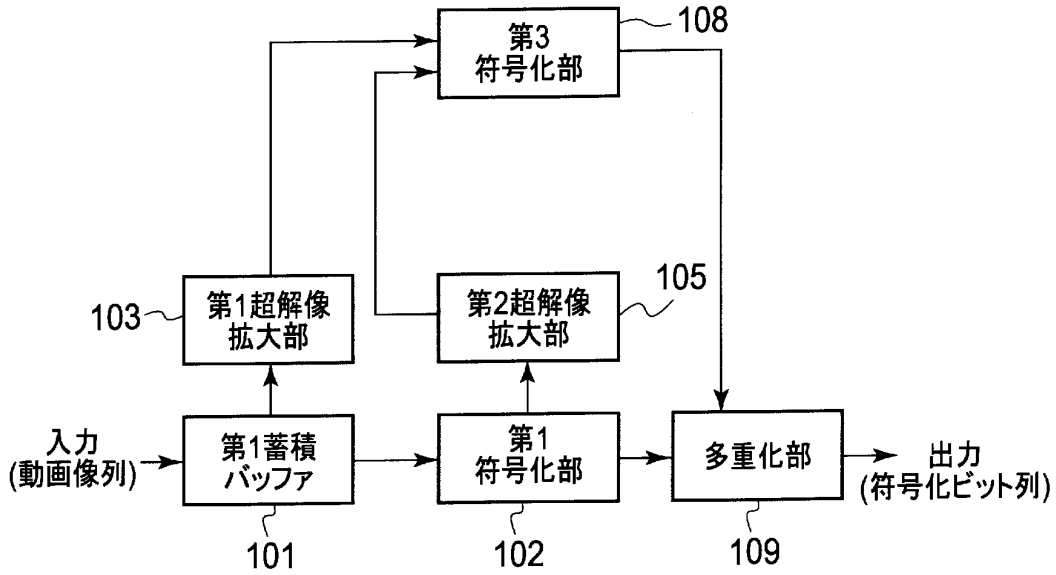
[図15]


300 多重化ビット列
310
符号化パラメータ情報ビット列
320
第1符号化ビット列
340
第3符号化ビット列
識別情報ビット列 311

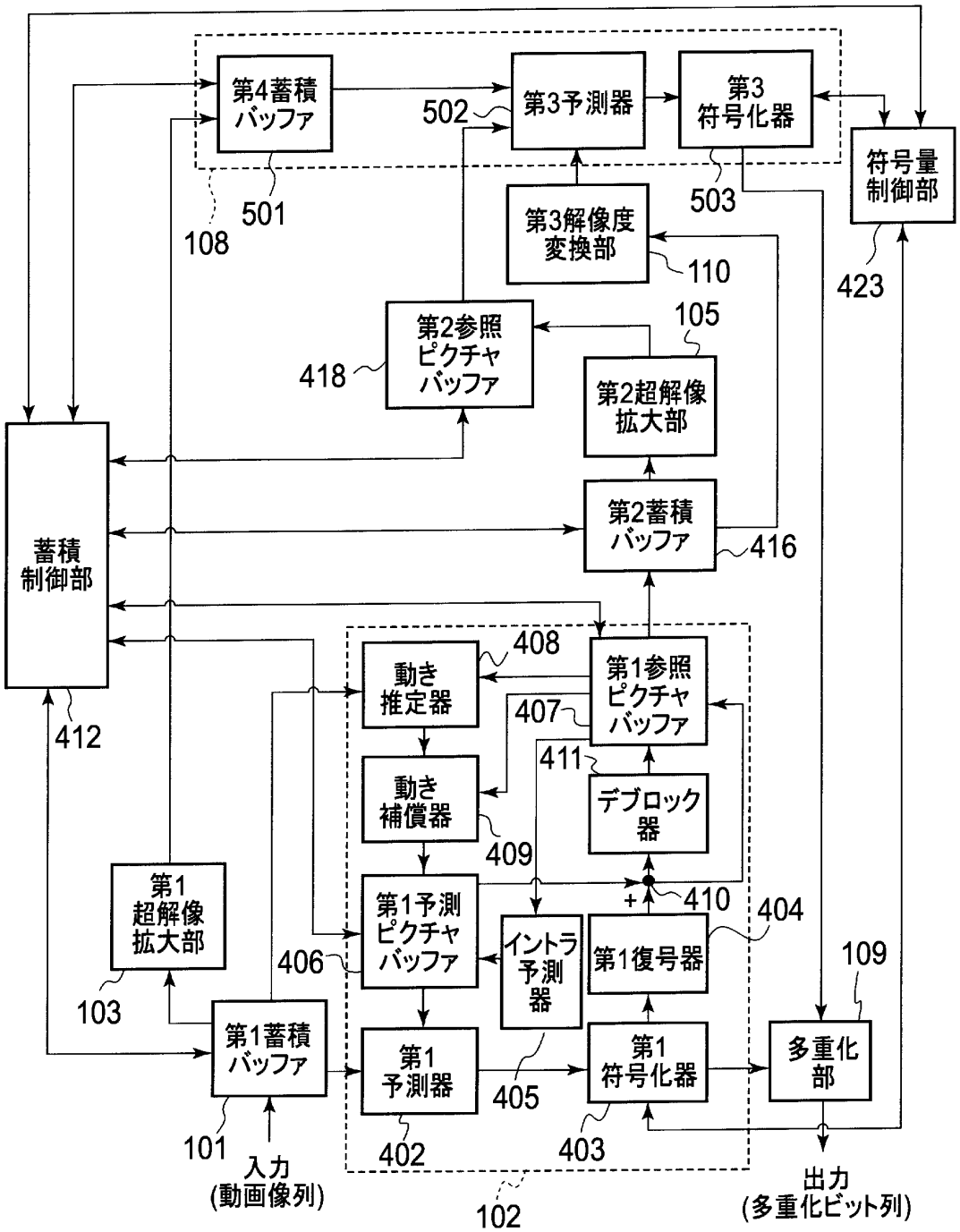
[図16]


第3
符号化部
108
第3解像度
変換部
110
103
第1超解像
拡大部
入力
(動画像列)
第1蓄積
バッファ
第1
符号化部
多重化部
出力
(符号化ビット列)
101
102
109

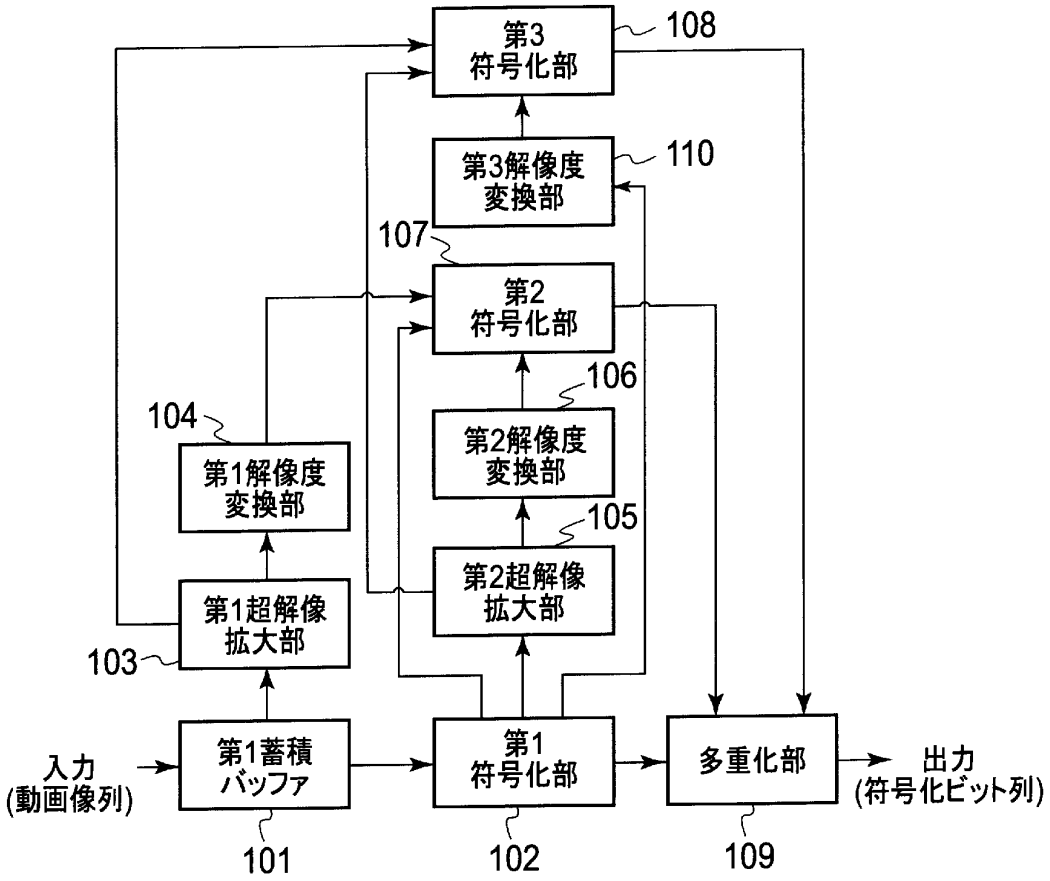
[図17]


第3
符号化部
108
105
103
第1超解像
拡大部
第2超解像
拡大部
入力
(動画像列)
第1蓄積
バッファ
第1
符号化部
多重化部
出力
(符号化ビット列)
101
102
109

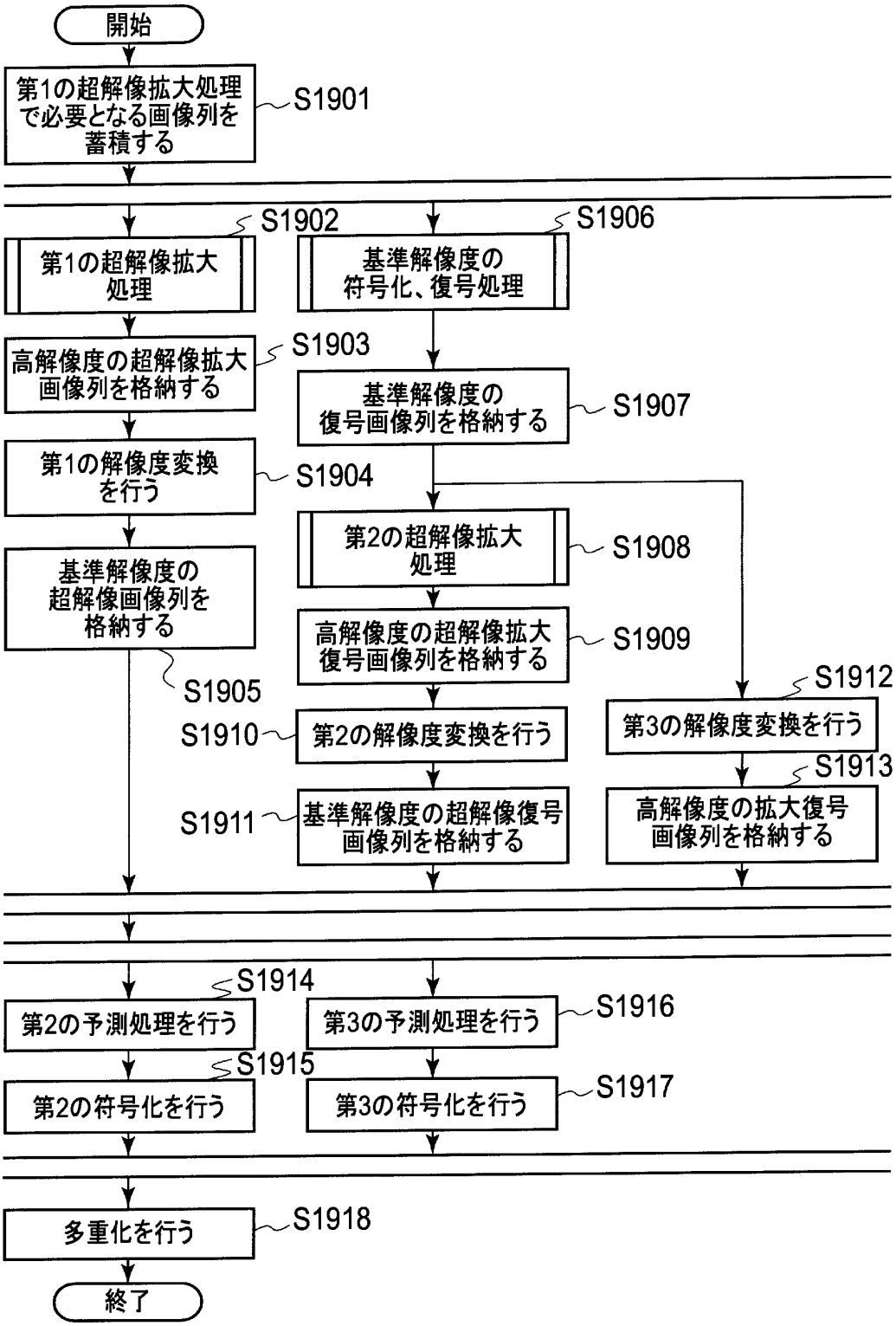
[図18]


第4蓄積バッファ
502
第3予測器
第3符号化器
符号量制御部
501
503
108
第3解像度変換部
110
423
105
第2参照ピクチャバッファ
418
第2超解像拡大部
蓄積制御部
第2蓄積バッファ
416
412
408
動き推定器
第1参照ピクチャバッファ
407
411
動き補償器
デブロック器
409
410
404
第1超解像拡大部
第1予測ピクチャバッファ
イントラ予測器
第1復号器
406
109
103
第1蓄積バッファ
第1予測器
第1符号化器
多重化部
405
101
402
403
入力(動画像列)
102
出力(多重化ビット列)

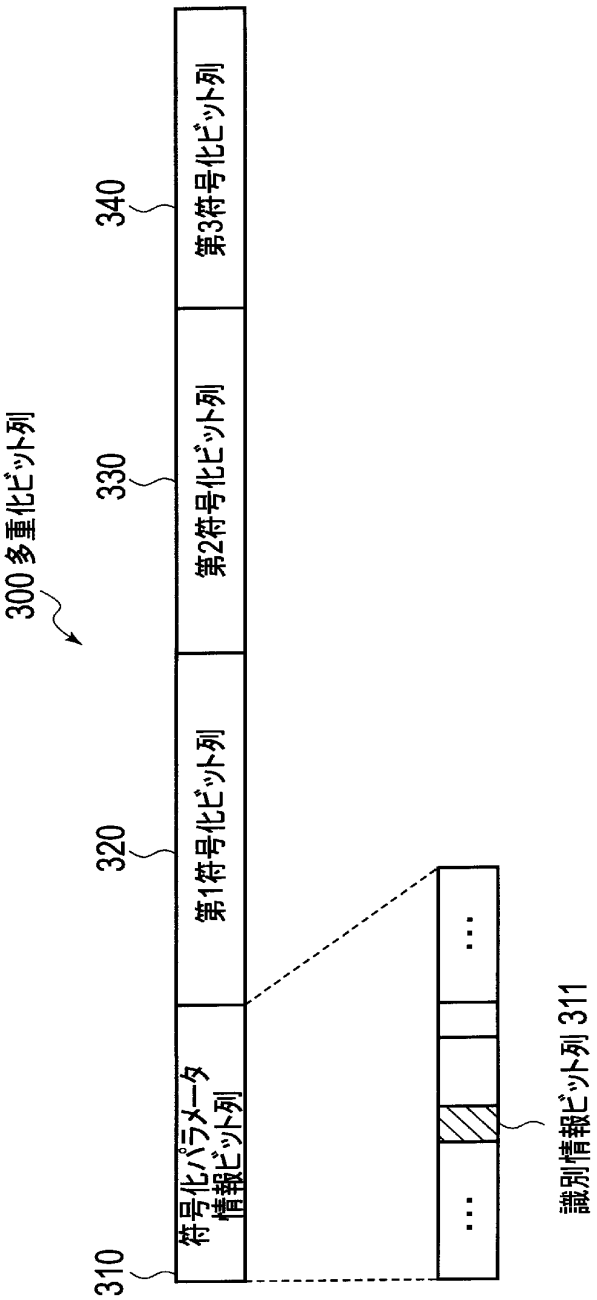
[図19]


第3
符号化部
108
第3解像度
変換部
110
107
第2
符号化部
106
第2解像度
変換部
105
第2超解像
拡大部
104
第1解像度
変換部
第1超解像
拡大部
103
入力
(動画像列)
第1蓄積
バッファ
101
第1
符号化部
102
多重化部
109
出力
(符号化ビット列)

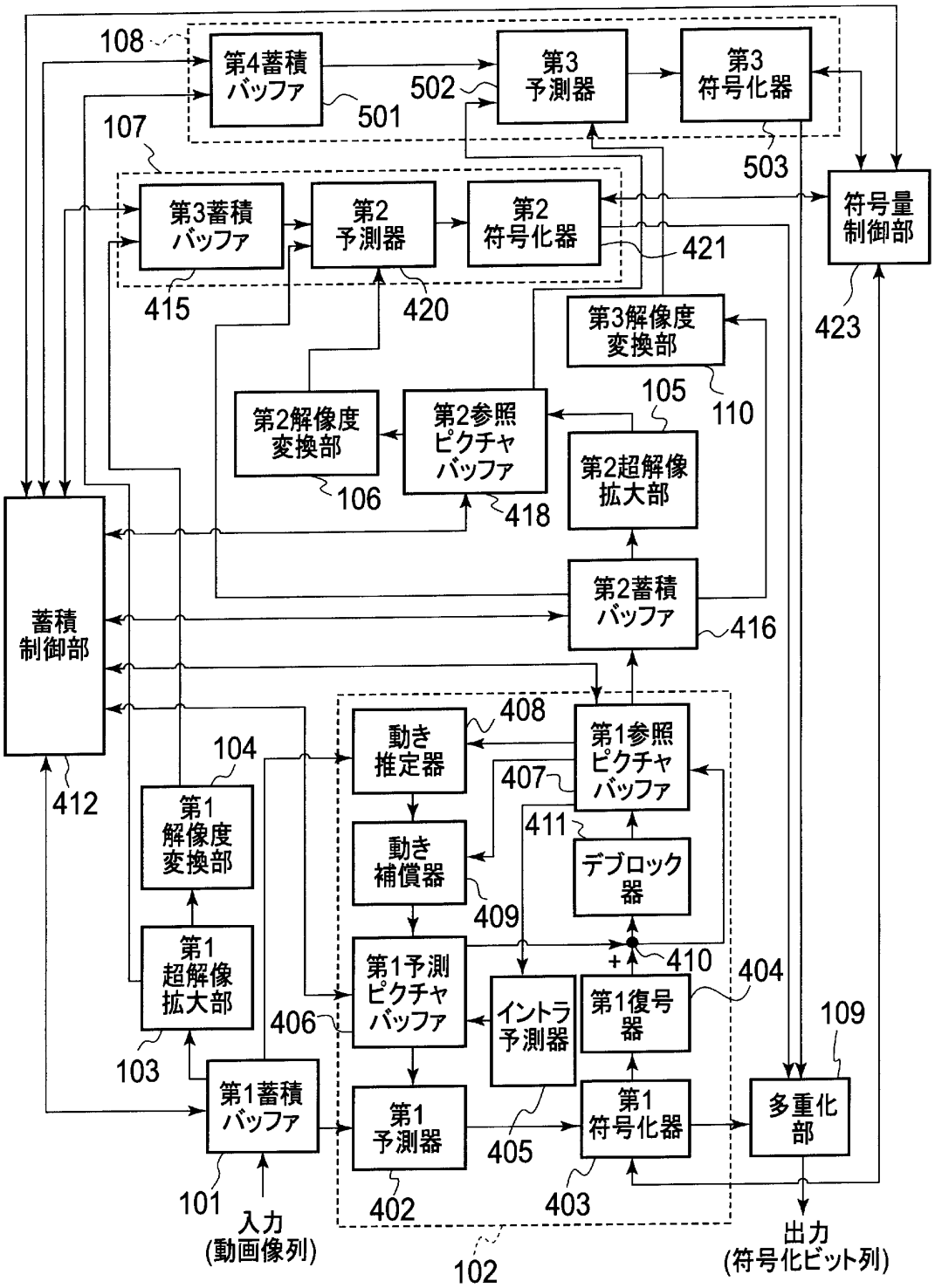
[図20]


開始
第1の超解像拡大処理で必要となる画像列を蓄積する
S1901
S1902
第1の超解像拡大処理
S1903
高解像度の超解像拡大画像列を格納する
S1904
第1の解像度変換を行う
S1905
基準解像度の超解像画像列を格納する
S1906
基準解像度の符号化、復号処理
S1907
基準解像度の復号画像列を格納する
S1908
第2の超解像拡大処理
S1909
高解像度の超解像拡大復号画像列を格納する
S1910
第2の解像度変換を行う
S1911
基準解像度の超解像復号画像列を格納する
S1912
第3の解像度変換を行う
S1913
高解像度の拡大復号画像列を格納する
S1914
第2の予測処理を行う
S1915
第2の符号化を行う
S1916
第3の予測処理を行う
S1917
第3の符号化を行う
S1918
多重化を行う
終了

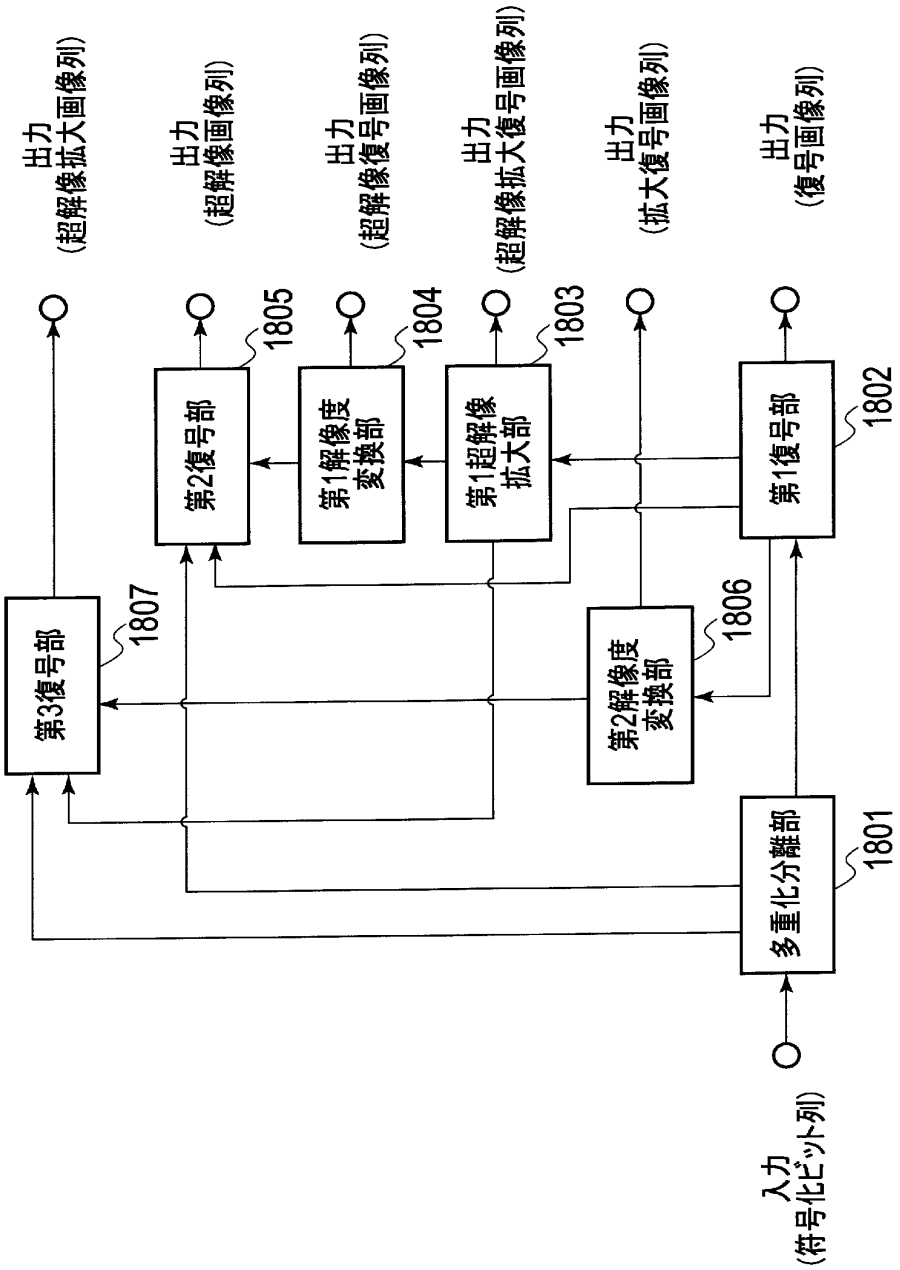
[図21]


300 多重化ビット列
310
符号化パラメータ情報ビット列
320
第1符号化ビット列
330
第2符号化ビット列
340
第3符号化ビット列
識別情報ビット列 311

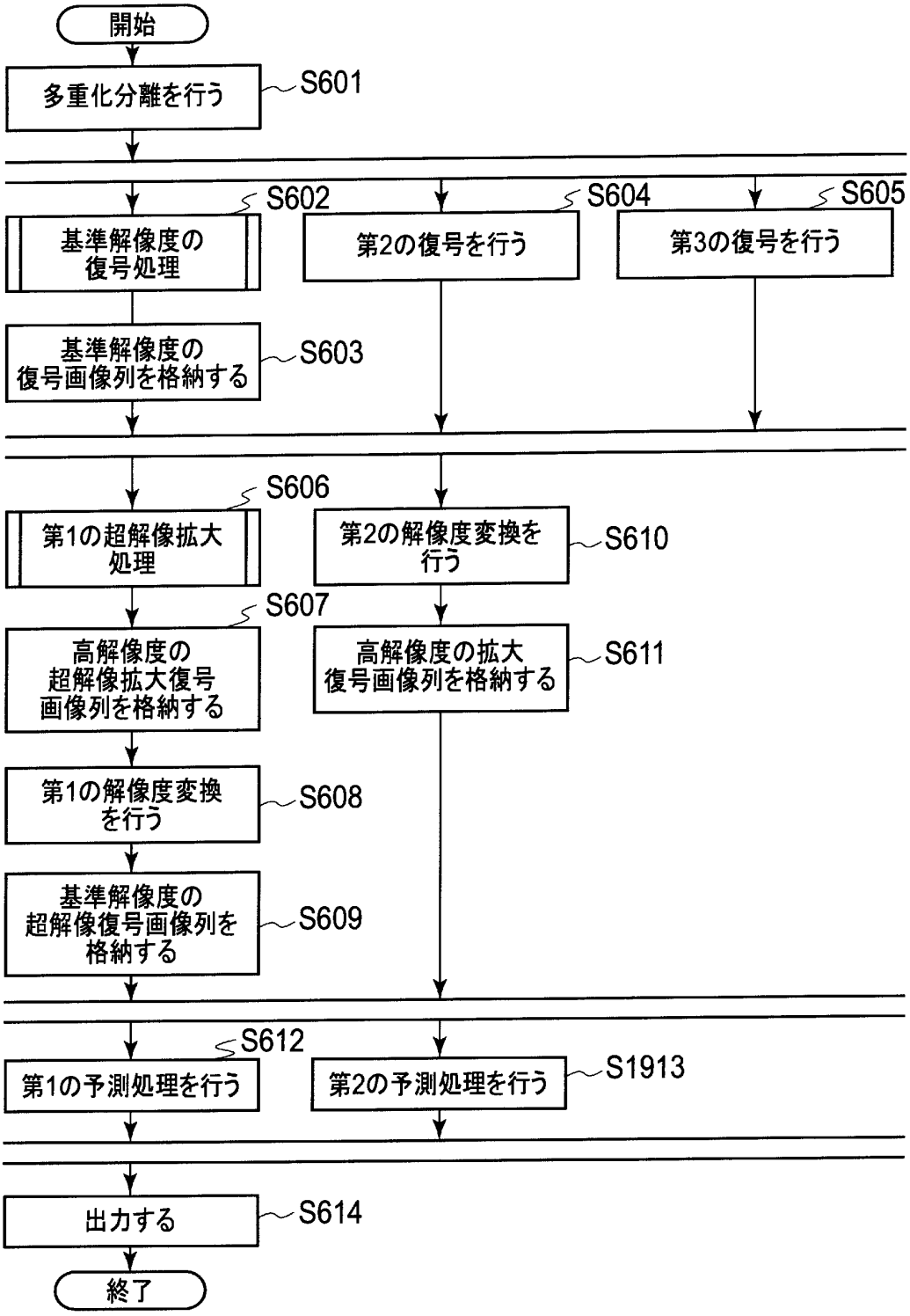
[図22]


108
第4蓄積バッファ
501
502
第3予測器
第3符号化器
503
107
第3蓄積バッファ
第2予測器
第2符号化器
421
符号量制御部
423
415
420
第3解像度変換部
105
110
第2解像度変換部
106
第2参照ピクチャバッファ
418
第2超解像拡大部
蓄積制御部
412
第2蓄積バッファ
416
408
動き推定器
第1参照ピクチャバッファ
104
407
第1解像度変換部
411
動き補償器
デブロック器
409
第1超解像拡大部
410
404
第1予測ピクチャバッファ
406
イントラ予測器
第1復号器
109
103
第1蓄積バッファ
第1予測器
405
第1符号化器
多重化部
101
402
403
入力
(動画像列)
102
出力
(符号化ビット列)

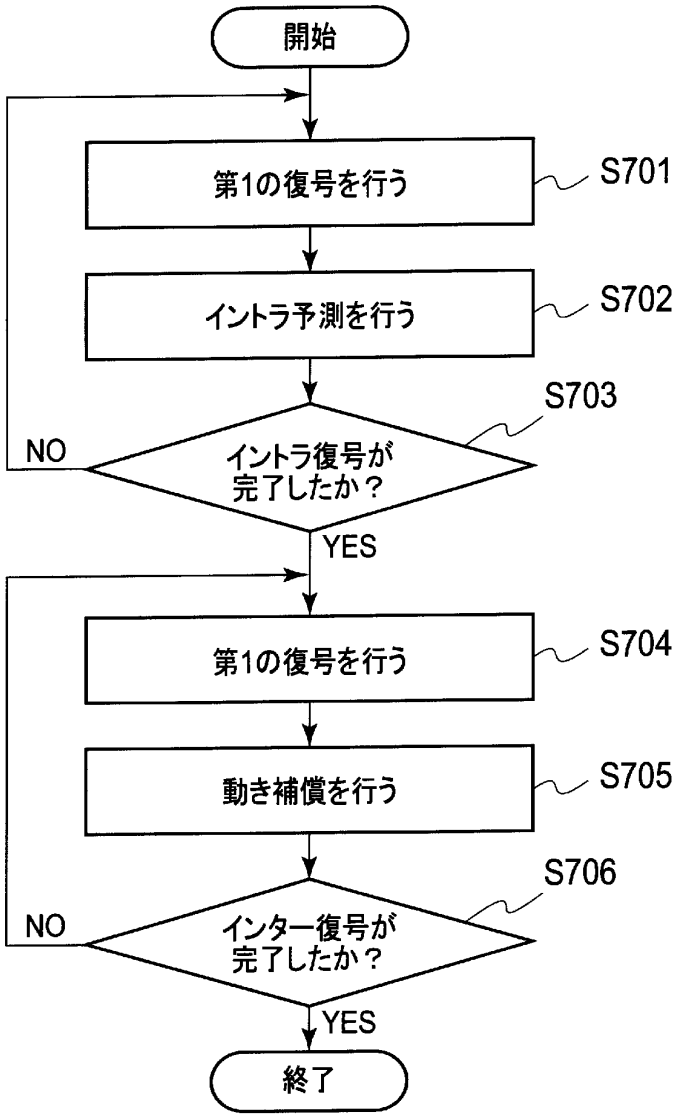
[図23]


入力
(符号化ビット列)
多重化分離部
1801
第1復号部
1802
第2解像度
変換部
1806
第3復号部
1807
第1超解像
拡大部
1803
第1解像度
変換部
1804
第2復号部
1805
出力
(超解像拡大画像列)
出力
(超解像画像列)
出力
(超解像復号画像列)
出力
(超解像拡大復号画像列)
出力
(拡大復号画像列)
出力
(復号画像列)

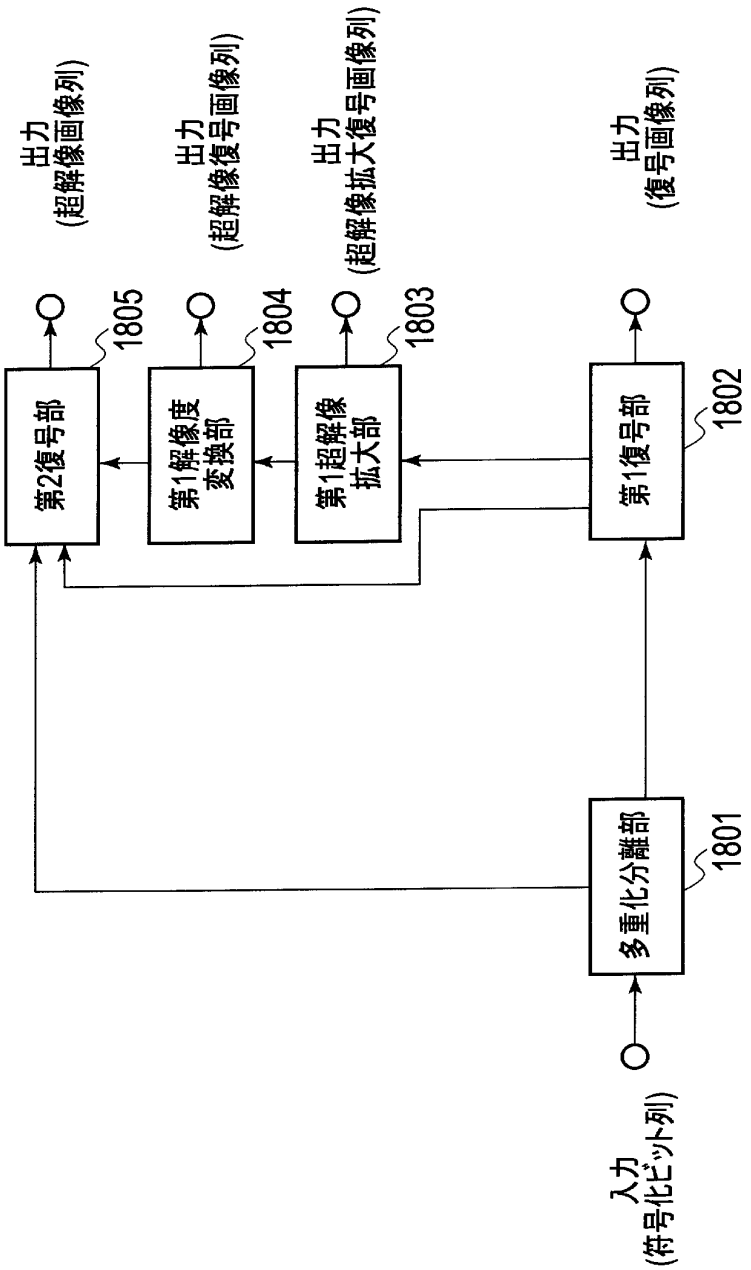
[図24]


開始
多重化分離を行う
S601
S602
基準解像度の復号処理
S604
第2の復号を行う
S605
第3の復号を行う
基準解像度の復号画像列を格納する
S603
S606
第1の超解像拡大処理
第2の解像度変換を行う
S610
S607
高解像度の超解像拡大復号画像列を格納する
高解像度の拡大復号画像列を格納する
S611
第1の解像度変換を行う
S608
基準解像度の超解像復号画像列を格納する
S609
S612
第1の予測処理を行う
第2の予測処理を行う
S1913
出力する
S614
終了

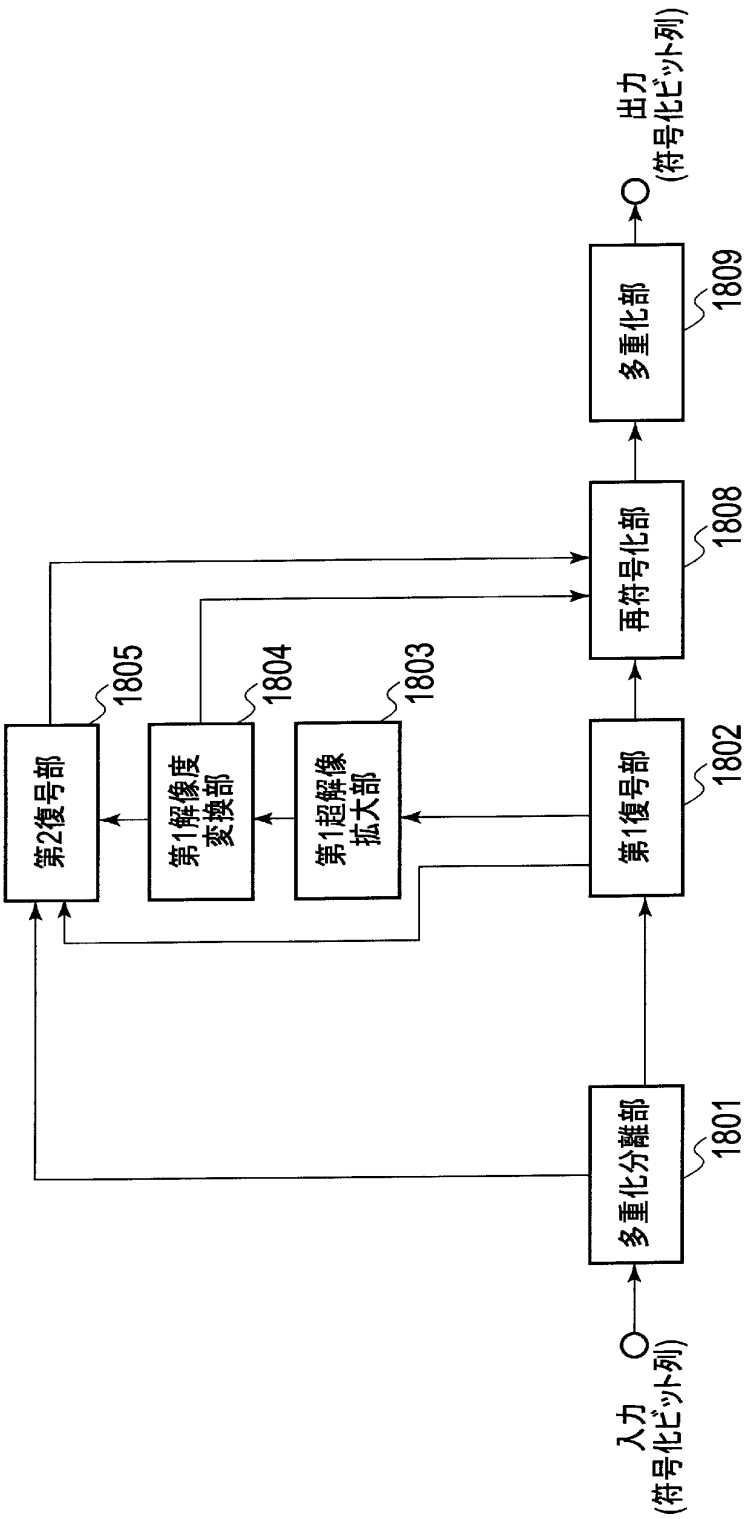
[図25]


開始
第1の復号を行う
S701
イントラ予測を行う
S702
S703
イントラ復号が
完了したか？
NO
YES
第1の復号を行う
S704
動き補償を行う
S705
S706
インター復号が
完了したか？
NO
YES
終了

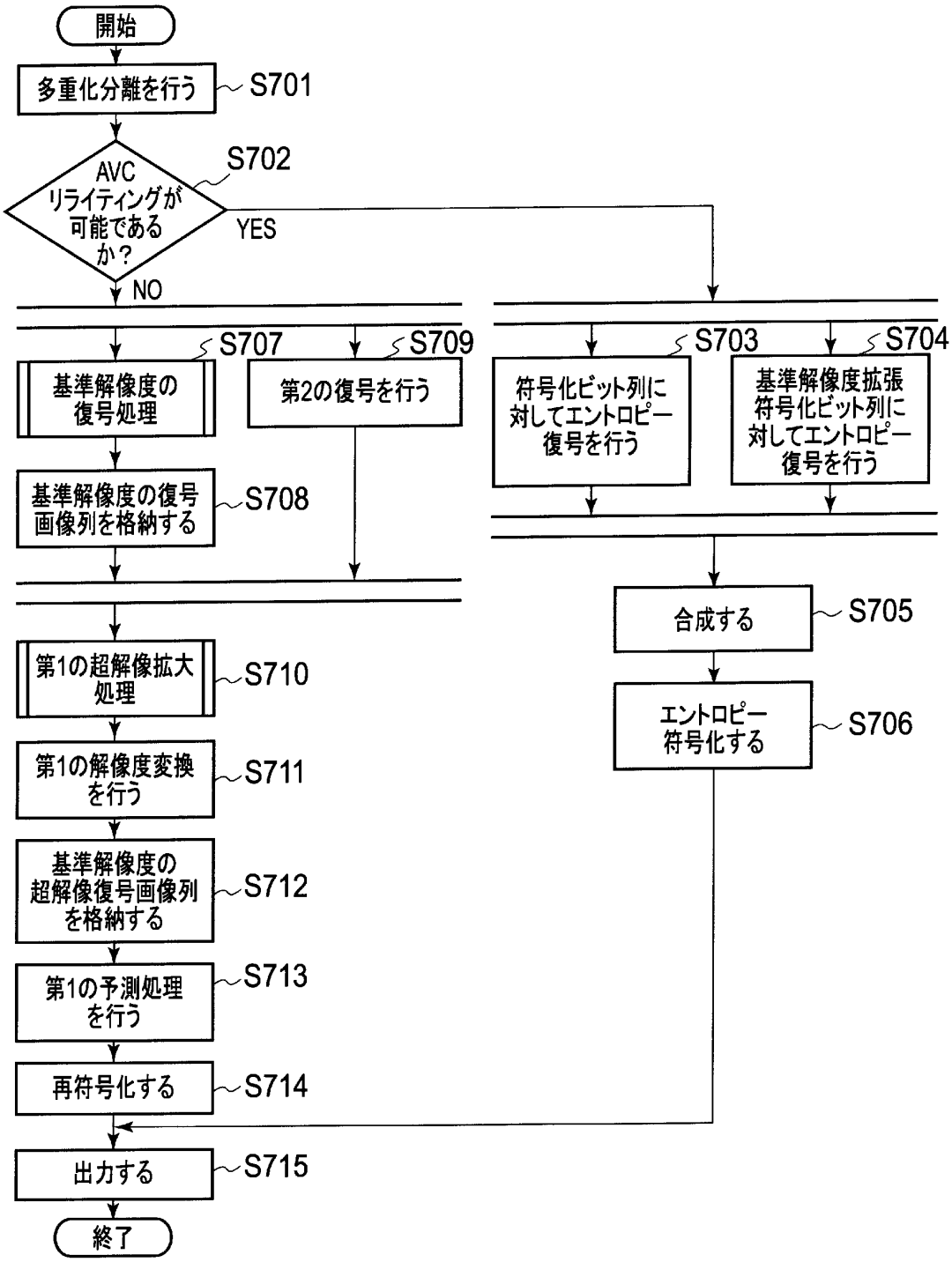
[図26]


入力
(符号化ビット列)
多重化分離部
1801
第1復号部
1802
第1超解像
拡大部
1803
第1解像度
変換部
1804
第2復号部
1805
出力
(復号画像列)
出力
(超解像拡大復号画像列)
出力
(超解像復号画像列)
出力
(超解像画像列)

[図27]


入力
(符号化ビット列)
多重化分離部
1801
第1復号部
1802
第1超解像
拡大部
1803
第1解像度
変換部
1804
第2復号部
1805
再符号化部
1808
多重化部
1809
出力
(符号化ビット列)

[図28]


開始
多重化分離を行う
S701
AVC
リライティングが
可能である
か？
S702
YES
NO
S707
S709
基準解像度の
復号処理
第2の復号を行う
基準解像度の復号
画像列を格納する
S708
S703
S704
符号化ビット列に
対してエントロピー
復号を行う
基準解像度拡張
符号化ビット列に
対してエントロピー
復号を行う
合成する
S705
エントロピー
符号化する
S706
第1の超解像拡大
処理
S710
第1の解像度変換
を行う
S711
基準解像度の
超解像復号画像列
を格納する
S712
第1の予測処理
を行う
S713
再符号化する
S714
出力する
S715
終了

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日本国特許庁
JAPAN PATENT OFFICE

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This is to certify that the annexed is a true copy of the following application as filed with this Office.

出願年月日 Date of Application:	２００８年　５月３０日
出願番号 Application Number:	特願２００８－１４２４３３
パリ条約による外国への出願に用いる優先権の主張の基礎となる出願の国コードと出願番号 The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is	ＪＰ２００８－１４２４３３
出願人 Applicant(s):	日本ビクター株式会社

２００９年　６月　２日

特許庁長官
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Japan Patent Office

鈴木隆史

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【物件名】　明細書　1
【物件名】　図面　1
【物件名】　要約書　1

【書類名】特許請求の範囲
【請求項１】
基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、
基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、
前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像度をもつ超解像拡大・変換画像を生成する第１解像度変換部と、
前記第１解像度変換部からの前記超解像拡大・変換画像を符号化対象画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する第２符号化部と、
を有する動画像符号化装置。
【請求項２】
請求項１記載の動画像符号化装置において、
前記第２符号化部は、さらに、
前記第１符号化部からの前記復号画像を参照画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する、動画像符号化装置。
【請求項３】
請求項１または請求項２記載の動画像符号化装置において、さらに、
前記第１符号化部から基準解像度の前記復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、
前記超解像拡大復号画像に対し第２の解像度変換処理を行って基準解像度をもつ超解像拡大・変換復号画像を生成する第２解像度変換部と、を有し、
前記第２符号化部は、さらに、
前記第２解像度変換部からの前記超解像拡大・変換復号画像を参照画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する、動画像符号化装置。
【請求項４】
請求項１～請求項３の記載の動画像符号化装置において、
前記第１の超解像拡大部は、
超解像拡大処理を行う際の基準となる基準画像と、少なくとも１枚の観測画像とに基づいて、所望の高解像度の画素位置への位置合わせを行い、不等間隔にサンプリングされた不均一高解像度画像を生成する位置合わせ器と、
前記位置合わせ器にて生成された不均一高解像度画像に対し所定の不均一補間処理を行って、所望の高解像度を持つ補間画像を生成する補間器と、
前記補間器にて生成された前記補間画像を取得して、所定の復元処理を行い、所望の解像度を持つ推定画像を生成する推定画像生成器と、
前記位置合わせ器から前記不均一高解像度画像を取得するとともに、前記推定画像生成器から前記不均一推定画像を取得して、取得したそれぞれの画像を利用して、所定の判定方法に従って超解像拡大処理の繰り返しが必要か否かを判定し、その判定の結果、繰り返しが必要な場合は、前記補間器に対して処理を継続するための制御情報を供給する一方、繰り返しが必要ない場合には、前記推定画像生成器に対して超解像度拡大結果である高解像度の推定画像を出力するための制御情報を出力する繰り返し判定器と、
を有する動画像符号化装置。
【請求項５】
請求項１～請求項４のいずれか一の請求項に記載された動画像符号化装置において、
さらに、
前記第１符号化部からの前記第１符号化ビット列と、前記第２符号化部からの前記第２符号化ビット列と、前記第１符号化部における符号化および前記第２符号化部における符号化の際に使用した各種符号化パラメータ情報とを、所定の構文構造に基づいて多重化する多重化部、

を有する動画像符号化装置。
【請求項６】
請求項２～請求項５のいずれか一の請求項に記載された動画像符号化装置において、
さらに、
前記第１符号化部および前記第１超解像拡大部の前段に設けられ、基準解像度の前記動画像列を蓄積する第１蓄積バッファと、
前記第１符号化部と前記第２符号化部の間に設けられ、前記第１符号化部からの前記復号画像を蓄積する第２蓄積バッファと、
前記第１蓄積バッファと、前記第２蓄積バッファと、前記第１符号化部と、前記第２符号化部とにおける各バッファ蓄積量を検出し、各バッファ蓄積量を制御する蓄積制御部と、
前記蓄積制御部における前記各バッファ蓄積量に基づいて、前記第１符号化部と前記第２符号化部とにおける符号量制御を行う符号量制御部と、
を有する動画像符号化装置。
【請求項７】
基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、
基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、
前記第１符号化部から前記復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、
前記第１符号化部から前記復号画像を取得し、第３の解像度変換処理を行って基準解像度よりも高い解像度をもつ解像度変換拡大復号画像を生成する第３解像度変換部と、
前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第２超解像拡大部からの前記超解像拡大復号画像と、前記第３超解像拡大部からの前記解像度変換拡大復号画像とを参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、
を有する動画像符号化装置。
【請求項８】
基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、
基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、
前記第１符号化部から前記復号画像を取得し、第３の解像度変換処理を行って基準解像度よりも高い解像度をもつ解像度変換拡大復号画像を生成する第３解像度変換部と、
前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第３解像度変換部からの前記解像度変換拡大復号画像を参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、
を有する動画像符号化装置。
【請求項９】
基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、
基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、
前記第１符号化部から前記復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、
前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第２超解像拡大部からの前記超解像拡大復号画像を参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、
を有する動画像符号化装置。

出証特２００９－３０１７００６

【請求項１０】
基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、
基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、
前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像度をもつ超解像拡大・変換画像を生成する第１解像度変換部と、
前記第１符号化部から前記復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、
前記第２超解像拡大部からの前記超解像拡大復号画像に対し第２の解像度変換処理を行って基準解像度をもつ超解像拡大・変換復号画像を生成する第２解像度変換部と、
前記第１解像度変換部からの前記超解像拡大・変換画像を符号化対象画像として、前記第１符号化部からの前記復号画像と、前記第２解像度変換部からの基準解像度をもつ超解像拡大・変換復号画像とを参照画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する第２符号化部と、
前記第１符号化部から前記復号画像を取得し、第３の解像度変換処理を行って基準解像度よりも高い解像度をもつ解像度変換拡大復号画像を生成する第３解像度変換部と、
前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第２超解像拡大部からの前記超解像拡大復号画像と、前記第３解像度変換部からの前記解像度変換拡大復号画像をと参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、
を有する動画像符号化装置。
【請求項１１】
基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成するステップと、
基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成するステップと、
前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像度をもつ超解像拡大・変換画像を生成するステップと、
前記超解像拡大・変換画像を符号化対象画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成するステップと、
を有する動画像符号化方法。
【請求項１２】
基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成するステップと、
基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成するステップと、
前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像度をもつ超解像拡大・変換画像を生成するステップと、
前記超解像拡大・変換画像を符号化対象画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成するステップと、
をコンピュータに実行させる動画像符号化プログラム。

【書類名】明細書
【発明の名称】動画像符号化装置、動画像符号化方法、および動画像符号化プログラム
【技術分野】
【０００１】
本発明は、動画像列に対し超解像拡大処理等を行う動画像符号化装置、動画像符号化方法、および動画像符号化プログラムに関する。
【背景技術】
【０００２】
映像の空間解像度スケーラビリティを実現する従来技術として、例えば、ベースレイヤとエンハンスメントレイヤの２層の階層符号化装置において、エンハンスメントレイヤと同じ空間解像度の入力映像信号をベースレイヤの空間解像度に縮小（デシメーション）処理した後、ベースレイヤにて符号化し、そのベースレイヤ符号化の際のデコード信号を空間的に補間（インターポレーション）してエンハンスメントレイヤと同じ空間解像度にした信号とエンハンスメントレイヤと同じ空間解像度の入力映像信号との間で相関を利用した予測を行い、その予測誤差信号を符号化して、そこで得た符号化ビットストリームとベースレイヤ符号化で得られたビットストリームを多重化したものを復号装置へ伝送し、復号装置ではその多重化された符号化ビットストリームをその逆に復号するものがある（例えば、特許文献１参照。）。
【特許文献１】特開平７－１６２８７０号公報
【発明の開示】
【発明が解決しようとする課題】
【０００３】
ところで、ISO/IEC SC29 WG11において規格標準化されているMPEG-1、-2、-4/AVC/SVCなどに代表される動画像符号化では、局部復号（ローカルデコード）によって得られる復号ピクチャを参照ピクチャとして利用して動き推定により動きベクトル情報を生成し、動き補償により生成された動きベクトル情報を利用して、符号化対象となっている対象ピクチャに最も近い画像品質を持つような予測ピクチャを生成し、その後、対象ピクチャと予測ピクチャとの残差情報を求め、この残差情報に対して所定の符号化処理を行って、時間方向の相関性の高さを利用して高い符号化効率を実現している。つまり、予測ピクチャの画像品質を向上させ、対象ピクチャとの相関を高めることで、更なる符号化効率の向上が期待できる。しかし、十分な符号量を割り当てることができないと、動きベクトル情報の精度が十分でなくなったり、局部復号結果である参照ピクチャの画像品質が十分得られなくなったりすることによって、予測ピクチャの画像品質が低下し、結果として符号化効率が低下する。
【０００４】
また、上述の特許文献１やMPEG-4 SVCなどに代表される動画像の階層符号化でも、現在符号化を行おうとしている階層よりも下の階層の参照ピクチャから予測ピクチャもしくは予測ブロックを生成し、現在の階層の対象ピクチャもしくは対象ブロックとの間で階層間予測を行うことにより、異なる空間解像度間の相関性の高さを利用して更なる符号化効率の向上を図っている。しかし、時間方向の相関性の高さを利用する場合と同様に、階層間の相関性の高さを利用する場合も、十分な符号量を割り当てることができないと、予測ピクチャもしくは予測ブロックの画像品質は低下し、結果として符号化効率が低下してしまうという課題が生じる。
【０００５】
また、符号化対象として入力した動画像に対して所定の解像度変換処理を行って、入力した動画像の持つ空間解像度(以後、基準解像度)よりも低い空間解像度（以後、低解像度）の動画像を生成し、少なくとも2階層の動画像に対して階層間の相関性の高さを利用して階層符号化を行っている。しかし、このような階層符号化では、仮に可逆の符号化処理を行った場合であっても、入力動画像の基準解像度によって、表現できる空間方向の空間周波数成分情報に帯域制限がかかるとともに、階層符号化を行う際に、階層符号化の局部

復号、もしくは階層符号化によって得られる符号化ビットストリームを復号して得られる復号画像が、入力動画像に対して、符号化条件の下で最も入力動画像の画像品質に近くなるように符号化処理を行うことから、階層間の相関性を利用して新たな空間周波数成分情報の推定が可能であっても、基準解像度で表現できる空間周波数成分情報より多くのの空間周波数成分情報を符号化し、伝送することができないという課題が生じる。

【０００６】

そこで、本発明は、入力動画像の解像度で表現される空間周波数成分情報より多くのの空間周波数成分情報を符号化し、伝送することができる動画像符号化装置、動画像符号化方法、および動画像符号化方法を提供することを目的とする。

【課題を解決するための手段】

【０００７】

前記課題を解決するため、本発明の動画像符号化装置は、例えば図９に示すように、基準解像度の動画像列に対し第１の符号化および復号処理を行って前記基準解像度の第１符号化ビット列および基準解像度の復号画像を生成する第１符号化部と、基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像度をもつ超解像拡大・変換画像を生成する第１解像度変換部と、前記第１解像度変換部からの前記超解像拡大・変換画像を符号化対象画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する第２符号化部と、を有する。

ここで、例えば図７に示すように、前記第２符号化部は、さらに、前記第１符号化部からの前記復号画像を参照画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する、ようにしても良い。

また、例えば図１および図８に示すように、さらに、前記第１符号化部から前記基準解像度の復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、前記超解像拡大復号画像に対し第２の解像度変換処理を行って基準解像度をもつ超解像拡大・変換復号画像を生成する第２解像度変換部と、を有し、前記第２符号化部は、さらに、前記第２解像度変換部からの前記超解像拡大・変換復号画像を参照画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する、ようにしても良い。

また、例えば図４の（ａ）に示すように、前記第１の超解像拡大部は、超解像拡大処理を行う際の基準となる基準画像と、少なくとも１枚の観測画像とに基づいて、所望の高解像度の画素位置への位置合わせを行い、不等間隔にサンプリングされた不均一高解像度画像を生成する位置合わせ器と、前記位置合わせ器にて生成された不均一高解像度画像に対し所定の不均一補間処理を行って、所望の高解像度を持つ補間画像を生成する補間器と、前記補間器にて生成された前記補間画像を取得して、所定の復元処理を行い、所望の解像度を持つ推定画像を生成する推定画像生成器と、前記位置合わせ器から前記不均一高解像度画像を取得するとともに、前記推定画像生成器から前記不均一推定画像を取得して、取得したそれぞれの画像を利用して、所定の判定方法に従って超解像拡大処理の繰り返しが必要か否かを判定し、その判定の結果、繰り返しが必要な場合は、前記補間器に対して処理を継続するための制御情報を供給する一方、繰り返しが必要ない場合には、前記推定画像生成器に対して超解像拡大処理結果である高解像度の推定画像を出力するための制御情報を出力する繰り返し判定器と、を有するようにしても良い。

また、例えば図１等に示すように、さらに、前記第１符号化部からの前記第１符号化ビット列と、前記第２符号化部からの前記第２符号化ビット列と、前記第１符号化部における符号化および前記第２符号化部における符号化の際に使用した各種符号化パラメータ情報とを、所定の構文構造に基づいて多重化する多重化部、を有するようにしても良い。

また、例えば図１０に示すように、さらに、前記第１符号化部および前記第１超解像拡大部の前段に設けられ、基準解像度の前記動画像列を蓄積する第１蓄積バッファと、前記第１符号化部と前記第２符号化部の間に設けられ、前記第１符号化部からの前記復号画像を蓄積する第２蓄積バッファと、前記第１蓄積バッファと、前記第２蓄積バッファと、前

記第１符号化部と、前記第２符号化部とにおける各バッファ蓄積量を検出し、各バッファ蓄積量を制御する蓄積制御部と、前記蓄積制御部における前記各バッファ蓄積量に基づいて、前記第１符号化部と前記第２符号化部とにおける符号量制御を行う符号量制御部と、を有するようにしても良い。

また、本発明の動画像符号化装置は、例えば図１３に示すように、基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、前記第１符号化部から前記復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、前記第１符号化部から前記復号画像を取得し、第３の解像度変換処理を行って基準解像度よりも高い解像度をもつ解像度変換拡大復号画像を生成する第３解像度変換部と、前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第２超解像拡大部からの前記超解像拡大復号画像と、前記第３超解像拡大部からの前記解像度変換拡大復号画像とを参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、を有する。

また、本発明の動画像符号化装置は、例えば図１６に示すように、基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、前記第１符号化部から前記復号画像を取得し、第３の解像度変換処理を行って基準解像度よりも高い解像度をもつ解像度変換拡大復号画像を生成する第３解像度変換部と、前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第３解像度変換部からの前記解像度変換拡大復号画像を参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、を有する。

また、本発明の動画像符号化装置は、例えば図１７に示すように、基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、前記第１符号化部から前記復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第２超解像拡大部からの前記超解像拡大復号画像を参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、を有する。

また、本発明の動画像符号化装置は、例えば図１９に示すように、基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像度をもつ超解像拡大・変換画像を生成する第１解像度変換部と、前記第１符号化部から前記復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、前記第２超解像拡大部からの前記超解像拡大復号画像に対し第２の解像度変換処理を行って基準解像度をもつ超解像拡大・変換復号画像を生成する第２解像度変換部と、前記第１解像度変換部からの前記超解像拡大・変換画像を符号化対象画像として、前記第１符号化部からの前記復号画像と、前記第２解像度変換部からの基準解像度をもつ超解像拡大・変換復号画像とを参照画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する第２符号化部と、前記第１符号化部から前記復号画像を取得し、第３の解像度変換処理を行って基準解像度よりも高い解像度をもつ解像度変換拡大復号画像を生成する第３解像度変換部と、前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第２超解像拡大部からの前記超解像拡

大復号画像と、前記第３解像度変換部からの前記解像度変換拡大復号画像とを参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、を有する。

また、本発明の動画像符号化方法は、基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成するステップと、基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成するステップと、前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像度をもつ超解像拡大・変換画像を生成するステップと、前記超解像拡大・変換画像を符号化対象画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成するステップと、を有する。

また、本発明の動画像符号化プログラムは、基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成するステップと、基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成するステップと、前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像度をもつ超解像拡大・変換画像を生成するステップと、前記超解像拡大・変換画像を符号化対象画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成するステップと、をコンピュータに実行させる。

【発明の効果】

【０００８】

本発明の動画像符号化装置、動画像符号化方法、および動画像符号化プログラムによれば、第１符号化部が基準解像度の入力動画像を符号化する一方、第１超解像拡大部が基準解像度の入力動画像に対し超解像拡大処理を行うことにより、入力動画像中に潜在的に含まれるが基準解像度では十分表現できていなかった空間方向および時間方向の周波数成分情報を含め、その後、第１解像度変換部によって所定の解像度変換処理等を行ってから第２符号化部にて符号化するようにしたので、第２符号化部では、基準解像度の入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行えるという効果を生じる。ここで、第２符号化部では、第１符号化部での復号信号やその復号信号を第２超解像拡大処理および第２解像度変換処理等の加工をした信号を参照信号として利用して符号化することもできる。

【０００９】

また、本発明の動画像符号化装置、動画像符号化方法、および動画像符号化プログラムによれば、第１符号化部が基準解像度の入力動画像を符号化する一方、第１超解像拡大部が基準解像度の入力動画像に対し超解像拡大処理を行うことにより、入力動画像中に潜在的に含まれるが基準解像度では十分表現できていなかった空間方向および時間方向の周波数成分情報を含め、その後その信号を第３符号化部にて符号化するようにしたので、第３符号化部では、基準解像度の入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行えるという効果を生じる。ここで、第３符号化部では、第１符号化部での復号信号を第２超解像拡大処理や第３解像度変換処理等の加工をして第１超解像拡大信号と同じ解像度に高解像度化した信号を参照信号として符号化することもできる。

【発明を実施するための最良の形態】

【００１０】

実施の形態１．

【００１１】

図１は、本発明の実施の形態１の動画像符号化装置の構成例を示すブロック図である。

【００１２】

図１において、実施の形態１の動画像符号化装置は、第１蓄積バッファ１０１、第１符号化部１０２、第１超解像拡大部１０３、第１解像度変換部１０４、第２超解像拡大部１０５、第２解像度変換部１０６、第２符号化部１０７、多重化部１０９を有している。

【００１３】

第１蓄積バッファ１０１は、入力として入力する動画像に対し、後述される所定の超解

像前符号化および第１超解像拡大処理を行う際に必要となる、少なくとも２枚の画像を蓄積し、第１符号化部１０２、第１超解像拡大部１０３等に対し、それぞれにおいて必要とされる画像を供給する機能を有する。

【００１４】

第１符号化部１０２は、第１蓄積バッファ１０１から、所定の符号化処理に必要な、基準解像度をもつ画像を取得して、取得した基準解像度をもつ画像に対して所定の符号化処理（以後、超解像前符号化処理と呼ぶ）を行い、第１符号化ビット列を生成し、生成した第１符号化ビット列を多重化部１０９に供給する機能を有する。また、第１符号化部１０２は、所定の復号処理を行い、復号画像を、第２超解像拡大部１０５および第２符号化部１０７に供給する機能を有する。また、第１符号化部１０２は、復号画像を一時的に格納するための機能を有することが望ましい。ここで、所定の復号処理は、生成した第１符号化ビット列に対して復号処理を行って復号画像を生成するように構成しても良い。また、所定の符号化処理に含まれる局部復号処理によって局部復号結果から復号画像を生成するように構成しても良い。

【００１５】

第１超解像拡大部１０３は、第１蓄積バッファ１０１から、所定の超解像拡大処理に必要となる、少なくとも２枚の基準解像度をもつ画像を取得して、取得した基準解像度をもつ画像に対し、所定の超解像拡大処理を行い、基準解像度よりも高い解像度をもつ、超解像拡大画像を生成し、生成した超解像拡大画像を第１解像度変換部１０４に供給する機能を有する。ここで、所定の超解像拡大処理を行う際の拡大率は、所定の拡大率情報として設定されるか、外部のユーザ等から設定される拡大率情報を取得する機能を有し、取得した拡大率情報に基づいて拡大率が特定されて所定の超解像拡大処理を行うように構成しても良い。更に、所定の拡大率情報は、図示しない所定のエントロピー符号化処理を行って拡大率情報ビット列を生成し、多重化部１０９に供給して、復号装置側に伝送するように構成すると更に良い。この点は、第２超解像拡大部１０５も同様である。なお、第１超解像拡大部１０３および第２超解像拡大部１０５の詳細構成例および動作例は、図４において後述する。

【００１６】

第１解像度変換部１０４は、第１超解像拡大部１０３から超解像拡大画像を取得して、取得した超解像拡大画像に対して所定の解像度変換処理を行い、基準解像度よりも高い解像度をもつ超解像拡大画像から、例えば、基準解像度等をもつ超解像画像（超解像拡大・変換画像）を生成し、第２符号化部１０７に供給する機能を有する。

【００１７】

第２超解像拡大部１０５は、第１符号化部１０２から、所定の超解像拡大処理に必要となる、少なくとも２枚の基準解像度をもつ復号画像を取得して、取得した基準解像度の復号画像に対し、所定の超解像拡大処理を行い、基準解像度よりも高い解像度をもつ、超解像拡大復号画像を生成し、生成した超解像拡大復号画像を第２解像度変換部１０６に供給する機能を有する。ここで、第１超解像拡大部１０３と同様に、所定の超解像拡大処理を行う際の拡大率は、所定の拡大率情報として設定されるか、外部のユーザ等から設定される拡大率情報を取得する機能を有し、取得した拡大率情報に基づいて拡大率が特定されて所定の超解像拡大処理を行うようにしても良い。なお、第２超解像拡大部１０５における拡大後の解像度は、第１超解像拡大部１０３における拡大後の解像度と同じでも、異なっていてもどちらでも良い。

【００１８】

第２解像度変換部１０６は、第２超解像拡大部１０５から超解像拡大復号画像を取得して、取得した超解像拡大復号画像に対して所定の解像度変換処理を行って、基準解像度よりも高い解像度をもつ超解像拡大復号画像から、例えば、基準解像度をもつ超解像復号画像（超解像拡大・変換復号画像）を生成し、第２符号化部１０７に供給する機能を有する。ここで、所定の解像度変換処理を行う際の解像度変換率は、所定の解像度変換率情報として設定されるか、外部のユーザ等から設定される解像度変換率情報を取得する機能を有

し、取得した解像度変換率情報に基づいて解像度変換率が特定されて所定の解像度変換処理を行うように構成しても良い。ここで、解像度変換率情報は、図示しない所定のエントロピー符号化処理を行って解像度変換率情報ビット列を生成し、多重化部１０９に供給するように構成すると更に良い構成となる。

【００１９】

第２符号化部１０７は、第１解像度変換部１０４から基準解像度の入力画像の超解像拡大・変換信号を符号化対象ピクチャとし、第１符号化部１０２から前記復号画像を第１参照ピクチャとし、第２解像度変換部１０６から基準解像度の復号画像の超解像拡大・変換復号信号を第２参照ピクチャとして、所定の予測処理および第２の符号化処理を行って、第２符号化ビット列を生成し、生成した第２符号化ビット列を多重化部１０９に供給する機能を有する。

【００２０】

ここで、第２符号化部１０７における所定の予測処理を行う際に利用する参照ピクチャは、復号画像から得られる第１参照ピクチャと、超解像拡大・変換復号画像から得られる第２参照ピクチャとのどちらか一方を利用して予測ピクチャを生成し、対象ピクチャから予測ピクチャを減算することで残差情報を生成するような構成としても良い。

【００２１】

また、第１参照ピクチャ、および第２参照ピクチャのどちらも利用せず、対象ピクチャを残差情報として生成するような構成を含めても良い。

【００２２】

更に、第２符号化部１０７は、各ピクチャ、もしくは所定のピクチャ数ごとに参照ピクチャの選択を制御するために、第１参照ピクチャと第２参照ピクチャのどちらを利用したかを特定するための参照ピクチャ選択情報を生成し、図示しない所定のエントロピー符号化部によってエントロピー符号化処理を行って参照ピクチャ選択情報の符号化ビット列を生成し、多重化部１０９に供給するようにしても良い。なお、後述するように、参照ピクチャ情報の符号化ビット列は、多重化ビット列３００の符号化パラメータ情報ビット列３１０として多重化される。また、対象ピクチャをそれぞれ所定の大きさをもつ領域ごとに隙間なく分割し、第１参照ピクチャと第２参照ピクチャも同様に所定の大きさをもつ領域ごとに隙間なく分割し、対応する領域ごとに第１参照ピクチャと第２参照ピクチャのどちらを利用するかを特定しながら予測ピクチャを生成し、対象ピクチャから予測ピクチャを減算することで残差情報を生成するようにしても良い。ここで、所定の大きさをもつ領域ごとに、どの参照ピクチャを利用したかを特定するための情報を参照ピクチャ選択情報とし、図示しない所定のエントロピー符号化部によってエントロピー符号化処理を行い、生成された参照ピクチャ選択情報の符号化ビット列を多重化部１０９に供給するようにしても良い。ここで、所定の大きさをもつ領域の形状は、所定の矩形領域、または所定の領域分割によって得られる任意形状領域であることが望ましい。

【００２３】

また、第２符号化部１０７は、符号化対象ピクチャから第１参照ピクチャを減算して得られる残差情報を第１の残差情報として所定の第２の符号化処理を行って第１の第２符号化ビット列を生成するとともに、符号化対象ピクチャから第２参照ピクチャを減算して得られる残差情報を第２の残差情報として所定の第２の符号化処理を行って第２の第２符号化ビット列を生成し、更に、第１参照ピクチャ、および第２参照ピクチャのどちらも利用せず、対象ピクチャのみから残差情報を生成し、第３の残差情報として所定の第２の符号化処理を行って第３の第２符号化ビット列を生成し、生成した第１から第３の第２符号化ビット列を多重化部１０９に供給する機能を有するようにしても良い。

【００２４】

また、第２符号化部１０７は、例えば、MPEG-4 SVCにおけるCGS(Coarse Grain Scalability)レイヤの符号化を実行し、第１符号化部１０２の基準解像度の動画像列の空間解像度との間の空間解像度が同一である場合には、MPEGおよびITU-Tとの共同グループであるJVT(Joint Video Team)におけるAVCリライティングにて示される、SVCからAVCに容易に変

換できるようにするための抑制条件を満たすような所定の構文構造に基づいて第２符号化を行って第２符号化ビット列を生成するようにしても良い。このようにすれば、第２符号化部１０７にて生成される第２符号化ビット列は、階層符号化であるSVCの符号化形式から単層の符号化であるAVCの符号化形式に、完全な復号と符号化を行うような再符号化を行うことなく変換することができる符号化ビット列を生成することができる。

【００２５】

多重化部１０９は、第１符号化部１０２から第１符号化ビット列を取得すると共に、第２符号化部１０７から第２符号化ビット列を取得して、所定の構文構造に基づいて、符号化の際に利用した動きベクトル情報や量子化パラメータ情報、さらには上述の参照ピクチャ選択情報等の各種符号化パラメータや符号化モードと、これらを特定するための識別情報を挿入しながら、第１符号化ビット列と、第２符号化ビット列との多重化処理を行い、後述する図３に示すような多重化ビット列を生成する機能を有する。

【００２６】

以上のような構成を本実施の形態として少なくとも有し、入力される動画像に対して所定の超解像拡大処理および所定の解像度変換処理で生成される基準解像度の入力画像の超解像拡大・変換信号を利用する構成にすることで、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行うことができる。ここで、第１超解像拡大部１０３、第２超解像拡大部１０５が利用する拡大率は、必ずしも同じ拡大率である必要はない。同様に、第１解像度変換部１０４、第２解像度変換部１０６で利用する解像度変換率は、必ずしも同じ解像度変換率である必要はない。ただし、図１においては、第１解像度変換部１０４および第２解像度変換部１０６による解像度変換処理後の空間解像度は、基準解像度となるような解像度変換率であるものとする。

【００２７】

次に、図１に示す実施の形態１の動画像符号化装置の動作を、図２のフローチャートを参照しながら説明する。

【００２８】

まず、入力される動画像を、第１超解像拡大部１０３における第１超解像拡大処理で必要とされるピクチャ数の画像を、第１蓄積バッファ１０１に格納する（ステップＳ２０１）。

【００２９】

第１超解像拡大部１０３は、所定の超解像拡大処理を行う際に必要となる少なくとも２枚の画像を、第１蓄積バッファ１０１から取得し、所定の第１超解像拡大処理を行う（ステップＳ２０２）。これにより、入力される動画像がもつ空間解像度である基準解像度よりも高い解像度をもつ、超解像拡大画像を生成し、第１解像度変換部１０４に供給する。なお、第１超解像拡大部１０３の具体的構成および超解像処理の内容については後述する。

【００３０】

その後、第１解像度変換部１０４は、第１超解像拡大部１０３から超解像拡大画像を取得し、所定の解像度変換処理を行う（ステップＳ２０３）。これにより、基準解像度の入力画像の超解像拡大・変換信号を生成し、第２符号化部１０７に生成した基準解像度の入力画像の超解像拡大・変換信号を供給する。

【００３１】

その後、第２符号化部１０７は、第１解像度変換部１０４から基準解像度の入力画像の超解像拡大・変換信号を取得し、一時的に蓄積するための所定のバッファに格納する（ステップＳ２０４）。

【００３２】

その一方、第１符号化部１０２は、第１蓄積バッファ１０１から所定の超解像前符号化処理を行う際に必要となる基準解像度の動画像列を取得し、基準解像度の符号化、復号処理を行う（ステップＳ２０５）。これにより、符号化処理結果である基準解像度の第１符号化ビット列と、復号結果である基準解像度の復号画像を生成する。その後、第１符号化

部１０２は、生成した第１符号化ビット列を多重化部１０９に供給し、生成した基準解像度の復号画像を第２超解像拡大部１０５および第２符号化部１０７に供給する。

【００３３】

その後、第２符号化部１０７は、第１符号化部１０２から前記復号画像を取得し、一時的に蓄積するための所定のバッファに格納する（ステップＳ２０６）。

【００３４】

その後、第２超解像拡大部１０５は、第１超解像拡大部１０３と同様に、第１符号化部１０２から前記復号画像を取得し、所定の超解像拡大処理を行う（ステップＳ２０７）。これにより、基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成し、第２解像度変換部１０６に供給する。

【００３５】

その後、第２解像度変換部１０６は、第２超解像拡大部１０５から超解像拡大復号画像を取得し、所定の解像度変換処理を行う（ステップＳ２０８）。これにより、基準解像度の復号画像の超解像拡大・変換復号信号を生成し、第２符号化部１０７に供給する。

【００３６】

その後、第２符号化部１０７は、第２解像度変換部１０６から基準解像度の復号画像の超解像拡大・変換復号信号を取得し、一時的に蓄積するための所定のバッファに格納する（ステップＳ２０９）。

【００３７】

なお、ステップ２０２～２０４の処理と、ステップ２０５～２０９の処理とは、並列に実行しても良いし、どちらか一方を先に実行しても良い。

【００３８】

ステップ２０２～２０９の処理が完了すると、第２符号化部１０７は、入力画像を第１超解像拡大部１０３および第１解像度変換部１０４にて第１の超解像拡大および解像度変換した入力画像の超解像拡大・変換信号を符号化対象ピクチャとし、入力画像を第１符号化部１０２にてそのまま符号化および復号した復号画像を第１参照ピクチャとし、その復号画像を第２超解像拡大部１０５および第２解像度変換部１０６にて第２超解像拡大および解像度変換した復号画像の超解像拡大・変換復号信号を第２参照ピクチャとして、所定の第２の予測処理を行う（ステップＳ２１０）。これにより、第２符号化部１０７は、基準解像度の残差情報を生成する。その後、生成した残差情報に対して所定の第２の符号化である第２の符号化処理を行う（ステップＳ２１１）。これにより、第２符号化ビット列を生成し、多重化部１０９に供給する。

【００３９】

その後、多重化部１０９は、第１符号化部１０２から第１符号化ビット列、第２符号化部１０７から第２符号化ビット列を取得する。所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化パラメータ情報を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、第１符号化ビット列、第２符号化ビット列の多重化処理を行い（ステップＳ２１２）、多重化ビット列を生成する。以上のようなステップを経ることで、本実施の形態の一連の動作が完了する。

【００４０】

このようなステップを実行することで、本発明の動画像符号化装置を動作させることにより、所望の符号化ビット列を生成することができる。

【００４１】

図３は、多重化部１０９が出力する多重化ビット列３００の一例を示している。

【００４２】

図３に示す多重化ビット列３００では、少なくとも符号化パラメータ情報ビット列３１０、第１符号化部１０２からの第１符号化ビット列３２０、第２符号化部１０７からの第２符号化ビット列３３０を多重化している。

【００４３】

ここで、符号化パラメータ情報ビット列３１０には、第１符号化部１０２や第２符号化部１０７がそれぞれの符号化の際に使用した動きベクトル情報や、量子化パラメータ情報、符号化モード、上述の参照ピクチャ選択情報等の各種符号化パラメータが格納されている共に、この多重化ビット列３００に第１符号化ビット列３２０と、第２符号化ビット列３３０とが多重化されていることを示す識別情報ビット列３１１とが挿入されている。

【００４４】

なお、本実施の形態の動作を複数の並列処理によって説明したが、この並列処理部分を連続的に処理するように、本実施の形態の構成を動作させても勿論よい。

【００４５】

このように、第１超解像拡大部１０３および第２超解像拡大部１０５を有すると共に、第１解像度変換部１０４および第２解像度変換部１０６を有するので、第１の解像度変換処理により、入力画像と同じ基準解像度であるが、第１超解像拡大処理によって空間方向および時間方向の周波数成分情報が拡大された超解像拡大画像に対して、所望の周波数成分まで周波数帯域を制限することによって基準解像度の入力画像の超解像拡大・変換信号を生成することができる。

【００４６】

そして、このように生成された基準解像度の入力画像の超解像拡大・変換信号は、入力動画像がもつ周波数成分情報の情報量よりも多くの情報量をもつように生成された超解像拡大画像から、基準解像度の空間周波数で表現できる最大の周波数帯域までの周波数成分情報を、基準解像度の入力画像の超解像拡大・変換信号に含めることができるため、このように入力動画像が持つ周波数成分情報の情報量を拡張した上で動画像符号化処理を行い、基準解像度の第１符号化ビット列および基準解像度の第２符号化ビット列を生成することで、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行うことができる。

【００４７】

また、入力された基準解像度の動画像に対して所定の符号化および復号処理によって基準解像度の復号画像を生成することができる。この基準解像度の復号画像に対して、所定の第２超解像拡大処理によって空間方向および時間方向の周波数成分情報が拡大された、基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成し、この生成した超解像拡大復号画像に対して所定の第２の解像度変換処理によって基準解像度の復号画像の超解像拡大・変換復号信号を生成することができる。そして、この生成した基準解像度の復号画像の超解像拡大・変換復号信号を基準解像度の参照ピクチャとし、基準解像度の入力画像の超解像拡大・変換信号との間で所定の予測処理を行った後に、所定の第２の符号化処理を行って、第２符号化ビット列を生成することができる。このように、基準解像度の復号画像の超解像拡大・変換復号信号を参照ピクチャとして利用し、基準解像度の入力画像の超解像拡大・変換信号との間で、同一解像度間における空間解像度の相関性を利用した階層符号化を行って、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行うことができる。

【００４８】

また、第２符号化部１０７は、予測ピクチャを生成する際に、入力画像を第１符号化部１０２にてそのまま符号化および復号した復号画像を第１参照ピクチャとする一方、その復号画像を第２超解像拡大部１０５および第２解像度変換部１０６にて第２超解像拡大および解像度変換した復号画像の超解像拡大・変換復号信号を第２参照ピクチャとし、第１参照ピクチャと第２参照ピクチャとのどちらか一方を利用して符号化処理を行って、要求に応じて、基準解像度の入力画像の超解像拡大・変換信号と復号画像との間における空間解像度の相関性を利用した場合と、基準解像度の入力画像の超解像拡大・変換信号と超解像拡大・変換復号信号との間における空間解像度の相関性を利用した場合の階層符号化を行うことができ、異なる多重化ビット列を生成し、復号側へ供給、蓄積、または伝送することができる。

【００４９】

また、予測ピクチャを生成する際に、各ピクチャ、もしくは所定のピクチャ数ごとに参照ピクチャの選択を制御することで、復号画像の画像品質に応じて適応的に予測ピクチャを生成することが可能となり、結果として符号化効率を向上させることが可能となる。

【００５０】

更に、第１および第２参照ピクチャのどちらを利用したかを特定するための参照ピクチャ選択情報を生成し、多重化部１０９に供給して、多重化ビット列３００に多重化するように構成することで、符号化時に利用した参照ピクチャを容易に特定することができる。

【００５１】

また、符号化対象ピクチャをそれぞれ所定の大きさをもつ領域ごとに隙間なく分割し、第１参照ピクチャと第２参照ピクチャも同様に所定の大きさをもつ領域ごとに隙間なく分割し、対応する領域ごとに第１参照ピクチャと第２参照ピクチャのどちらを利用するかを特定しながら予測ピクチャを生成すれば、復号画像の画像品質に応じてより適応的に予測ピクチャを生成することが可能となり、結果として符号化効率を向上させることが可能となる。

【００５２】

また、入力された基準解像度の動画像に対して、所定の符号化および復号処理を行って基準解像度の第１符号化ビット列を生成することができるとともに、第２の符号化処理を行って第２符号化ビット列を生成し、これらの符号化ビット列を、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化モード情報等の符号化パラメータ情報を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、所定の多重化処理を行うことにより多重化ビット列を生成することができる。このような多重化ビット列を生成することにより、本来入力動画像に対する符号化結果と、超解像拡大処理および解像度変換処理によって得られた超解像画像によって拡大された周波数成分情報との予測誤差に対する符号化結果とを単一の符号化ビット列とし、図示されない外部の蓄積装置に伝送した後に所定の記録媒体に記録したり、図示されない外部の通信装置によってネットワーク配信したりすることにより、本実施の形態の動画像符号化装置によって大量の情報量をもつ動画像を効率よく符号化し、蓄積、および伝送することを可能にする。

【００５３】

また、第１の符号化部１０２からの第１符号化ビット列と、第２符号化部１０７からの第２符号化ビット列とを取得し、符号化モード情報に応じて所定の多重化処理を行って多重化ビット列を生成することで、多様な符号化ビット列を生成できるとともに、復号側で選択的な復号を可能にする。

【００５４】

次に、本発明および本実施の形態で用いられる所定の超解像拡大処理について説明する。

【００５５】

一般に、超解像拡大処理による画像の高解像度化は、単に位置ずれがある等といった、比較的画像間の相関が高い複数の低解像度画像から１枚の高解像度画像を推定することによって行われるものであり、近年数多くの研究で報告されている。例えば、「Sung C.P.、Min K.P.共著、Super-Resolution Image Reconstruction: A Technical Overview, IEEE SignalProc. Magazine, 第26巻, 第3号, p.21-36, 2003年」などがある。

【００５６】

また、「B.C.Tom, A.K.Katsaggelos共著、Reconstruction of a high-resolution image by simultaneous registration, restoration, and interpolation of low-resolution images, Proc. IEEE Int. Conf. Image Processing, 第２巻、p.539-542, 1995年」に開示されているＭＬ（Maximum-likelihood）法というものが提案されている。このＭＬ法では、高解像度画像から推定された低解像度画像の画素値と実際に観測された画素値の二乗誤差を評価関数とし、評価関数を最小化するような高解像度画像を推定画像としている。この方法は、最尤推定の原理に基づいて超解像処理を行う方法である。

【００５７】
また、「R.R.Schulz, R.L.Stevenson共著、Extraction of high-resolution frames from video sequences, IEEE Trans. Image Processing, 第５巻, p.996-1011, 1996年」に開示されているＭＡＰ（Maximum A Posterior）法というものが提案されている。ＭＡＰ法では、二乗誤差に高解像度画像の確率情報を付加した評価関数を最小化するような高解像度画像の推定を行う。この方法は、高解像度画像に対する何らかの先見情報を利用して、事後確率を最大化する最適化課題として高解像度画像の推定を行う超解像処理方法である。
【００５８】
更に、「H.Stark, P.Oskoui共著、High resolution image recovery from image-plane arrays, using convex projections, J.Opt. Soc. Am. A, 第６巻, p.1715-1726, 1989年」に開示されているＰＯＣＳ（Projection Onto Convex Sets）法というものが提案されている。このＰＯＣＳ法では、高解像度画像と低解像度画像の画素値に関して連立方程式を作成し、その方程式を逐次的に解くことにより、高解像度画像を得る超解像処理方法である。
【００５９】
本実施の形態における所定の超解像拡大処理は、例えば、上述のような超解像処理を適用したものである。
【００６０】
以下、図４、および図５を参照して、本発明および本実施の形態で用いる超解像拡大処理の基本構成例を説明する。
【００６１】
図４の（ａ）は、本発明の実施の形態１における第１超解像拡大部１０３の詳細構成を示すブロック図、図４の（ｂ）は、超解像処理を示す概念図、図５は、超解像処理の動作例を示すフローチャートである。
【００６２】
図４の（ａ）において、本実施の形態１の第１超解像拡大部１０３は、位置合わせ器１０３１、補間器１０３２、推定画像生成器１０３３、繰り返し判定器１０３４を有している。なお、第２超解像拡大部１０５も同様の構成を有している。
【００６３】
位置合わせ器１０３１は、図４（ｂ）（I）に示すような、超解像拡大処理を行う際の基準となる基準画像と、少なくとも１枚の観測画像を取得する。ここでは、図４（ｂ）（I）に示すような基準画像と、観測画像１と、観測画像２とを取得するものとする。位置合わせ器１０３１は、図４（ｂ）（II）に示すように、取得した基準画像と観測画像１，２の解像度よりも高解像度の画素位置への位置合わせを行い、不等間隔にサンプリングされた不均一高解像度画像を生成する機能を有する。また、生成した不均一高解像度画像を補間器１０３２、繰り返し判定器１０３４に供給する機能を有する。ここで、生成される不均一高解像度画像は、例えば図４（ｂ）（II）で示すように、基準画像の各画素を基準として観測画像の位置合わせを行い、基準画像との間の相関が最も高くなる位置に配置するようにすることが望ましい。また、位置合わせで適用される解像度は、超解像拡大処理後に得られる解像度よりも高い解像度で位置合わせを行うようにすることが望ましい。なお、図４（ｃ）については、図６（ｃ）と対比して後述する。
【００６４】
補間器１０３２は、位置合わせ器１０３１にて生成された不均一高解像度画像を取得して、また、取得した不均一高解像度画像から所定の不均一補間処理を行って、所望の高解像度を持つ補間画像を生成し、推定画像生成器１０３３に供給する機能を有する。また、補間器１０３２は、繰り返し判定器１０３４から処理を継続するための制御情報を取得する。ここで、処理を継続するための制御情報には、推定画像生成器１０３３によって生成された不均一推定画像が含まれると良い。また、補間器１０３２は、制御情報に応じて繰り返し処理を行う場合には、所定の更新方法に従って不均一推定画像を利用し、位置合わ

せ器１０３１から取得した不均一高解像度画像を更新するとともに、それぞれの補間画素を修正しても良い。

【００６５】

推定画像生成器１０３３は、補間器１０３２にて生成された補間画像を取得し、所定のカメラモデルから得られる点広がり関数（ＰＳＦ関数）を考慮して所定の復元処理を行い、必要であれば所定のノイズ除去処理を行って、図４（ｂ）（III）で示すような所望の解像度を持つ推定画像を生成する機能を有する。また、推定画像に対してリサンプル処理を行って、不均一高解像度画像の各画素に対応する、不均一推定画像を生成し、繰り返し判定器１０３４に供給する機能を有する。また、繰り返し判定器１０３４から制御情報を取得するとともに、制御情報に応じて、生成した所望の解像度を持つ推定画像を高解像度画像として外部に対して出力する機能を有する。

【００６６】

繰り返し判定器１０３４は、位置合わせ器１０３１から不均一高解像度画像を取得するとともに、推定画像生成器１０３３から不均一推定画像を取得して、取得したそれぞれの画像を利用して、所定の判定方法に従って超解像拡大処理の繰り返しが必要か否かを判定し、その判定の結果、繰り返しが必要な場合は、補間器１０３２に対して処理を継続するための制御情報を供給する一方、繰り返しが必要ない場合には、推定画像生成器１０３３に対して超解像拡大処理結果である高解像度の推定画像を出力するための制御情報を供給する機能を有する。

【００６７】

ここで、更に高速な超解像拡大処理を行う必要がある場合には、例えば、特許第３８３７５７５号で開示されているような、超解像処理の高速化方法を、本発明の画像処理装置に適用するようにすると、更に良い構成を実現することができる。

【００６８】

次に、図４の（ａ）に示す超解像拡大部１０３の動作を、図５のフローチャートを参照しながら説明する。

【００６９】

まず、位置合わせ器１０３１は、超解像拡大処理を行う際の基準となる基準画像と、少なくとも１枚の観測画像とを取得する（Ｓ５００）。その後、所望の解像度よりも高い解像度によって、取得したそれぞれの画像の位置合わせを行う（Ｓ５１０）。その際、基準画像の各画素を対応する位置に配置した後、この基準画像との相関が最も高くなるように観測画像の各画素を配置することで、不等間隔にサンプリングされた不均一高解像度画像を生成する。

【００７０】

その後、補間器１０３２は、生成された不均一高解像度画像を取得し、所定の不均一補間処理を行って画素の補間を行う（Ｓ５２０）。これにより、所望の高解像度を持つ補間画像を生成する。

【００７１】

次に、推定画像生成器１０３３は、補間画像を取得し、所定の復元処理を行い、必要であれば所定のノイズ除去処理を行って、所望の解像度を持つ推定画像を生成する（Ｓ５３０）。また、推定画像に対してリサンプル処理を行って、不均一解像度画像の各画素に対応する、不均一推定画像を生成する。

【００７２】

次に、繰り返し判定器１０３４は、位置合わせ器１０３１から不均一解像度画像を取得するとともに、推定画像生成器１０３３から不均一推定画像を取得する。取得したそれぞれの画像を利用して、所定の判定方法に従って超解像拡大処理の繰り返しが必要か否かを判定する（Ｓ５４０）。

【００７３】

超解像拡大処理の繰り返しが必要であると判定された場合（Ｓ５４０　ＹＥＳ）は、補間器１０３２に対して処理を継続するための制御情報を供給する。また、超解像拡大処理

の繰り返しが必要でないと判定された場合（Ｓ５４０　ＮＯ）は、推定画像生成器１０３３に対して超解像拡大処理結果である高解像度の推定画像を出力するための制御情報を供給し、推定画像生成器１０３３は制御情報に応じて、生成した所望の解像度を持つ推定画像を、超解像拡大処理によって得られた高解像度画像として出力する（Ｓ５５０）。これにより、本実施の形態１の超解像拡大処理が完了する。

【００７４】

次に、第１解像度変換部１０４および第２解像度変換部１０６における所定の解像度変換処理の一例について説明する。

【００７５】

図６（ａ）は、第１解像度変換部１０４の構成例を示すブロック図である。

【００７６】

図６（ａ）において、第１解像度変換部１０４は、画素挿入器１０４１、フィルタリング処理器１０４２、画素間引き器１０４３を有する。なお、第２解像度変換部１０６や後述する他の実施の形態の第３解像度変換部１１０も同様に構成されている。

【００７７】

画素挿入器１０４１は、入力された画像の解像度を拡大し、扱うことができる空間周波数帯域を拡張するために、画素間に新たな画素を挿入することで入力画像のアップサンプル画像を生成し、フィルタリング処理器１０４２に供給する。

【００７８】

フィルタリング処理器１０４２は、画素挿入器１０４１からアップサンプル画像を取得し、所定のローパスフィルタを利用してフィルタリング処理を行うことにより帯域制限画像を生成し、画素間引き器１０４３に供給する。ここで、所定のローパスフィルタを利用したフィルタリング処理は、解像度変換部が最終的に出力する画像の空間解像度が表現できる空間周波数帯域の範囲内に、帯域制限および補間ができるローパスフィルタを用いて、アップサンプル画像に対するフィルタリング処理を行えばよく、利用するフィルタは、例えば、sinc関数やLanczos関数に基づいたフィルタ、周波数応答が全帯域にわたって平坦かつ急峻な遮断周波数特性を持つように設計されたFIRおよびIIRフィルタを用いると良い。また、Nearest-neighbor法、Bilinear法、Bicubic法、Spline法、などに基づいたフィルタを用いて処理を軽減させても構わない。

【００７９】

画素間引き器１０４３は、フィルタリング処理器１０４２から帯域制限画像を取得し、解像度変換部が最終的に出力する画像の解像度に合わせるために、所定の画素間引き処理を行い、出力画像を生成する。

【００８０】

図６（ｂ）は、第１解像度変換部１０４のような解像度変換部の解像度変換によって画像の拡大処理を行った後に、縮小処理を行った場合に、画像内の信号成分がどのように変化するかを示した概念図である。

【００８１】

図６（ｂ）（I）に示すように、入力画像に本来含まれる空間周波数成分はｆａまでであるとすると、解像度変換部における解像度変換処理では、仮に扱うことのできる空間周波数成分を拡大するために解像度を高めて画像の拡大処理を行ったとしても、画像の画素数は増大するものの、含まれる空間周波数成分自体を増やすことはできない。よって、図６（ｂ）（II）のような元のままの空間周波数成分のみを含む状態となり、その後、ローパスフィルタリング処理によってｆｍａｘまで帯域制限し、元の空間解像度をもつ画素数まで画素間引き処理をしても、元のままの空間周波数成分を含む画像が生成される。

【００８２】

これに対し、図４（ｃ）は、第１超解像拡大部１０３のような超解像拡大部の超解像拡大処理を行った後に、縮小処理を行った場合に、画像内の信号成分がどのように変化するかを示した概念図である。

【００８３】

図４（ｃ）（I）に示すように、入力画像に本来含まれる空間周波数成分はｆａまでであるとすると、超解像拡大部における超解像拡大処理では、図４（ｂ）のような処理に基づいて、含まれる空間周波数成分自体が増加する。仮にこのような処理によって図４（ｃ）（II）に示すように、含まれる空間周波数成分はｆｂまで拡張されたとすると、その後、ローパスフィルタリング処理によってｆｍａｘまで帯域制限を行うと、本来含まれていたｆａまでの空間周波数成分以上の成分を、空間周波数ｆｍａｘまで表現できる画像内に含めた画像が生成される。

【００８４】

従って、第１超解像拡大部１０３がこのような超解像拡大処理を行うことにより、同じ解像度の画像であっても、本来含まれるべき画像成分を補った画像を生成して利用できるという点が、第１解像度変換部１０４における解像度変換処理との大きな違いである。このことは、第２超解像拡大部１０５と第３解像度変換部１１０等との関係でも同様である。

【００８５】

ここで、所定の解像度変換処理を行う際の解像度変換率は、所定の解像度変換率情報として設定されるか、外部のユーザ等から設定される解像度変換率情報を取得する機能を有し、取得した解像度変換率情報に基づいて解像度変換率が特定されて所定の解像度変換処理を行うようにしても良い。

【００８６】

例えば、図６（ａ）に示すように第１解像度変換部１０４や第２解像度変換部１０６を構成すると、基準解像度よりも高い解像度となっている超解像拡大画像から、基準解像度の超解像拡大・変換画像となるように画像の縮小処理を行う場合には、画素挿入器１０４１における画素間に新たな画素を挿入する割合と、画素間引き器１０４３における画素間引きを行う割合を解像度変換率に応じて設定する。

【００８７】

ここで、解像度変換率は、解像度変換率＝画素挿入率／画素間引き率と表せ、画素挿入率は、画素挿入率＝入力画素／出力画素、画素間引き率は、画素間引き率＝入力画素／出力画素である。

【００８８】

例えば、解像度変換率２で基準解像度から超解像拡大画像が生成されている場合を考えると、基準解像度に戻すための解像度変換率は１／２であることから、画素挿入器１０４１では入力画素：出力画素＝１：１、つまり入力画像をそのままアップサンプル画像としてフィルタリング処理器１０４２に供給するように設定する。画素間引き器１０４３では入力画素：出力画素＝２：１、つまり２画素につき１画素の間引き処理を行って出力画像を生成する。

【００８９】

また、図６（ａ）に示す第１解像度変換部１０４の構成を利用して画像の拡大処理を行う場合には、例えば、解像度変換率２＝２／１で基準解像度の２倍の拡大画像を生成する場合を考えると、画素挿入器１０４１では入力画素：出力画素＝１：２、つまり１画素につき１画素の挿入を行ってアップサンプル画像を生成してフィルタリング処理器１０４２に供給するように設定する。画素間引き器１０４３では入力画素：出力画素＝１：１、つまり間引き処理を行わずにそのまま出力画像として出力するように設定する。

【００９０】

なお、図６（ａ）に示す第１解像度変換部１０４の構成は、あくまで一例であり、より自由な解像度への画像の拡大・縮小処理が必要な場合には、Spline法などを利用することで、実数の位置精度で自由な位置の画素を、入力画像から生成し、所望の解像度を持つ画像を生成することができるように構成することもできる。

【００９１】

従って、本実施の形態１の動画像符号化装置によれば、入力動画像がもつ空間解像度を基準解像度とし、入力動画像中に潜在的に含まれるが基準解像度では十分表現できていな

かった空間方向および時間方向の周波数成分情報を、第１超解像拡大部１０３による所定の超解像処理に基づいて復元した上で基準解像度よりも高い解像度で表現し、入力動画像が持つ周波数成分情報の情報量を拡張した超解像拡大画像を生成した上で動画像符号化処理を行って、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行えるという効果を生じる。

【００９２】

また、本実施の形態１の動画像符号化装置では、第１超解像拡大部１０３にて生成した超解像拡大画像に対して、第１解像度変換部１０４にて所定の解像度変換処理を行い、基準解像度で表現された超解像拡大・変換画像を生成するようにしているので、入力動画像中に潜在的に含まれるが基準解像度では十分表現できていなかった空間方向および時間方向の周波数成分情報を生成し、本来含まれていなかった周波数成分情報を、基準解像度で表現できる周波数成分情報の範囲内に制限した上で超解像画像に含ませることにより、入力動画像では表現できていなかった周波数成分情報を超解像画像に反映し、この超解像画像に基づいて動画像符号化処理を行って、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行えるという効果を生じる。

【００９３】

更に、本実施の形態１の動画像符号化装置では、第１の符号化部１０２にて符号化および復号されて生成された基準解像度の復号画像に対し、第２超解像拡大部１０５および第２解像度変換部１０６にて所定の超解像処理および解像度変換処理を行って、超解像拡大復号画像および基準解像度の復号画像の超解像拡大・変換復号信号を生成し、第２符号化部１０７は、入力画像を第１超解像拡大部１０３および第１解像度変換部１０４にて第１の超解像拡大および解像度変換した入力画像の超解像拡大・変換信号を符号化対象ピクチャとし、入力画像を第１符号化部１０２にてそのまま符号化および復号した復号画像を第１参照ピクチャとし、その復号画像を第２超解像拡大部１０５および第２解像度変換部１０６にて第２超解像拡大および解像度変換した復号画像の超解像拡大・変換復号信号を第２参照ピクチャとして、所定の第２の予測処理を行って符号化するようにしたので、従来の動画像符号化で得られる予測ピクチャもしくは予測ブロックの画像品質よりも良い画像品質の予測ピクチャもしくは予測ブロックを得ることができ、結果として符号化効率を向上させる効果を生じる。

【００９４】

実施の形態２．

上記実施の形態１では、図１に示すように第２符号化部１０７に２つの参照ピクチャ、すなわち入力画像を第１符号化部１０２にてそのまま符号化および復号した復号画像である第１参照ピクチャと、その復号画像を第２超解像拡大部１０５および第２解像度変換部１０６にて第２超解像拡大および解像度変換した復号画像の超解像拡大・変換復号信号である第２参照ピクチャとを入力して、予測効率の高い参照ピクチャを利用するように説明したが、例えば、図７に示すように、第２符号化部１０７に入力画像を第１符号化部１０２にてそのまま符号化および復号した復号画像である第１参照ピクチャのみ入力させるか、あるいは図８に示すように、第２符号化部１０７に第１符号化部１０２からの復号画像を第２超解像拡大部１０５および第２解像度変換部１０６にて第２超解像拡大および解像度変換した復号画像の超解像拡大・変換復号信号である第２参照ピクチャのみ入力させて、第２符号化部１０７は、第１または第２参照ピクチャのみを利用して、第１の超解像拡大および解像度変換した入力画像の超解像拡大・変換信号を符号化対象ピクチャとして予測符号化するようにしても勿論よい。

【００９５】

また、さらに、図９に示すように、第２符号化部１０７に２つの参照ピクチャ、すなわち入力画像を第１符号化部１０２にてそのまま符号化および復号した復号画像である第１参照ピクチャと、その復号画像を第２超解像拡大部１０５および第２解像度変換部１０６にて第２超解像拡大および解像度変換した復号画像の超解像拡大・変換復号信号である第２参照ピクチャとのいずれも入力させず、第２符号化部１０７は、第１の超解像拡大およ

び解像度変換した入力画像の超解像拡大・変換信号を符号化対象ピクチャとして予測符号化するようにしても勿論よい。

【００９６】

実施の形態３．

次に、本発明の実施の形態３の動画像符号化装置について説明する。

【００９７】

図１０は、実施の形態３の動画像符号化装置の構成例を示すブロック図である。

【００９８】

図１０に示す実施の形態３の動画像符号化装置は、図１に示す実施の形態１の動画像符号化装置の構成を更に詳細にし、さらに、蓄積制御部４１２、第２蓄積バッファ４１６、第２参照ピクチャバッファ４１８、符号量制御部４２３を新たに追加したものである。

【００９９】

また、図１０において、第１符号化部１０２は、第１予測器４０２、第１符号化器４０３、第１復号器４０４、イントラ予測器４０５、第１予測ピクチャバッファ４０６、第１参照ピクチャバッファ４０７、動き推定器４０８、動き補償器４０９、加算器４１０、デブロック器４１１を有している。これにより、一般的な動画像符号化であるISO/IEC SC29 WG11において規格標準化されているMPEG-4 AVCと同等の機能を実現できる。ただし、ここでの第１符号化部１０２の詳細構成は一例であり、第１符号化部１０２の機能を実現できる、別の異なる構成であっても勿論よい。例えば、ディジタル放送などで利用されているMPEG-2であっても構わないし、MPEG-4 AVCのスケーラブル拡張であるMPEG-4 SVCであっても構わない。また、JPEG2000に代表される、ウェーヴレット変換に基づく超解像前符号化器を採用しても構わない。

【０１００】

また、図１０において、第２符号化部１０７は、第３蓄積バッファ４１５、第２予測器４２０、第２符号化器４２１を有している。

【０１０１】

次に、図１０に示す実施の形態３の動画像符号化装置について、図１に示す実施の形態１の構成要素とは、異なる機能や新たな機能を有する構成要素について説明する。

【０１０２】

第１予測器４０２は、第１蓄積バッファ１０１から、所定の符号化処理に必要な、基準解像度をもつ画像を取得するとともに、第１予測ピクチャバッファ４０６から格納された予測ピクチャもしくは予測ブロックを取得して、第１予測器４０２は、取得した画像および予測ピクチャに対して所定の予測処理を行って残差情報を生成し、第１符号化器４０３に供給する機能を有する。ここで、第１予測器４０２における予測処理は、取得した基準解像度をもつ画像の各画像を符号化対象ピクチャとし、取得した予測ピクチャもしくは予測ブロックを対象ピクチャから減算することで、残差情報を生成し、第１符号化器４０３に供給するような処理であると良い。

【０１０３】

第１符号化器４０３は、第１予測器４０２から予測処理後の残差情報を取得し、所定の符号化処理によって前記基準解像度の第１符号化ビット列を生成し、第１復号器４０４および多重化部１０９に供給する機能を有する。ここで、第１符号化器４０３は、図１１（ａ）に示すように第１復号器４０４に対して第１符号化ビット列を供給するようにしても良いし、図１１（ｂ）に示すように所定の符号化処理の過程で量子化後情報を生成し、第１復号器４０４に供給するようにしても良い。また、第１符号化器４０３は、符号量制御部４２３からの制御情報に基づいて、符号化処理によって生成される第１符号化ビット列の符号量を変動させる機能を有する。

【０１０４】

第１復号器４０４は、図１１（ａ），（ｂ）に示す第１符号化器４０３の出力に応じて、図１２（ａ）に示すように第１符号化器４０３から第１符号化ビット列を取得するか、あるいは図１２（ｂ）に示すように第１符号化器４０３から量子化後情報を取得して、第

１符号化ビット列もしくは量子化後情報に対して所定の復号処理を行って復号残差情報を生成し、加算器４１０に供給する機能を有する。

【０１０５】

イントラ予測器４０５は、所定のイントラ予測処理を行う際に必要となる、復号済みの画像情報を取得し、所定のイントラ予測処理を行ってイントラ予測情報を生成し、第１予測ピクチャバッファ４０６に供給する機能を有する。ここで、イントラ予測器４０５が生成するイントラ予測情報は、予測対象となっているブロックの周囲のブロックで、かつ復号済みのブロックから所定のイントラ予測処理に基づいて生成したイントラ予測ブロックであることが望ましい。

【０１０６】

第１予測ピクチャバッファ４０６は、イントラ予測器４０５からイントラ予測情報、動き補償器４０９から動き補償予測情報を取得し、予測ピクチャもしくは予測ブロックとして蓄積し、第１予測器４０２および加算器４１０に予測ピクチャもしくは予測ブロックを供給する機能を有する。ここで、第１予測ピクチャバッファ４０６は、蓄積制御部４１２から蓄積制御情報を取得し、この蓄積制御情報に基づいて予測ピクチャもしくは予測ブロックの取得、蓄積、供給を制御しても良い。

【０１０７】

第１参照ピクチャバッファ４０７は、デブロック器４１１からデブロック処理後の復号ピクチャもしくは復号ブロック、加算器４１０から復号ピクチャもしくは復号ブロックを取得し、参照ピクチャもしくは参照ブロックとして蓄積し、蓄積した参照ピクチャもしくは参照ブロックを、要求に応じて少なくともイントラ予測器４０５、動き推定器４０８、動き補償器４０９、第２蓄積バッファ４１６に供給する機能を有する。ここで、第１参照ピクチャバッファ４０７は、蓄積制御部４１２から蓄積制御情報を取得し、この蓄積制御情報に基づいて参照ピクチャもしくは参照ブロックの取得、蓄積、供給を制御しても良い。

【０１０８】

動き推定器４０８は、第１蓄積バッファ１０１から符号化対象ピクチャと、第１参照ピクチャバッファ４０７から参照ピクチャを取得し、所定の動き推定を行って動きベクトル情報を生成する機能を有する。動き推定器４０８は、生成した動きベクトル情報を少なくとも動き補償器４０９に供給する機能を有する。ここで、動き推定器４０８によって生成された動きベクトル情報は、図示されていないエントロピー符号化器によって所定のエントロピー符号化処理が行われ、多重化部１０９に供給されるように構成すると更に良い構成となる。

【０１０９】

動き補償器４０９は、第１参照ピクチャバッファ４０７から参照ピクチャを取得するとともに、動き推定器４０８から動きベクトル情報を取得して、動き補償器４０９は、取得した参照ピクチャと動きベクトル情報に基づいて所定の動き補償を行って予測ピクチャを生成し、第１予測ピクチャバッファ４０６に供給する機能を有する。

【０１１０】

加算器４１０は、第１復号器４０４から復号残差情報、第１予測ピクチャバッファ４０６から予測ピクチャまたは予測ブロックを取得して加算することで復号画像を生成し、第１参照ピクチャバッファ４０７およびデブロック器４１１に供給する機能を有する。

【０１１１】

デブロック器４１１は、加算器４１０から復号画像を取得し、所定のデブロック処理を行ってデブロック後の復号画像を生成し、第１参照ピクチャバッファ４０７に供給する機能を有する。

【０１１２】

図１１（ａ），（ｂ）は、実施の形態３の第１符号化器４０３の構成例を示している。

【０１１３】

第１符号化器４０３は、例えば、直交変換器４０３１、量子化器４０３２、エントロピ

ー符号化器４０３３を有している。

【０１１４】

直交変換器４０３１は、残差情報を取得し、所定の直交変換処理を行って直交変換係数情報を生成して量子化器に供給する機能を有する。

【０１１５】

量子化器４０３２は、直交変換器４０３１から直交変換係数情報を取得し、所定の量子化処理を行って量子化後情報を生成し、エントロピー符号化器４０３３に供給する機能を有する。ここで、第１復号器４０４において、符号化ビット列に対してエントロピー復号をせずに局部復号結果である量子化後情報を取得して所定の復号処理を行う構成の場合には、図１１（ｂ）に示すように、量子化器４０３２は、量子化後情報を第１復号器４０４に供給するように構成しても良い。

【０１１６】

エントロピー符号化器４０３３は、量子化器４０３２から量子化後情報を取得し、所定のエントロピー符号化処理を行って第１符号化ビット列を生成し、多重化部１０９に供給する機能を有する。また、第１復号器４０４において、第１符号化ビット列に対してエントロピー復号を行って量子化後情報を取得して所定の復号処理を行う構成の場合には、図１１（ａ）に示すように、エントロピー符号化器４０３３は、第１符号化ビット列を生成し、第１復号器４０４に供給するように構成しても良い。

【０１１７】

図１２（ａ），（ｂ）は、実施の形態３の第１復号器４０４の構成例を示している。

【０１１８】

第１復号器４０４は、局部復号処理を行うために、少なくとも図１２（ａ），（ｂ）に示すように逆量子化器４０４２、逆直交変換器４０４３を有している。また、第１符号化ビット列を取得して完全な復号処理を行うような構成であれば、図１２（ａ）に示すように更にエントロピー復号器４０４１を備えるようにしても良い。

【０１１９】

エントロピー復号器４０４１は、第１符号化器４０３から第１符号化ビット列を取得し、所定のエントロピー復号処理を行って量子化後情報を生成し、逆量子化器４０４２に供給する機能を有する。

【０１２０】

逆量子化器４０４２は、エントロピー復号器４０４１もしくは量子化器４０３２から量子化後情報を取得し、所定の逆量子化処理を行って、逆量子化後の直交変換係数情報を生成し、逆直交変換器４０４３に供給する機能を有する。

【０１２１】

逆直交変換器４０４３は、逆量子化器４０４２から逆量子化後の直交変換係数情報を取得し、所定の直交変換処理を行って復号残差情報を生成し、加算器４１０に供給する機能を有する。

【０１２２】

図１０に戻り、実施の形態３の第２符号化部１０７は、第３蓄積バッファ４１５、第２予測器４２０、第２符号化器４２１を有している。

【０１２３】

第３蓄積バッファ４１５は、第１解像度変換部１０４から基準解像度の入力画像の超解像拡大・変換信号を取得して蓄積するとともに、第２予測器４２０に供給する機能を有する。また、第３蓄積バッファ４１５は、蓄積制御部４１２から蓄積制御情報を取得し、この蓄積制御情報に基づいて前記基準解像度の入力画像の超解像拡大・変換信号の取得、蓄積、供給を制御する機能を有する。

【０１２４】

第２予測器４２０は、第３蓄積バッファ４１５から基準解像度の入力画像の超解像拡大・変換信号と、第２蓄積バッファ４１６から基準解像度の復号画像、第２解像度変換部１０６から基準解像度の復号画像の超解像拡大・変換復号信号を取得して、入力画像の超解

像拡大・変換信号を符号化対象ピクチャとし、第１符号化部１０２からの復号画像を第１参照ピクチャとし、基準解像度の復号画像の超解像拡大・変換復号信号の各超解像拡大・変換復号画像を第２参照ピクチャとした上で、所定の予測処理を行って予測ピクチャを生成し、対象ピクチャから予測ピクチャを減算することで残差情報を生成して第２符号化器４２１に供給する機能を有する。

【０１２５】

第２符号化器４２１は、第２予測器４２０から残差情報を取得し、所定の符号化処理を行って前記第２符号化ビット列を生成し、多重化部１０９に供給すると共に、符号量制御部４２３からの制御情報に基づいて、符号化処理によって生成される第２符号化ビット列の符号量を変動させる機能を有する。

【０１２６】

蓄積制御部４１２は、各蓄積バッファに対して蓄積制御情報を供給することで、各蓄積バッファの蓄積状態やピクチャの取得や供給のタイミングを制御する機能を有する。

【０１２７】

第２蓄積バッファ４１６は、第１参照ピクチャバッファ４０７から前記復号画像を取得して、取得した基準解像度の復号画像を第２超解像拡大部１０５および第２予測器４２０に供給する機能を有する。

【０１２８】

また、第２蓄積バッファ４１６は、蓄積制御部４１２から蓄積制御情報を取得し、この蓄積制御情報に基づいて前記復号画像の取得、蓄積、供給を制御する機能を有する。

【０１２９】

第２参照ピクチャバッファ４１８は、第２超解像拡大部１０５から超解像拡大復号画像を取得して蓄積し、取得した超解像拡大復号画像を第２解像度変換部１０６に供給する機能を有する。その際、第２参照ピクチャバッファ４１８は、蓄積制御部４１２から蓄積制御情報を取得し、この蓄積制御情報に基づいて前記基準解像度の入力画像の超解像拡大・変換信号の取得、蓄積、供給を制御する。

【０１３０】

符号量制御部４２３は、各符号化器が生成する符号化ビット列の符号量を監視し、所定の範囲の符号量に収まるように、各符号化器の動作を制御すると共に、符号量の状態や、蓄積制御部４１２から得られる各蓄積バッファの状態に応じて、各蓄積バッファの動作を変更するように蓄積制御部４１２を制御する機能を有する。ここで、符号量制御部４２３は、各符号化器の動作を制御して符号量の制御を行う際に、各符号化器の量子化パラメータ情報を変更することで、符号量の制御を行う。また、必要に応じて、各符号化器の残差情報の信号振幅の状態や、各予測器でどちらの参照ピクチャが利用されたかを特定することができる参照ピクチャ選択情報に基づいて、復号画像に対する超解像拡大処理が有効であったか、有効でなかったかを判定し、有効でなかった場合には、蓄積制御部４１２に第２蓄積バッファ４１６に対して、第２超解像拡大部１０５に対する復号画像の供給を停止するように指示するとともに、超解像拡大処理が有効であった場合に利用していた量子化パラメータ情報とは異なる、第１参照ピクチャに基づいて生成された予測残差情報用の量子化パラメータ情報を利用するように切り替えることで、符号量を制御できるようにすると良い構成となる。

【０１３１】

従って、本実施の形態３の動画像符号化装置によれば、図１に示す実施の形態１の動画像符号化装置と同様の効果が得られると共に、蓄積制御部４１２と、符号量制御部４２３等とを有し、各バッファにおける蓄積制御や、第１符号化部１０２と第２符号化部１０７とにおける符号量制御を行うようにしたので、第１符号化部１０２と第２符号化部１０７とにおける符号量や、各バッファにおける蓄積量を考慮した符号化を実行することができる。

【０１３２】

なお、本実施の形態３では、図１に示す実施の形態１の動画像符号化装置に対し、蓄積

量制御部４１２と符号量制御部４２３等を設け、各バッファにおける蓄積量制御や第１符号化部１０２と第２符号化部１０７とにおける符号量制御を行うように説明したが、図７や、図８、図９に示す実施の形態２の動画像符号化装置に対し、蓄積量制御部４１２と符号量制御部４２３等を設けて同様に蓄積量制御や符号量制御を行うようにしても勿論よい。

【０１３３】

実施の形態４．

次に、本発明の実施の形態４の動画像符号化装置について説明する。

【０１３４】

図１３は、実施の形態４の動画像符号化装置の構成例を示すブロック図である。

【０１３５】

図１３において、実施の形態４の動画像符号化装置は、第１蓄積バッファ１０１、第１符号化部１０２、第１超解像拡大部１０３、第２超解像拡大部１０５、第３解像度変換部１１０、第３符号化部１０８、多重化部１０９を有している。

【０１３６】

第１蓄積バッファ１０１は、図１における実施の形態と同等の機能を有するため、ここでは説明を省略する。

【０１３７】

第１符号化部１０２は、図１における実施の形態と同等の機能を有する。ここで、実施の形態４では、生成された復号画像は、第２超解像拡大部１０５および第３解像度変換部１１０に供給するように構成する。

【０１３８】

第１超解像拡大部１０３は、図１における実施の形態と同等の機能を有する。ここで、実施の形態４の第１超解像拡大部１０３は、生成した基準解像度よりも高い解像度をもつ超解像拡大画像を第３符号化部１０８に供給する機能を有する。

【０１３９】

第２超解像拡大部１０５は、図１における実施の形態と同等の機能を有する。ここで、実施の形態４の第２超解像拡大部１０５は、生成した基準解像度よりも高い解像度をもつ超解像拡大復号画像を、第３符号化部１０８に供給する機能を有する。

【０１４０】

第３解像度変換部１１０は、第１符号化部１０２から基準解像度の復号画像を取得し、取得した基準解像度の復号画像に対して所定の解像度変換処理を行って、第１超解像拡大部１０３が生成する超解像拡大画像、および第２超解像拡大部１０５が生成する超解像拡大復号画像の空間解像度と同じ解像度をもつ、高解像度の拡大復号画像である解像度変換拡大復号画像を生成し、第３符号化部１０８に供給する機能を有する。ここで、所定の解像度変換処理を行う際の解像度変換率は、所定の解像度変換率情報として設定されるか、外部のユーザ等から設定される解像度変換率情報を取得する機能を有し、取得した解像度変換率情報に基づいて解像度変換率が特定されて所定の解像度変換処理を行うように構成しても良い。

【０１４１】

第３符号化部１０８は、第１超解像拡大部１０３から超解像拡大画像を取得すると共に、第３解像度変換部１１０からは高解像度の解像度変換拡大復号画像を、第２超解像拡大部１０５からは高解像度の超解像拡大復号画像を取得して、取得した超解像拡大画像を符号化対象ピクチャとし、第３解像度変換部１１０からの解像度変換拡大復号画像を第１参照ピクチャ、第２超解像拡大部１０５からの超解像拡大復号画像を第２参照ピクチャとして、所定の予測処理および符号化処理を行い、第３符号化ビット列を生成し、生成した第３符号化ビット列を多重化部１０９に供給する機能を有する。

【０１４２】

ここで、第３符号化部１０８における所定の予測処理を行う際に利用する参照ピクチャは、解像度変換拡大復号画像から得られる第１参照ピクチャと、超解像拡大復号画像から

得られる第２参照ピクチャとのどちらか一方を利用して予測ピクチャを生成し、対象ピクチャから予測ピクチャを減算することで残差情報を生成する。

【０１４３】

また、第１参照ピクチャ、および第２参照ピクチャのどちらも利用せず、対象ピクチャを残差情報として生成するような構成を含めても良い。

【０１４４】

更に、第３符号化部１０８は、各ピクチャ、もしくは所定のピクチャ数ごとに参照ピクチャの選択を制御するために、第１参照ピクチャと第２参照ピクチャのどちらを利用したかを特定するための参照ピクチャ選択情報を生成し、図示しない所定のエントロピー符号化部によってエントロピー符号化処理を行って参照ピクチャ選択情報の符号化ビット列を生成し、多重化部１０９に供給するようにしても良い。

【０１４５】

また、対象ピクチャをそれぞれ所定の大きさをもつ領域ごとに隙間なく分割し、第１参照ピクチャと第２参照ピクチャも同様に所定の大きさをもつ領域ごとに隙間なく分割し、対応する領域ごとに第１参照ピクチャと第２参照ピクチャのどちらを利用するかを特定しながら予測ピクチャを生成し、対象ピクチャから予測ピクチャを減算することで残差情報を生成するようにしても良い。ここで、所定の大きさをもつ領域ごとに、どの参照ピクチャを利用したかを特定するための情報を参照ピクチャ選択情報とし、図示しない所定のエントロピー符号化部によってエントロピー符号化処理を行い、生成された参照ピクチャ選択情報の符号化ビット列を多重化部１０９に供給するようにしても良い。ここで、所定の大きさをもつ領域の形状は、所定の矩形領域、または所定の領域分割によって得られる任意形状領域であることが望ましい。

【０１４６】

また、第３符号化部１０８は、符号化対象ピクチャから第１参照ピクチャを減算して得られる残差情報を、第１の残差情報として所定の第３符号化処理を行って第１の第３符号化ビット列を生成するとともに、対象ピクチャから第２参照ピクチャを減算して得られる残差情報を第２の残差情報として所定の第３符号化処理を行って第２の第３符号化ビット列を生成し、更に、第１参照ピクチャ、および第２参照ピクチャのどちらも利用せず、対象ピクチャのみから残差情報を生成し、第３の残差情報として所定の第３の符号化処理を行って第３の第３符号化ビット列を生成し、生成した第１から第３の第３符号化ビット列を多重化部１０９に供給する機能を有するようにしても良い。

【０１４７】

多重化部１０９は、第１符号化部１０２から第１符号化ビット列を取得すると共に、第３符号化部１０８から第３符号化ビット列を取得して、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化パラメータ情報を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、第１符号化ビット列、第３符号化ビット列の多重化処理を行い、出力である多重化ビット列を生成する機能を有する。

【０１４８】

また、多重化部１０９は、第１符号化部１０２からの第１符号化ビット列、第３符号化部１０８から第１および第２の第３符号化ビット列を取得するようにしても良い。ここで、多重化部１０９は、取得した基準解像度の第１符号化ビット列を複製し、基準解像度の第１から第３の第１符号化ビット列を生成しても良い。多重化部１０９は、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化パラメータ情報を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、基準解像度の第１の第１符号化ビット列と第１の第３符号化ビット列、基準解像度の第２の第１符号化ビット列と第２の第３符号化ビット列、基準解像度の第３の第１符号化ビット列と第３の第３符号化ビット列に対して多重化処理を行い、出力である多重化後の第１から第３の符号化ビット列を生成しても良い。ここで、多重化部１０９は、符号化モード情報などからの要求に応じて選択的に多重化後の第１から

第３の符号化ビット列を生成するようにしても構わない。また、ここで利用する符号化モード情報には、少なくとも多重化を制御するための情報が含まれているように構成しても良い。

【０１４９】

本実施の形態４の動画像符号化装置は、以上のような機能を有し、入力される動画像に対して所定の超解像拡大処理および所定の解像度変換処理で生成される超解像拡大画像や超解像拡大・変換画像を利用することで、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行うことができる。なお、図１３の構成において、第１超解像拡大部１０３、第２超解像拡大部１０５が利用する拡大率は、同一の拡大率であることが望ましいが、同一の拡大率でなくても良い。また、第３解像度変換部１１０で利用する解像度変換率は、第１超解像拡大部１０３が生成する超解像拡大画像、および第２超解像拡大部１０５が生成する超解像拡大復号画像がもつ空間解像度と同じ解像度となるような解像度変換率であることが望ましいが、同一の拡大率でなくても良い。

【０１５０】

次に、図１３に示す実施の形態４の動画像符号化装置の動作を、図１４のフローチャートを参照しながら説明する。

【０１５１】

図１４は、実施の形態４の動画像符号化装置の動作を示すフローチャートである。

【０１５２】

まず、図１３に示す実施の形態４の動画像符号化装置では、入力される動画像から第１超解像拡大部１０３における第１超解像拡大処理で必要とされるピクチャ数の画像を、第１蓄積バッファ１０１に格納する（Ｓ１４０１）。

【０１５３】

第１超解像拡大部１０３は、所定の超解像拡大処理を行う際に必要となる少なくとも２枚の画像を、第１蓄積バッファ１０１から取得し、所定の第１超解像拡大処理を行う（Ｓ１４０２）。これにより、入力される動画像がもつ空間解像度である基準解像度よりも高い解像度をもつ、超解像拡大画像を生成し、第３符号化部１０８に供給する。

【０１５４】

第３符号化部１０８は、第１超解像拡大部１０３から超解像拡大画像を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１４０３）。

【０１５５】

その一方、第１符号化部１０２は、第１蓄積バッファ１０１から所定の超解像前符号化処理を行う際に必要となる基準解像度の動画像列を取得し、基準解像度の符号化、復号処理を行う（Ｓ１４０４）。これにより、符号化処理結果である基準解像度の第１符号化ビット列と、復号結果である基準解像度の復号画像を生成する。

【０１５６】

その後、第１符号化部１０２は、生成した第１符号化ビット列を多重化部１０９に供給し、生成した基準解像度の復号画像を、一時的に蓄積するための所定のバッファに格納する（Ｓ１４０５）。

【０１５７】

第２超解像拡大部１０５は、第１符号化部１０２から前記復号画像を取得し、所定の超解像拡大処理を行う（Ｓ１４０６）。これにより、基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成し、第３符号化部１０８に供給する。

【０１５８】

その後、第３符号化部１０８は、第２超解像拡大部１０５から超解像拡大復号画像を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１４０７）。

【０１５９】

また、第３解像度変換部１１０は、第１符号化部１０２から前記復号画像を取得し、所定の解像度変換処理を行う（Ｓ１４０８）。これにより、基準解像度よりも高い解像度をもつ高解像度の拡大復号画像である解像度変換拡大復号画像を生成し、第３符号化部１０

８に供給する。

【０１６０】

その後、第３符号化部１０８は、第３解像度変換部１１０から高解像度の解像度変換拡大復号画像を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１４０９）。

【０１６１】

なお、Ｓ１４０２～Ｓ１４０２の処理と、Ｓ１４０４～Ｓ１４０７の処理と、Ｓ１４０２～Ｓ１４０２の処理は、並列処理でも、順番に処理しても良い。

【０１６２】

以上の処理が完了すると、第３符号化部１０８は、第１超解像拡大部１０３から取得した超解像拡大画像を符号化対象ピクチャとし、第３解像度変換部１１０から取得した解像度変換拡大復号画像を第１参照ピクチャとし、第２超解像拡大部１０５から取得した超解像拡大復号画像を第２参照ピクチャとして、所定の第３の予測処理を行う（Ｓ１４１０）。これにより、高解像度の残差情報を生成する。その後、生成した残差情報に対して所定の第３の符号化である第３符号化処理を行う（Ｓ１４１１）。これにより、第３符号化ビット列を生成し、多重化部１０９に供給する。

【０１６３】

その後、多重化部１０９は、第１符号化部１０２から第１符号化ビット列、第３符号化部１０８から第３符号化ビット列を取得し、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化パラメータ情報を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら多重化処理を行い（Ｓ１４１２）、図１５に示すような多重化ビット列を生成する。以上のようなステップを経ることで、本実施の形態の一連の動作が完了する。

【０１６４】

図１５は、実施の形態４の多重化部１０９が生成する多重化ビット列３００の構造の一例を示すデータ構造図である。

【０１６５】

多重化ビット列３００に、符号化パラメータ情報ビット列３１０と、第１符号化部１０２からの第１符号化ビット列３２０と、第３符号化部１０８からの第３符号化ビット列３４０とが多重化される。

【０１６６】

なお、本実施の形態４の動作を複数の並列処理によって説明したが、この並列処理部分を連続的に処理するように、本実施の形態の構成を動作させても勿論よい。

【０１６７】

従って、本実施の形態４の動画像符号化装置によれば、上記実施の形態１等と同様に、第１超解像拡大部１０３および第２超解像拡大部１０５により、第１および第２超解像拡大処理を行うような構成とすることで、入力動画像がもつ空間解像度を基準解像度とし、第１超解像拡大処理により、基準解像度よりも高い解像度をもつ超解像拡大画像を生成することができる。

【０１６８】

その結果、この第１超解像拡大処理により、入力動画像から、入力動画像中に潜在的に含まれるが基準解像度では十分表現できていなかった空間方向および時間方向の周波数成分情報を、所定の超解像処理に基づいて復元した上で基準解像度よりも高い解像度で表現することができる。このように入力動画像が持つ周波数成分情報の情報量を拡張した上で動画像符号化処理を行って、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行うことができる。

【０１６９】

また、入力された基準解像度の動画像に対して、所定の符号化および復号処理を行って基準解像度の復号画像を生成し、この復号画像に対して所定の第２超解像拡大処理によって空間方向および時間方向の周波数成分情報が拡大された、基準解像度よりも高い解像度

をもつ超解像拡大復号画像を生成し、この生成された超解像拡大復号画像を、高解像度の参照ピクチャとし、超解像拡大画像との間で所定の予測処理を行った後に、所定の第３符号化処理を行って、第３符号化ビット列を生成することができる。このように、超解像拡大復号画像を参照ピクチャとして利用し、超解像拡大画像との間で、空間解像度の相関性を利用した階層符号化を行って、入力された動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行うことができる。

【０１７０】

つまり、本実施の形態４では、上記実施の形態１等と同様に、入力された本来の基準解像度の空間解像度で表現できる範囲内でしか表現できなかった画像の周波数成分情報を、画像自体に潜在的に含まれる相関性を利用して復元するために、所定の超解像拡大処理を行い、新たに生み出された、基準解像度よりも高い空間解像度でしか表現できない周波数成分情報を、超解像拡大画像として反映させ、このようにして生成された、新たな最終的な符号化対象である、超解像拡大画像と、本来の基準解像度の動画像列のそれぞれに含まれる空間解像度の周波数成分情報の違いを、本発明により符号化および伝送することが可能となる点が重要である。仮に、第２超解像拡大処理のみを行い、超解像拡大復号画像を生成して外部の表示装置に出力するような動画像復号装置があったとしても、復号対象となる基準解像度の第１符号化ビット列に対して所定の復号処理を行って生成された基準解像度の復号画像には、少なからず符号化時の劣化が含まれており、この復号画像に対して所定の第２超解像拡大処理を行ったとしても、符号化劣化を含んだ状態の基準解像度の復号画像に対して超解像拡大処理を行うため、一定の効果を得られるものの、必ずしも正しい超解像拡大処理を行うことができるとは限らない。このように必ずしも十分ではない超解像拡大復号画像に対して、本来あるべき超解像拡大画像に含まれる周波数成分情報との違いを、所定の拡張符号化処理によって符号化、および伝送することで、本発明では、超解像拡大画像に含まれる周波数成分情報を、より多く正確に、復号側に供給できるような構成となっている。

【０１７１】

また、本実施の形態４では、予測ピクチャを生成する際に、第３解像度変換部１１０からの第１参照ピクチャと、第２超解像拡大部１０５からの第２参照ピクチャとのどちらか一方を利用して第３の符号化である第３符号化処理を行って、要求に応じて、超解像拡大画像と第１参照ピクチャである解像度変換拡大復号画像との間における空間解像度の相関性を利用した場合と、超解像拡大画像と第２参照ピクチャである超解像拡大復号画像との間における空間解像度の相関性を利用した場合の階層符号化を行うことができ、異なる多重化ビット列を生成し、復号側へ供給、蓄積、または伝送することができる。

【０１７２】

また、本実施の形態４では、予測ピクチャを生成する際に、各ピクチャ、もしくは所定のピクチャ数ごとに参照ピクチャの選択を制御することで、復号画像の画像品質に応じて適応的に予測ピクチャを生成することが可能となり、結果として符号化効率を向上させることが可能となる。

【０１７３】

更に、本実施の形態４では、第１および第２参照ピクチャのどちらを利用したかを特定するための参照ピクチャ選択情報を生成し、多重化部１０９に供給するように構成することで、本発明の符号化時に利用した参照ピクチャを容易に特定することができるようになる。

【０１７４】

また、本実施の形態４では、符号化対象ピクチャをそれぞれ所定の大きさをもつ領域ごとに隙間なく分割し、第１参照ピクチャと第２参照ピクチャも同様に所定の大きさをもつ領域ごとに隙間なく分割し、対応する領域ごとに第１参照ピクチャと第２参照ピクチャのどちらを利用するかを特定しながら予測ピクチャを生成することで、復号画像の画像品質に応じてより適応的に予測ピクチャを生成することが可能となり、結果として符号化効率を向上させることが可能となる。

【０１７５】
また、入力された基準解像度の動画像に対して、所定の符号化および復号処理を行って基準解像度の第１符号化ビット列を生成するとともに、第３符号化処理を行って高解像度の第３符号化ビット列を生成し、これらの符号化ビット列を所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化パラメータ情報を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、所定の多重化処理を行うことにより多重化ビット列を生成することができる。このような多重化ビット列を生成することにより、本来入力動画像に対する符号化結果と、超解像拡大処理によって得られた超解像拡大画像によって拡大された周波数成分情報との予測誤差に対する符号化結果とを単一の符号化ビット列とし、図示されない外部の蓄積装置に伝送した後に所定の記録媒体に記録したり、図示されない外部の通信装置によってネットワーク配信したりすることにより、本実施の形態の動画像符号化装置によって大量の情報量をもつ動画像を効率よく符号化し、蓄積、および伝送することを可能にする。

【０１７６】
また、第１、第２の第３符号化ビット列を取得し、符号化モード情報に応じて多重化する符号化ビット列の組み合わせを特定し、特定された複数の符号化ビット列に対して所定の多重化処理を行って多重化ビット列を生成することで、多様な符号化ビット列を生成できるとともに、復号側で選択的な復号を可能にする。

【０１７７】
実施の形態５．
上記実施の形態４では、図１３に示すように第３符号化部１０８では、２つの参照ピクチャ、すなわち第１符号化部１０２からの復号画像を第３解像度変換部１１０にて第３解像度変換処理をした解像度変換拡大復号画像を第１参照ピクチャ、第１符号化部１０２からの復号画像を第２超解像拡大部１０５にて第２超解像拡大処理をした超解像拡大復号画像を第２参照ピクチャとして入力し、予測効率の高い参照ピクチャを予測ピクチャとして利用するように説明したが、例えば、図１６に示すように、第３解像度変換部１１０からの解像度変換拡大復号画像のみが参照ピクチャとして入力するか、あるいは、例えば、図１７に示すように、第２超解像拡大部１０５からの超解像拡大復号画像のみが参照ピクチャとして入力し、第１超解像拡大部１０３からの超解像拡大画像を符号化対象ピクチャとして予測符号化するようにしても勿論よい。

【０１７８】
実施の形態６．
次に、本発明の実施の形態６の動画像符号化装置について説明する。

【０１７９】
図１８は、実施の形態６の動画像符号化装置の構成例を示すブロック図である。

【０１８０】
図１８に示す実施の形態６の動画像符号化装置は、図１３に示す実施の形態４の動画像符号化装置の構成を更に詳細にし、さらに、蓄積制御部４１２、第２蓄積バッファ４１６、第２参照ピクチャバッファ４１８、符号量制御部４２３を新たに追加したものである。

【０１８１】
以下に、図１８において、図１３に示す実施の形態４の構成要素とは異なる機能や新たな機能を有する構成要素について説明する。

【０１８２】
第４蓄積バッファ５０１は、第１超解像拡大部１０３から超解像拡大画像を取得して蓄積し、蓄積した超解像拡大画像を第３予測器５０２に供給する機能を有する。なお、第４蓄積バッファ５０１は、蓄積制御部４１２から蓄積制御情報を取得し、この蓄積制御情報に基づいて超解像拡大画像の取得、蓄積、供給を制御しても良い。

【０１８３】
第３予測器５０２は、第４蓄積バッファ５０１から超解像拡大画像、第２参照ピクチャ

バッファ４１８から超解像拡大復号画像、第３解像度変換部１１０から解像度変換拡大復号画像を取得して、第３予測器５０２は、取得した超解像拡大画像の各超解像拡大画像を符号化対象ピクチャとし、解像度変換拡大復号画像から得られる各解像度変換拡大復号画像を解像度変換拡大復号画像から得られる第１参照ピクチャとし、超解像拡大復号画像の各超解像拡大復号画像を、超解像拡大復号画像から得られる第２参照ピクチャとした上で、所定の予測処理を行って予測ピクチャを生成し、符号化対象ピクチャから予測ピクチャを減算することで残差情報を生成して第３符号化器５０３に供給する機能を有すると更に良い構成となる。

【０１８４】

第３符号化器５０３は、第３予測器５０２から残差情報を取得し、所定の符号化処理を行って第３符号化ビット列を生成し、多重化部１０９に供給する機能を有する。また、第３符号化器５０３は、符号量制御部４２３からの制御情報に基づいて、符号化処理によって生成する第３符号化ビット列の符号量を変動させる機能を有することが望ましい。

【０１８５】

第３解像度変換部１１０は、第２蓄積バッファ４１６から前記復号画像を取得し、所定の解像度変換処理を行って、高解像度の拡大復号画像である解像度変換拡大復号画像を生成し、第３予測器５０２に供給する機能を有する。ここで、高解像度の解像度変換拡大復号画像は、第１超解像拡大部１０３が生成する超解像拡大画像、および第２超解像拡大部１０５が生成する超解像拡大復号画像がもつ空間解像度と同じ解像度となるように、第３解像度変換部１１０において所定の解像度変換処理が行われるようにしても良い。

【０１８６】

また、以下に、蓄積制御部４１２、第２蓄積バッファ４１６、第２参照ピクチャバッファ４１８、符号量制御部４２３に関して説明する。

【０１８７】

蓄積制御部４１２が備える機能は、図１０における実施の形態３の蓄積制御部４１２が備える機能と同等であれば良いことから、ここでは説明を省略する。

【０１８８】

第２蓄積バッファ４１６が備える機能は、図１０における実施の形態３の第２蓄積バッファ４１６が備える機能と同等であれば良いことから、ここでは説明を省略する。

【０１８９】

第２参照ピクチャバッファ４１８は、更に、第２超解像拡大部１０５から取得した超解像拡大復号画像を第３予測器５０２に供給する機能を有する。

【０１９０】

符号量制御部４２３が備える機能も、図１０における実施の形態３の符号量制御部４２３が備える機能と同等である。

【０１９１】

このように、図１８に示す本実施の形態６の動作は、図１０に示す実施の形態４の動作と同様であるため、ここでは説明を省略する。

【０１９２】

従って、本実施の形態６の動画像符号化装置によれば、図１３に示す実施の形態４の動画像符号化装置と同様の効果が得られると共に、図１０に示す実施の形態３と同様に、さらに、蓄積量制御部４１２と符号量制御部４２３等とを有し、各バッファにおける蓄積量制御や、第１符号化部１０２と第３符号化部１０８とにおける符号量制御を行うようにしたので、第１符号化部１０２と第３符号化部１０８とにおける符号量や、各バッファにおける蓄積量を考慮した符号化を実行することができる。

【０１９３】

なお、本実施の形態６では、図１３に示す実施の形態４の動画像符号化装置に対し、蓄積量制御部４１２と符号量制御部４２３等を設け、各バッファにおける蓄積量制御や第１符号化部１０２と第３符号化部１０８とにおける符号量制御を行うように説明したが、図１６や図１７に示す実施の形態５の動画像符号化装置に対し、蓄積量制御部４１２と符号

量制御部４２３等を設けて、同様に蓄積量制御や符号量制御を行うようにしても勿論よい。

【０１９４】

実施の形態７．

次に、本発明の実施の形態７の動画像符号化装置について説明する。

【０１９５】

図１９は、実施の形態７の動画像符号化装置の構成例を示すブロック図である。

【０１９６】

図１９に示す実施の形態７の動画像符号化装置は、図１に示す実施の形態１の動画像符号化装置と、図１３に示す実施の形態４の動画像符号化装置とを統合した構成となっており、各構成要素の基本的な機能において、同一であるものに関しては説明を省略し、異なる部分に関して以下に説明する。

【０１９７】

多重化部１０９は、更に、第１符号化部１０２からの第１符号化ビット列を取得すると共に、第２符号化部１０７から第２符号化ビット列を、第３符号化部１０８から第３符号化ビット列を取得して、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化パラメータ情報を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、第１符号化ビット列、第２符号化ビット列、第３符号化ビット列の多重化処理を行い、多重化ビット列を生成する機能を有する。ここで、多重化部１０９は、第１符号化部１０２から取得した基準解像度の第１符号化ビット列を複製して第１の第１符号化ビット列と第２の第１符号化ビット列として、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化パラメータ情報を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、複製した基準解像度の第１の第１符号化ビット列と、取得した第２符号化ビット列の多重化処理を行い、出力である多重化後の符号化ビット列を生成しても良い。また、多重化部１０９は、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化パラメータ情報を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、複製した基準解像度の第２の第１符号化ビット列と、取得した第３符号化ビット列の多重化処理を行い、出力である多重化後の第２の符号化ビット列を生成しても良い。

【０１９８】

また、多重化部１０９は、更に、第２符号化部１０７から第１および第２の第２符号化ビット列を取得し、第３符号化部１０８から第１および第２の第３符号化ビット列を取得しても良い。その上で、多重化部１０９は、取得した基準解像度の第１符号化ビット列を複製して、基準解像度の第１から第６の第１符号化ビット列を生成し、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化パラメータ情報を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、基準解像度の第１の第１符号化ビット列と第１の第２符号化ビット列、基準解像度の第２の第１符号化ビット列と第２の第２符号化ビット列、基準解像度の第３の第１符号化ビット列と第３の第２符号化ビット列、基準解像度の第４の第１符号化ビット列と第１の第３符号化ビット列、基準解像度の第５の第１符号化ビット列と第２の第３符号化ビット列、基準解像度の第６の第１符号化ビット列と第３の第３符号化ビット列との多重化処理を行って、多重化後の第１から第６の符号化ビット列を生成し、要求に応じて出力する機能を有すると更に良い構成となる。ここで、多重化部１０９は、要求に応じて選択的に多重化後の第１から第６の符号化ビット列を生成するようにしても構わない。

【０１９９】

以上のような機能を本実施の形態７は少なくとも有し、入力される動画像に対して所定の超解像拡大処理および所定の解像度変換処理で生成される基準解像度の入力画像の超解

像拡大信号や超解像拡大・変換信号を利用する構成にすることで、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行うことができる。ここで、図１９において、第１超解像拡大部１０３、第２超解像拡大部１０５が利用する拡大率は、同一の拡大率であることが望ましいが、異なる拡大率でもかまわない。また、第１解像度変換部１０４、第２解像度変換部１０６で利用する解像度変換率は、同一の解像度変換率であり、解像度変換処理後の空間解像度は、基準解像度となるような解像度変換率であることが望ましいが、異なる拡大率でもかまわない。更に、第３解像度変換部１１０で利用する解像度変換率は、第１超解像拡大部１０３が生成する超解像拡大画像、および第２超解像拡大部１０５が生成する超解像拡大復号画像がもつ空間解像度と同じ解像度となるような解像度変換率であることが望ましいが、異なる拡大率でもかまわない。

【０２００】

次に、図１９に示す実施の形態７の動作を、図２０のフローチャートを参照しながら説明する。

【０２０１】

まず、入力される動画像を、第１超解像拡大部１０３における第１超解像拡大処理で必要とされるピクチャ数の画像を、第１蓄積バッファ１０１に格納する（Ｓ１９０１）。

【０２０２】

第１超解像拡大部１０３は、所定の超解像拡大処理を行う際に必要となる少なくとも２枚の画像を、第１蓄積バッファ１０１から取得し、所定の第１超解像拡大処理を行う（Ｓ１９０２）。これにより、入力される動画像がもつ空間解像度である基準解像度よりも高い解像度をもつ、超解像拡大画像を生成し、第１解像度変換部１０４および第３符号化部１０８に供給する。

【０２０３】

その後、第３符号化部１０８は、第１超解像拡大部１０３から超解像拡大画像を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１９０３）。

【０２０４】

その後、第１解像度変換部１０４は、第１超解像拡大部１０３から超解像拡大画像を取得し、所定の解像度変換処理を行う（Ｓ１９０４）。これにより、基準解像度の入力画像の超解像拡大・変換信号を生成し、第２符号化部１０７に生成した基準解像度の入力画像の超解像拡大・変換信号を供給する。

【０２０５】

その後、第２符号化部１０７は、第１解像度変換部１０４から基準解像度の入力画像の超解像拡大・変換信号を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１９０５）。

【０２０６】

一方、第１符号化部１０２は、第１蓄積バッファ１０１から所定の超解像前符号化処理を行う際に必要となる基準解像度の動画像列を取得し、基準解像度の符号化、復号処理を行う（Ｓ１９０６）。これにより、符号化処理結果である基準解像度の第１符号化ビット列と、復号結果である基準解像度の復号画像を生成する。その後、第１符号化部１０２は、生成した第１符号化ビット列を多重化部１０９に供給し、生成した基準解像度の復号画像を第２超解像拡大部１０５、第２符号化部１０７、および第３解像度変換部１１０に供給する。

【０２０７】

次に、第２符号化部１０７は、第１符号化部１０２から前記復号画像を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１９０７）。

【０２０８】

また、第２超解像拡大部１０５は、第１符号化部１０２から基準解像度の復号画像を取得し、所定の超解像拡大処理を行う（Ｓ１９０８）。これにより、基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成し、第２解像度変換部１０６、および第３符号化部１０８に供給する。

【０２０９】
すると、第３符号化部１０８は、第２超解像拡大部１０５から超解像拡大復号画像を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ３０９）。
【０２１０】
また、第２解像度変換部１０６は、第２超解像拡大部１０５から超解像拡大復号画像を取得し、所定の解像度変換処理を行う（Ｓ１９１０）。これにより、基準解像度の超解像拡大・変換復号信号を生成し、第２符号化部１０７に供給する。
【０２１１】
そして、第２符号化部１０７は、第２解像度変換部１０６から基準解像度の超解像拡大・変換復号信号を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１９１１）。
【０２１２】
また、第３解像度変換部１１０は、第１符号化部１０２から前記復号画像を取得し、所定の解像度変換処理を行う（Ｓ１９１２）。これにより、高解像度の拡大復号画像である解像度変換拡大復号画像を生成し、第３符号化部１０８に供給する。
【０２１３】
その後、第３符号化部１０８は、第３解像度変換部１１０から高解像度の解像度変換拡大復号画像を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１９１３）。
【０２１４】
なお、Ｓ１９０２～Ｓ１９０５との処理と、Ｓ１９０６～Ｓ１９１１の処理と、Ｓ１９１２～Ｓ１９１３の処理は、並列処理しても、順番に処理してもどちらでも良い。
【０２１５】
そして、以上の処理が完了すると、第２符号化部１０７は、第１解像度変換部１０４から取得した入力画像の超解像拡大・変換画像を符号化対象ピクチャとし、第１符号化部１０２から取得した復号画像を第１参照ピクチャとし、第２解像度変換部１０６から取得した超解像拡大・変換復号画像を第２参照ピクチャとして、所定の第２の予測処理を行って基準解像度の残差情報を生成し（Ｓ１９１４）、生成した残差情報に対して所定の第２の符号化である第２の符号化処理を行う（Ｓ１９１５）。これにより、第２符号化ビット列を生成し、多重化部１０９に供給する。
【０２１６】
また、第３符号化部１０８は、第１超解像拡大部１０３から取得した入力画像の超解像拡大画像を符号化対象ピクチャとし、第３解像度変換部１１０から取得した解像度変換拡大復号画像を第１参照ピクチャとし、第２超解像拡大部１０５から取得した超解像拡大復号画像を第２参照ピクチャとして、所定の第３の予測処理を行って高解像度の残差情報を生成し（Ｓ１９１６）、生成した残差情報に対して所定の第３の符号化である第３符号化処理を行う（Ｓ１９１７）。これにより、第３符号化ビット列を生成し、多重化部１０９に供給する。その後、他の並列処理が完了するまで待機する。
【０２１７】
そして、多重化部１０９は、第１符号化部１０２から第１符号化ビット列、第２符号化部１０７から第２符号化ビット列、および第３符号化部１０８から第３符号化ビット列を取得し、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化パラメータ情報を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、第１符号化ビット列、第２符号化ビット列および第３符号化ビット列の多重化処理を行い（Ｓ１９１８）、多重化ビット列を生成する。以上のようなステップを経ることで、本実施の形態の一連の動作が完了する。
【０２１８】
図２１は、実施の形態７の多重化部１０９が生成する多重化ビット列３００の構造の一例を示すデータ構造図である。
【０２１９】

多重化ビット列３００に、符号化パラメータ情報ビット列３１０と、第１符号化部１０２からの第１符号化ビット列３２０と、第２符号化部１０７からの第２符号化ビット列３３０と、第３符号化部１０８からの第３符号化ビット列３４０とが多重化される。

【０２２０】

なお、本実施の形態の動作を複数の並列処理によって説明したが、この並列処理部分を連続的に処理するように、本実施の形態の構成を動作させても勿論よい。

【０２２１】

従って、本実施の形態７では、図１９に示すような構成とすることによって、図１に示す実施の形態１と、図１２に示す実施の形態４の構成によって得られるそれぞれの効果を同時に得ることができる。

【０２２２】

また、本実施の形態７では、第１符号化部１０２が入力された基準解像度の動画像に対して、所定の符号化および復号処理を行って基準解像度の第１符号化ビット列を生成し、第２符号化部１０７が第２の符号化処理を行って基準解像度の第２符号化ビット列を生成するとともに、第３符号化部１０８が第３符号化処理を行って高解像度の第３符号化ビット列を生成し、これら第１～第３の符号化ビット列を所定の多重化処理を行うことにより多重化ビット列を生成することにより、本来入力動画像に対する符号化結果と、超解像拡大処理および解像度変換処理によって得られた超解像拡大画像や超解像拡大・変換画像によって拡大された周波数成分情報との予測誤差に対する符号化結果とを単一の符号化ビットストリームによって効率よく蓄積もしくは伝送することができるとともに、復号側で選択的な復号を可能にする。

【０２２３】

また、本実施の形態７では、第２符号化部１０７が所定の予測処理を行う際に利用する参照ピクチャとして、基準解像度の復号画像から得られる第１参照ピクチャと、基準解像度の復号画像の超解像拡大・変換復号信号から得られる第２参照ピクチャとのどちらか一方を利用して予測ピクチャを生成し、基準解像度の入力画像の超解像拡大・変換信号から得られる符号化対象ピクチャから予測ピクチャを減算することで残差情報を生成し、この残差情報に対して所定の符号化処理を行って第２符号化ビット列を生成するとともに、第３符号化部１０８は、所定の予測処理を行う際に利用する参照ピクチャとして、高解像度の解像度変換拡大復号画像から得られる第１参照ピクチャと、超解像拡大復号画像から得られる第２参照ピクチャとのどちらか一方を利用して予測ピクチャを生成し、超解像拡大画像から得られる符号化対象ピクチャから予測ピクチャを減算することで残差情報を生成し、この残差情報に対して所定の符号化処理を行って第３符号化ビット列を生成するように構成することで、要求に応じて、基準解像度の入力画像の超解像拡大・変換信号と復号画像との間における空間解像度の相関性を利用した場合と、基準解像度の入力画像の超解像拡大・変換信号と超解像拡大・変換復号信号との間における空間解像度の相関性を利用した場合の階層符号化を行うことができるとともに、超解像拡大画像と解像度変換拡大復号画像との間における空間解像度の相関性を利用した場合と、超解像拡大画像と超解像拡大復号画像との間における空間解像度の相関性を利用した場合の階層符号化を行うことができ、異なる多重化ビット列を生成し、復号側へ供給、蓄積、または伝送することができる。

【０２２４】

更に、第１および第２参照ピクチャのどちらを利用したかを特定するための参照ピクチャ選択情報、および参照ピクチャ選択情報を生成し、多重化部１０９に供給するように構成することで、本実施の形態７の符号化時に利用した参照ピクチャを容易に特定することができるようになる。

【０２２５】

また、本実施の形態７では、第１符号化部１０２から得られる基準解像度の第１符号化ビット列、第２符号化部１０７から得られる第１から第３の第２符号化ビット列、第３符号化部１０８から得られる第１から第３の第３符号化ビット列に対して多重化処理を行い

、多重化後の第１から第６の符号化ビット列を要求に応じて生成することで多様な符号化ビット列の生成を可能にする。また、図示されない外部の蓄積装置に伝送した後に所定の記録媒体に記録したり、図示されない外部の通信装置によってネットワーク配信したりすることにより、本実施の形態の動画像符号化装置によって大量の情報量をもつ動画像を効率よく符号化し、蓄積、および伝送することを可能にするとともに、復号側で選択的な復号を可能にする。

【０２２６】

なお、図１９に示す実施の形態７の動画像符号化装置では、図１に示す実施の形態１の動画像符号化装置と、図１３に示す実施の形態４の動画像符号化装置とを統合した構成としているが、図７、図８、図９に示す実施の形態２の動画像符号化装置と、図１６、図１７に示す実施の形態５の動画像符号化装置とを統合したり、さらには図１に示す実施の形態１の動画像符号化装置と、図１６、図１７に示す実施の形態５の動画像符号化装置とを統合したり、図７、図８、図９に示す実施の形態２の動画像符号化装置と、図１３に示す実施の形態４の動画像符号化装置とを統合しても勿論よい。

実施の形態８．

【０２２７】

次に、本発明の実施の形態８の動画像符号化装置について説明する。

【０２２８】

図２２は、実施の形態８の動画像符号化装置の構成例を示すブロック図である。

【０２２９】

図２２に示す実施の形態８における構成要素は、図１３に示す実施の形態４と、図１８に示す実施の形態６とを統合したものである。従って、実施の形態８の動作も、実施の形態４との動作と、実施の形態６の動作とを組み合わせたものになるので、省略する。

【０２３０】

従って、本実施の形態８の動画像符号化装置によれば、図１９に示す実施の形態７の動画像符号化装置と同様の効果が得られると共に、図１０に示す実施の形態３や、図１８に示す実施の形態６と同様に、さらに、蓄積量制御部４１２と符号量制御部４２３等とを有し、各バッファにおける蓄積量制御や、第１符号化部１０２と第３符号化部１０８とにおける符号量制御を行うようにしたので、第１符号化部１０２と第３符号化部１０８とにおける符号量や、各バッファにおける蓄積量を考慮した符号化を実行することができる。

【０２３１】

なお、上記実施の形態１～８の説明では、動画像符号化装置をブロック図により図示してハードウエアにより構成したものとして説明したが、本発明では、これに限らず、ＣＰＵと、メモリやＨＤＤに格納された動画像符号化プログラムにより、上記実施の形態１～８の機能をソフトウェア処理により達成するようにしても勿論よい。また、本発明の動画像符号化装置、動画像符号化方法、および動画像符号化プログラムの適用される範囲は、動画像を符号化するような装置、方法、プログラム、システム等であれば、特に限定されるものではない。本発明は、例えば、ＴＶに代表される放送装置、携帯電話、テレビ会議装置、監視装置、ＤＶＤ－Ｒ／ＲＷやＢＤ－Ｒ／ＲＷ、ＨＤＤ、ＳＤ（商標または登録商標）、ホログラフィックメモリなどの追記および書き換え可能な記録媒体を利用した録画再生装置、およびカムコーダといった撮像記録再生装置、オーサリングなどの記録編集装置、動画像の配信装置などに適用しても構わない。

【図面の簡単な説明】

【０２３２】

【図１】本発明の実施の形態１を適用した動画像符号化装置の基本構成の例を示すブロック図である。

【図２】実施の形態１の動画像符号化装置の動作を示すフロチチャートである。

【図３】実施の形態１の多重化部１０９が生成する多重化ビット列の構造の一例を示すデータ構造図である。

【図４】実施の形態１の第１超解像拡大部１０３の詳細構成例を示すブロック図、お

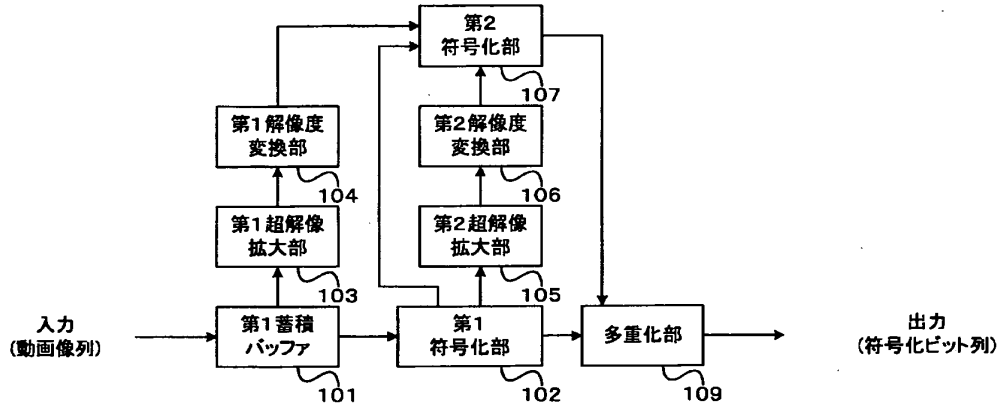
よび第１超解像拡大部１０３で行われる所定の超解像拡大処理の一例を示す概念図である。
【図５】実施の形態１の第１超解像拡大部１０３の動作を示すフローチャートである。
【図６】実施の形態１の第１解像度変換部１０４の詳細構成例を示すブロック図、および第１解像度変換部１０４で行われる所定の解像度変換処理の一例を示す概念図である。
【図７】実施の形態２の動画像符号化装置の構成例を示すブロック図である。
【図８】実施の形態２の動画像符号化装置の他の構成例を示すブロック図である。
【図９】実施の形態２の動画像符号化装置のさらに他の構成例を示すブロック図である。
【図１０】実施の形態３の動画像符号化装置の構成例を示すブロック図である。
【図１１】実施の形態３における第１符号化器４０３の構成例を示すブロック図である。
【図１２】実施の形態３における第１復号器４０４の構成例を示すブロック図である。
【図１３】実施の形態４の動画像符号化装置の構成例を示すブロック図である。
【図１４】実施の形態４の動画像符号化装置の動作例を示すフローチャートである。
【図１５】実施の形態４の多重化部１０９が生成する多重化ビット列の構造の一例を示すデータ構造図である。
【図１６】実施の形態５の動画像符号化装置の構成例を示すブロック図である。
【図１７】実施の形態５の動画像符号化装置の他の構成例を示すブロック図である。
【図１８】実施の形態６の動画像符号化装置の構成例を示すブロック図である。
【図１９】実施の形態７の動画像符号化装置の構成例を示すブロック図である。
【図２０】実施の形態７の動画像符号化装置の動作例を示すフローチャートである。
【図２１】実施の形態７の多重化部１０９が生成する多重化ビット列の構造の一例を示すデータ構造図である。
【図２２】実施の形態８の動画像符号化装置の構成例を示すブロック図である。

【符号の説明】

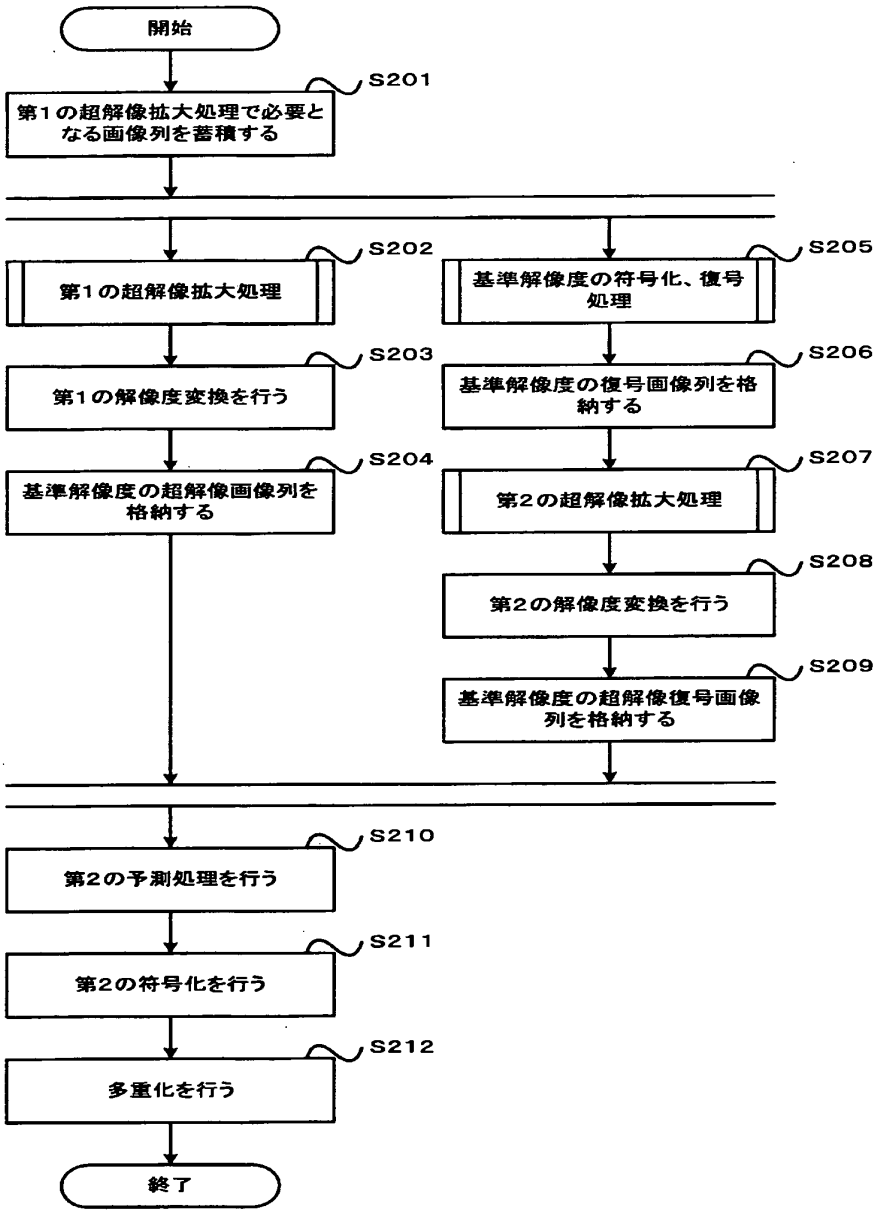
【０２３３】

１０２　第１符号化部
１０３　第１超解像拡大部
１０４　第１解像度変換部
１０５　第２超解像拡大部
１０６　第２解像度変換部
１０７　第２符号化部
１０８　第３符号化部
１０９　多重化部
１１０　第３解像度変換部

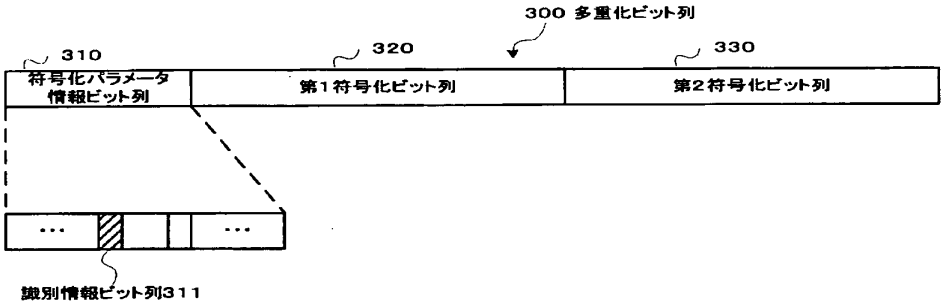
【書類名】図面
【図１】


第2
符号化部
107
第1解像度
変換部
104
第2解像度
変換部
106
第1超解像
拡大部
103
第2超解像
拡大部
105
入力
(動画像列)
第1蓄積
バッファ
101
第1
符号化部
102
多重化部
109
出力
(符号化ビット列)

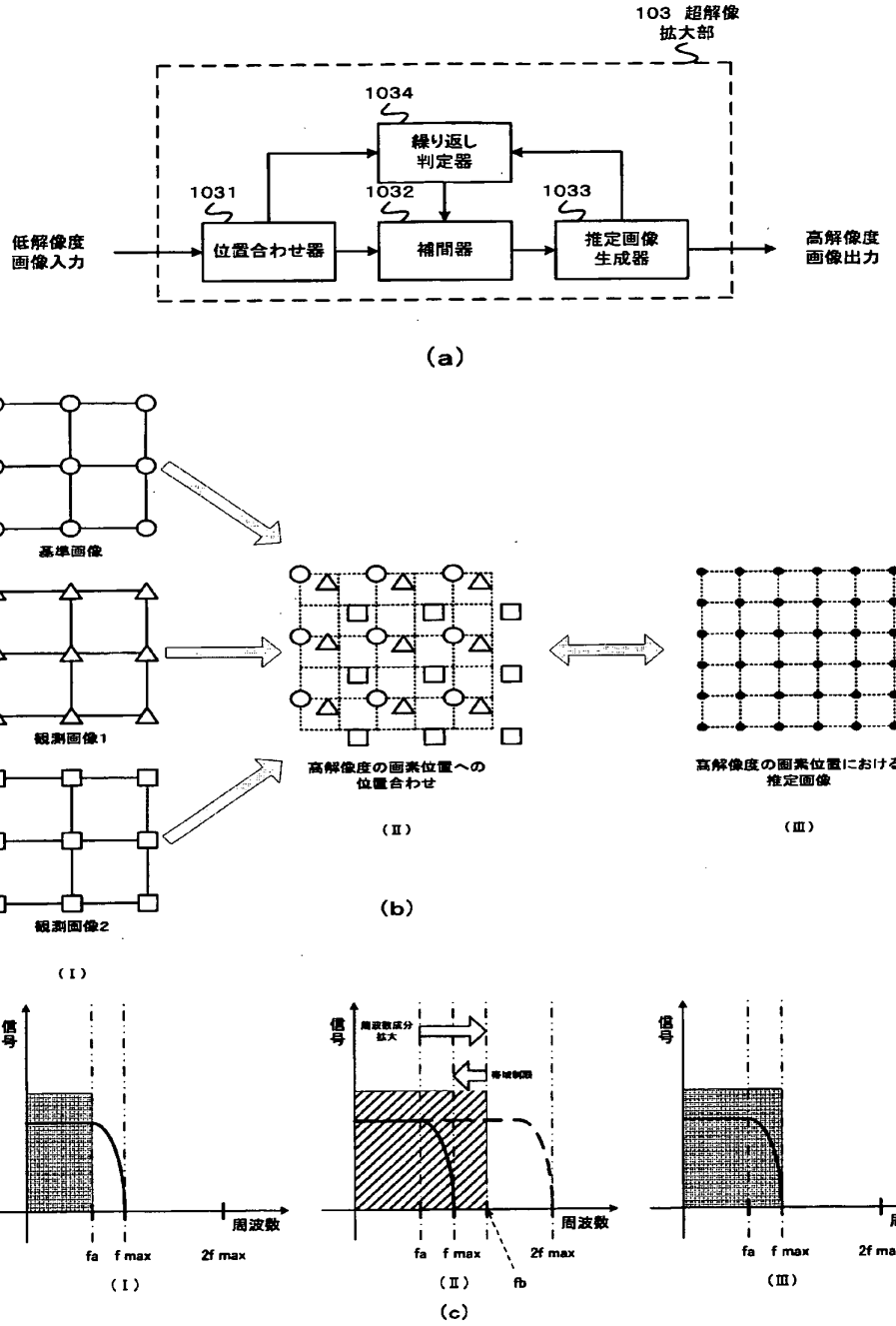
【図２】


開始
S201
第１の超解像拡大処理で必要となる画像列を蓄積する
S202
第１の超解像拡大処理
S203
第１の解像度変換を行う
S204
基準解像度の超解像画像列を格納する
S205
基準解像度の符号化、復号処理
S206
基準解像度の復号画像列を格納する
S207
第２の超解像拡大処理
S208
第２の解像度変換を行う
S209
基準解像度の超解像復号画像列を格納する
S210
第２の予測処理を行う
S211
第２の符号化を行う
S212
多重化を行う
終了

【図３】

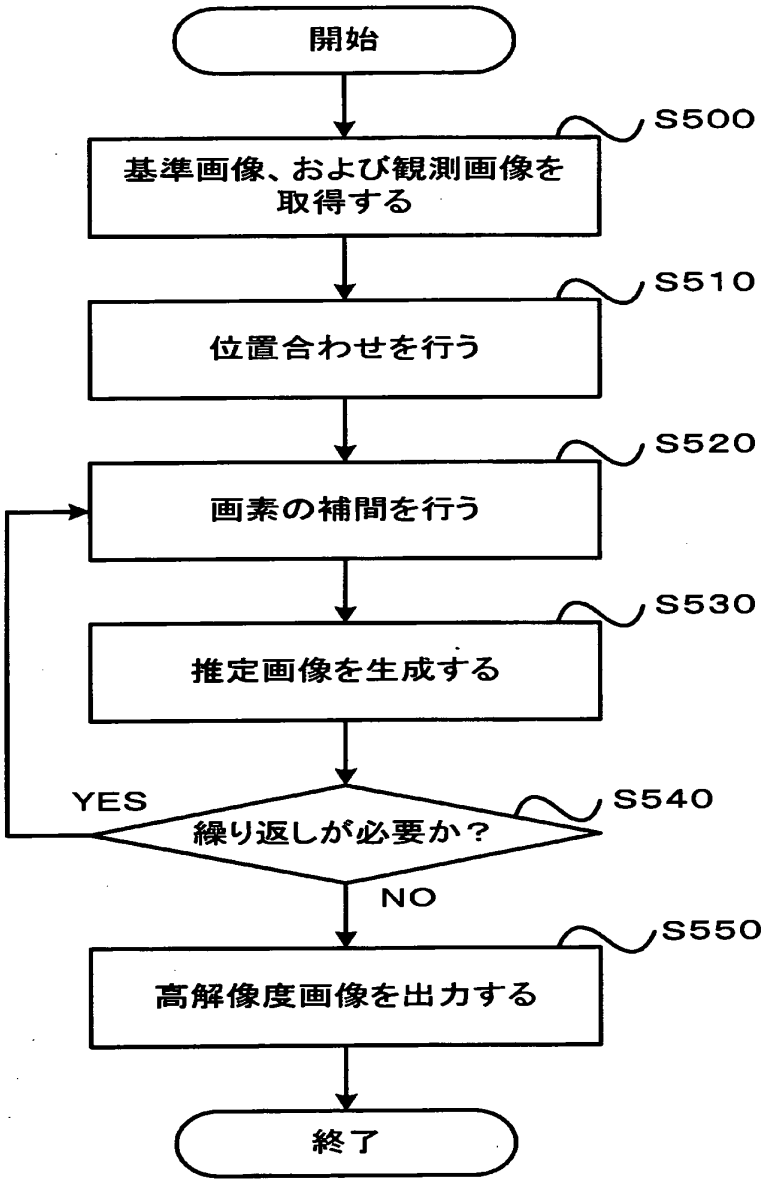

300 多重化ビット列
310
320
330
符号化パラメータ情報ビット列
第1符号化ビット列
第2符号化ビット列
識別情報ビット列311

【図４】

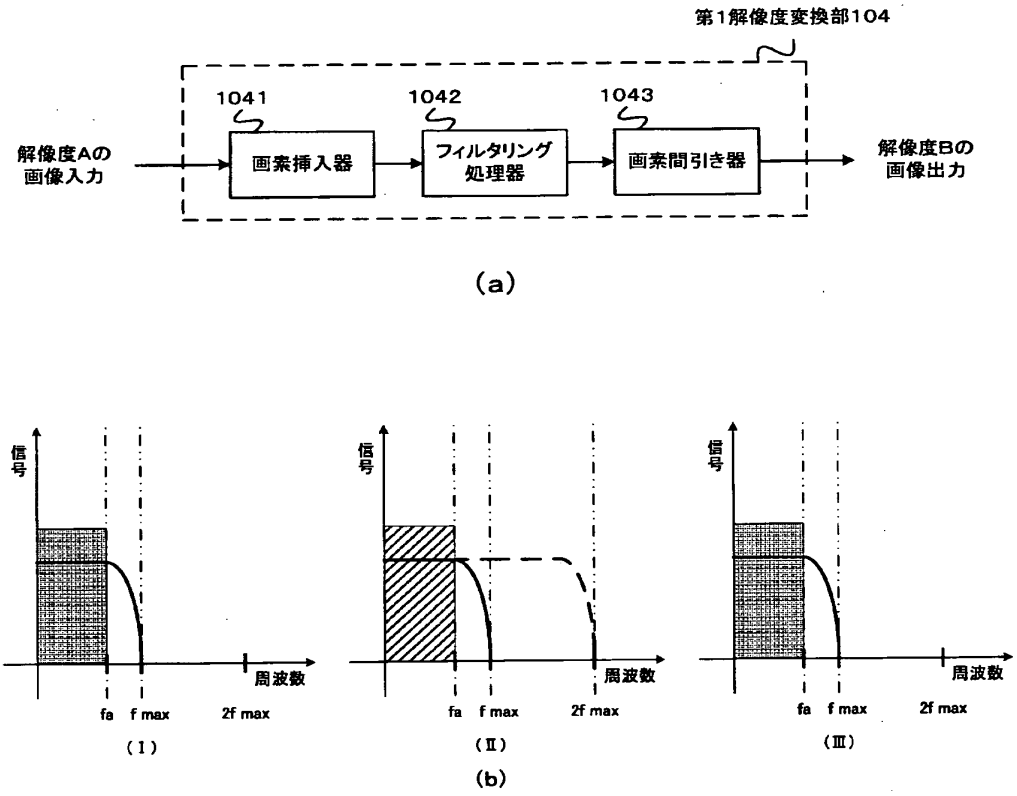


出証特２００９－３０１７００６

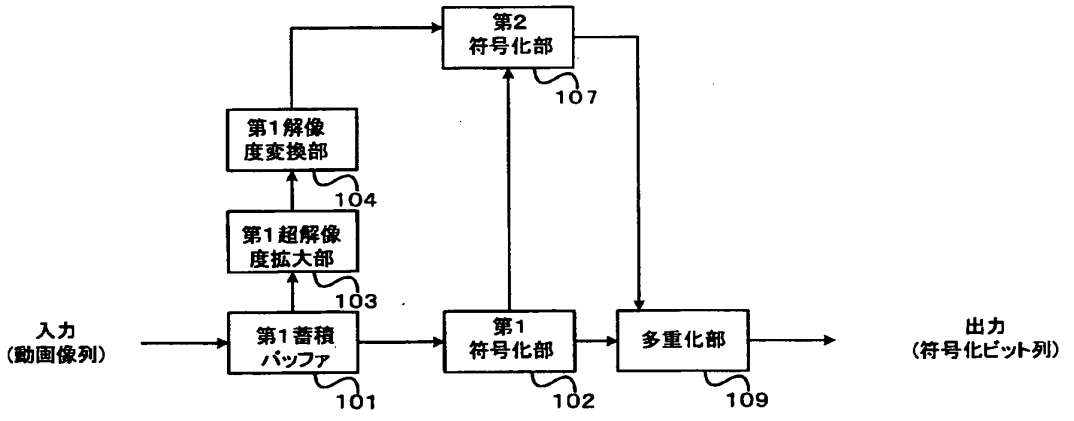
【図５】


開始
S500
基準画像、および観測画像を取得する
S510
位置合わせを行う
S520
画素の補間を行う
S530
推定画像を生成する
YES
S540
繰り返しが必要か？
NO
S550
高解像度画像を出力する
終了

【図６】

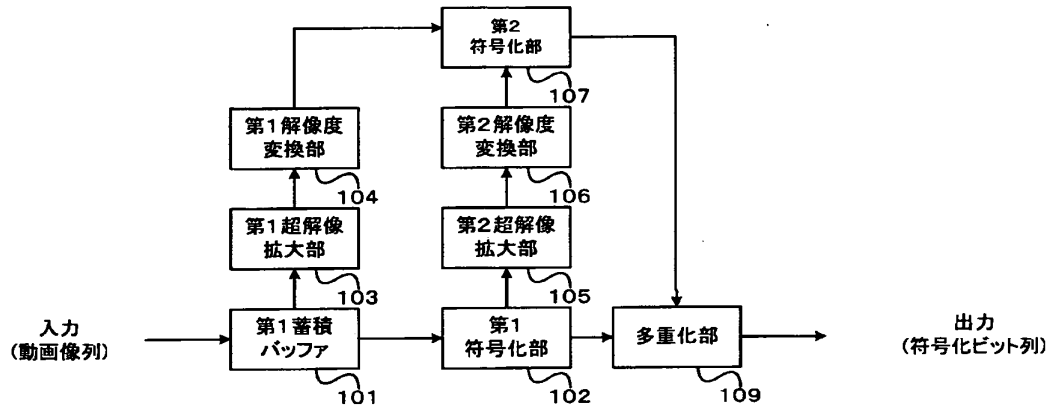


【図７】

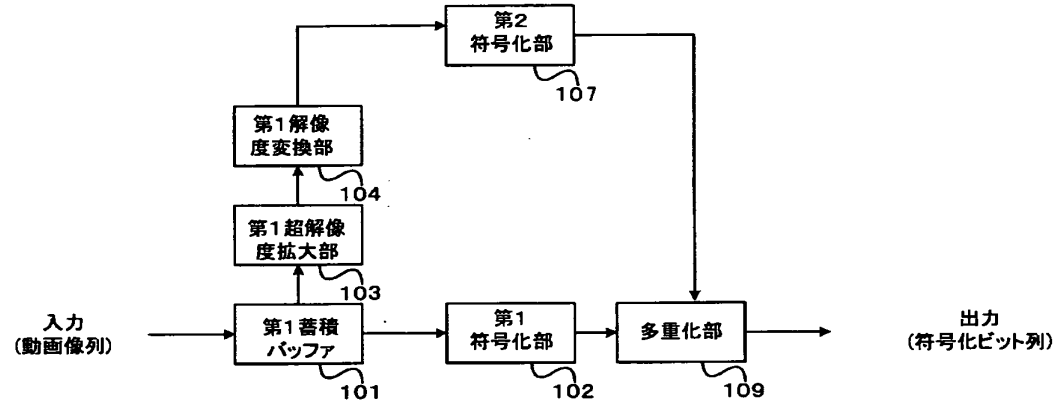


出証特２００９－３０１７００６

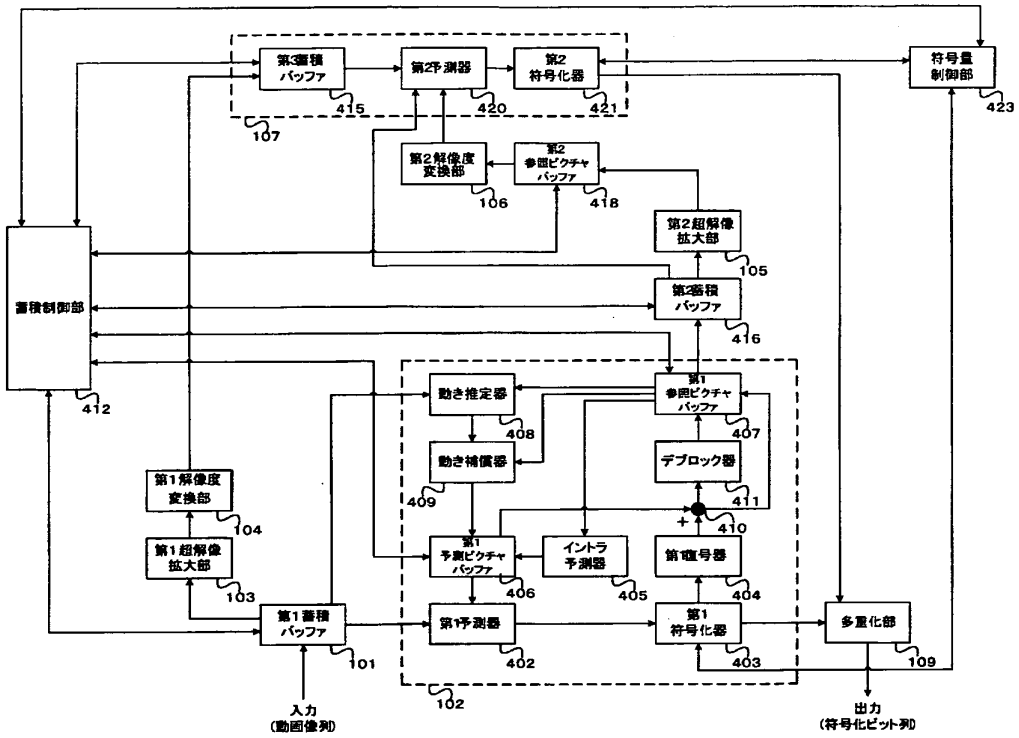
【図８】


第2
符号化部
107
第1解像度
変換部
104
第2解像度
変換部
106
第1超解像
拡大部
103
第2超解像
拡大部
105
入力
(動画像列)
第1蓄積
バッファ
101
第1
符号化部
102
多重化部
109
出力
(符号化ビット列)

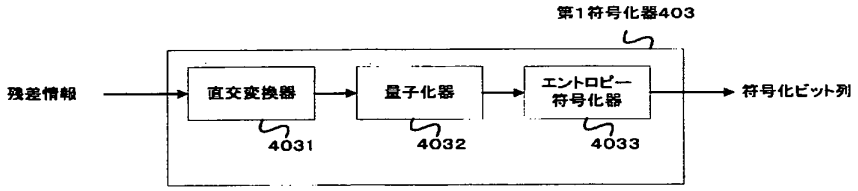
【図９】


第2
符号化部
107
第1解像
度変換部
104
第1超解像
度拡大部
103
入力
(動画像列)
第1蓄積
バッファ
101
第1
符号化部
102
多重化部
109
出力
(符号化ビット列)

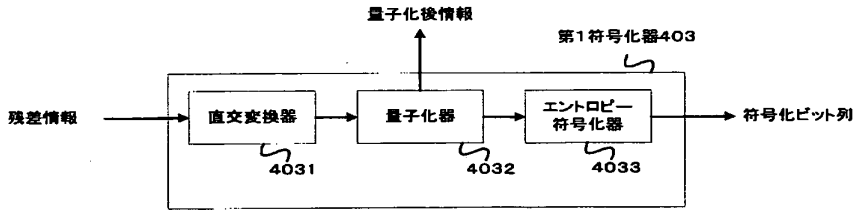
【図１０】


第3蓄積バッファ
415
第2予測器
420
第2符号化器
421
107
符号量制御部
423
第2解像度変換部
106
第2参照ピクチャバッファ
418
第2超解像拡大部
105
蓄積制御部
412
第2蓄積バッファ
416
動き推定器
408
第1参照ピクチャバッファ
407
動き補償器
409
デブロック器
411
410
第1解像度変換部
104
第1超解像拡大部
103
第1予測ピクチャバッファ
406
イントラ予測器
405
第1復号器
404
第1蓄積バッファ
101
第1予測器
402
第1符号化器
403
多重化部
109
102
入力
(動画像列)
出力
(符号化ビット列)

【図１１】

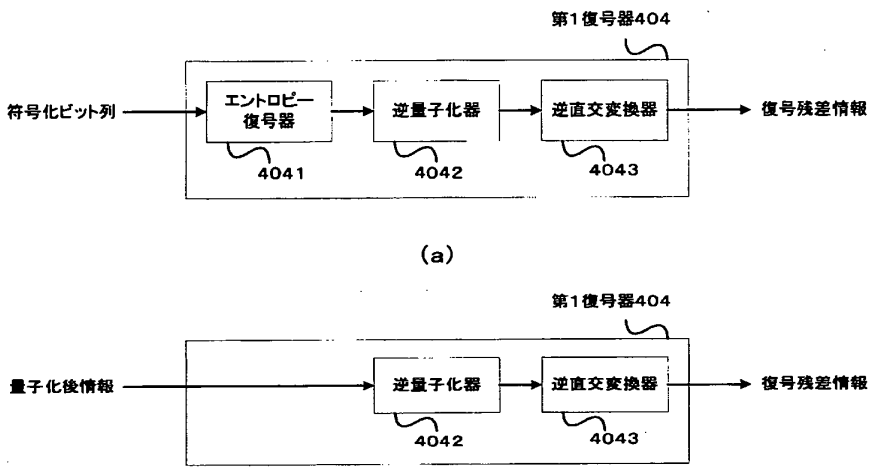

第1符号化器403
残差情報
直交変換器
4031
量子化器
4032
エントロピー符号化器
4033
符号化ビット列

(a)

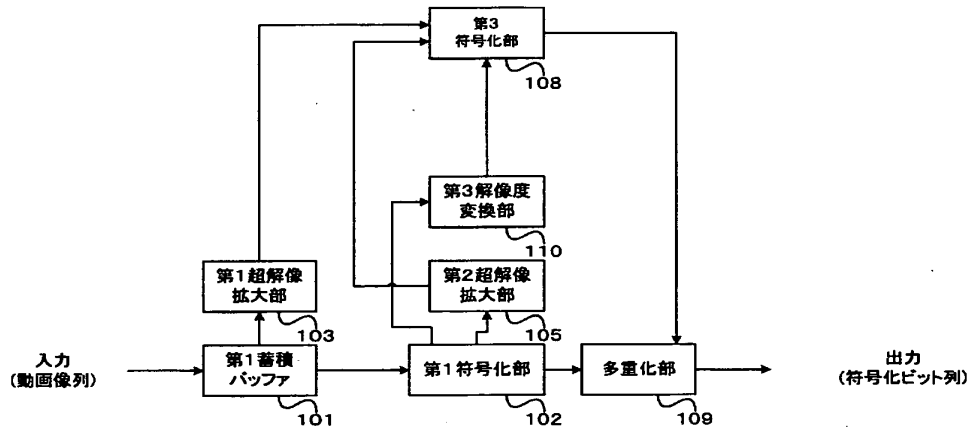

量子化後情報
第1符号化器403
残差情報
直交変換器
4031
量子化器
4032
エントロピー符号化器
4033
符号化ビット列

(b)

【図１２】

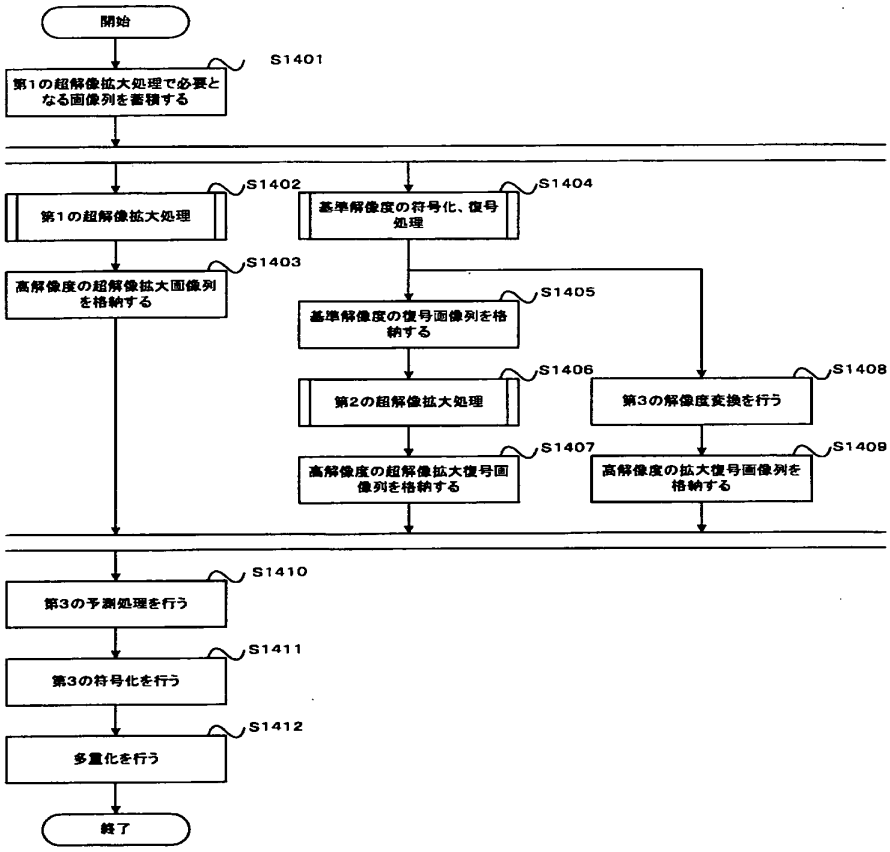


【図１３】

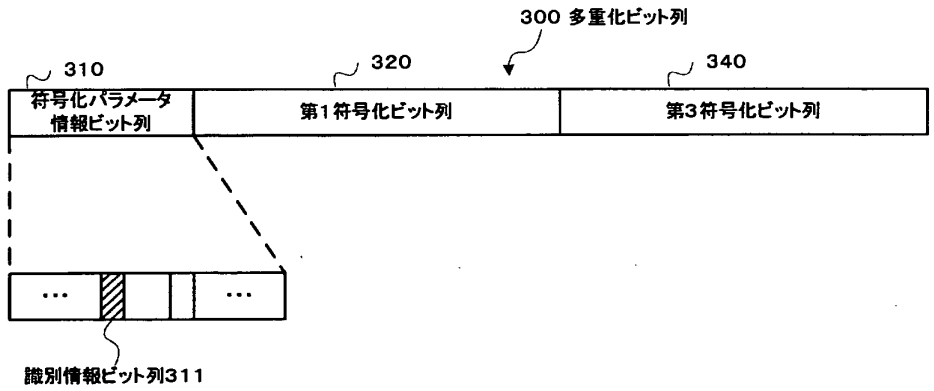


出証特２００９－３０１７００６

【図１４】

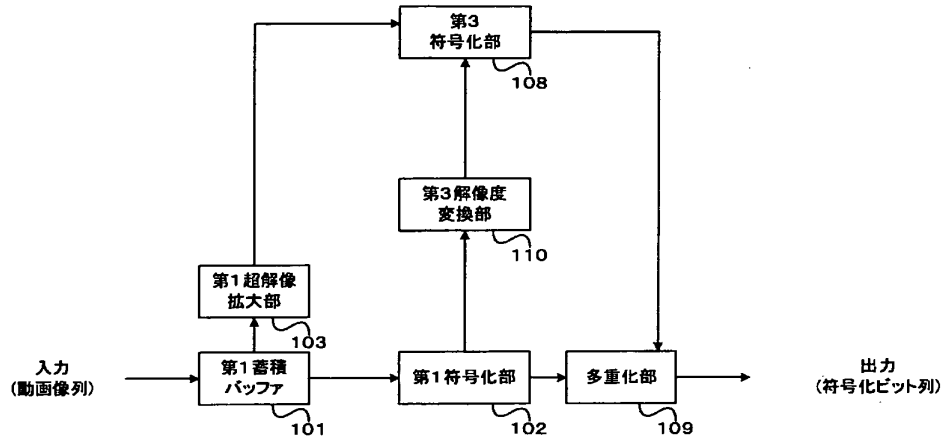


【図１５】

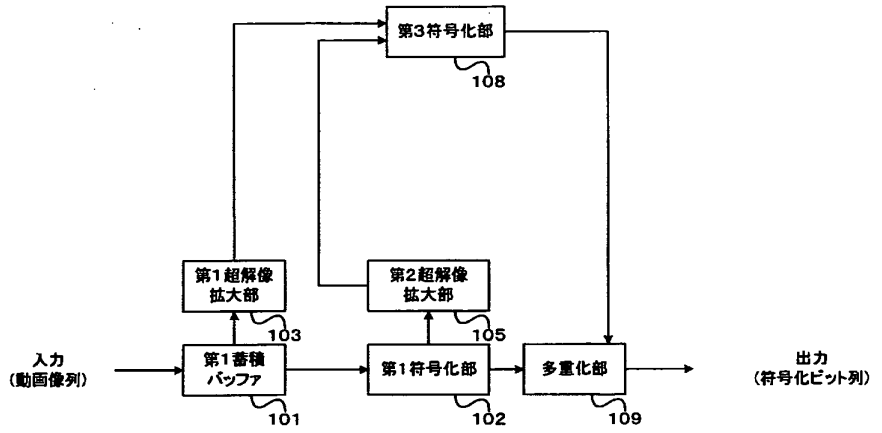


出証特２００９－３０１７００６

【図１６】

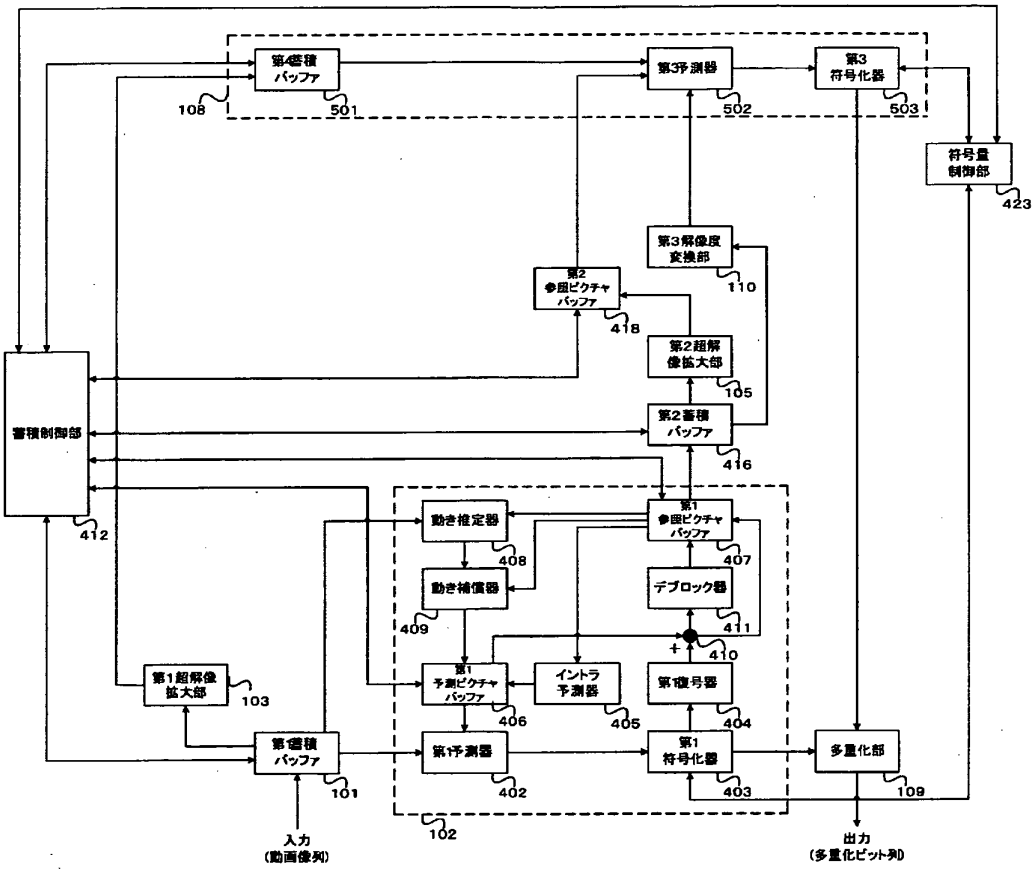


【図１７】



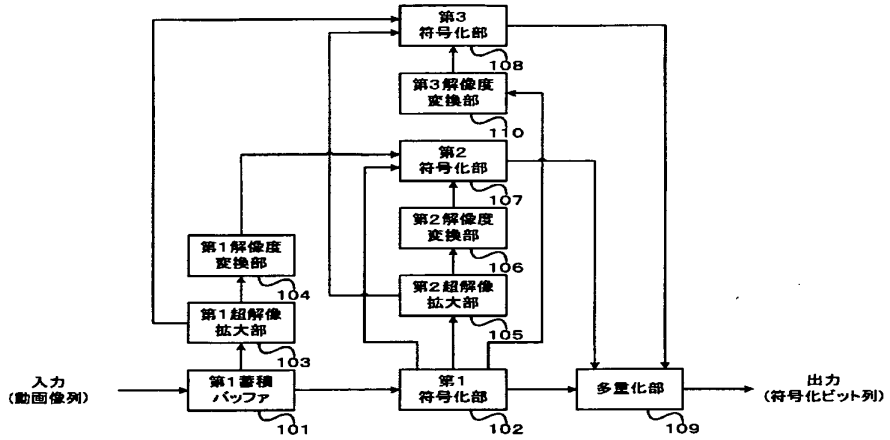
出証特２００９－３０１７００６

【図１８】

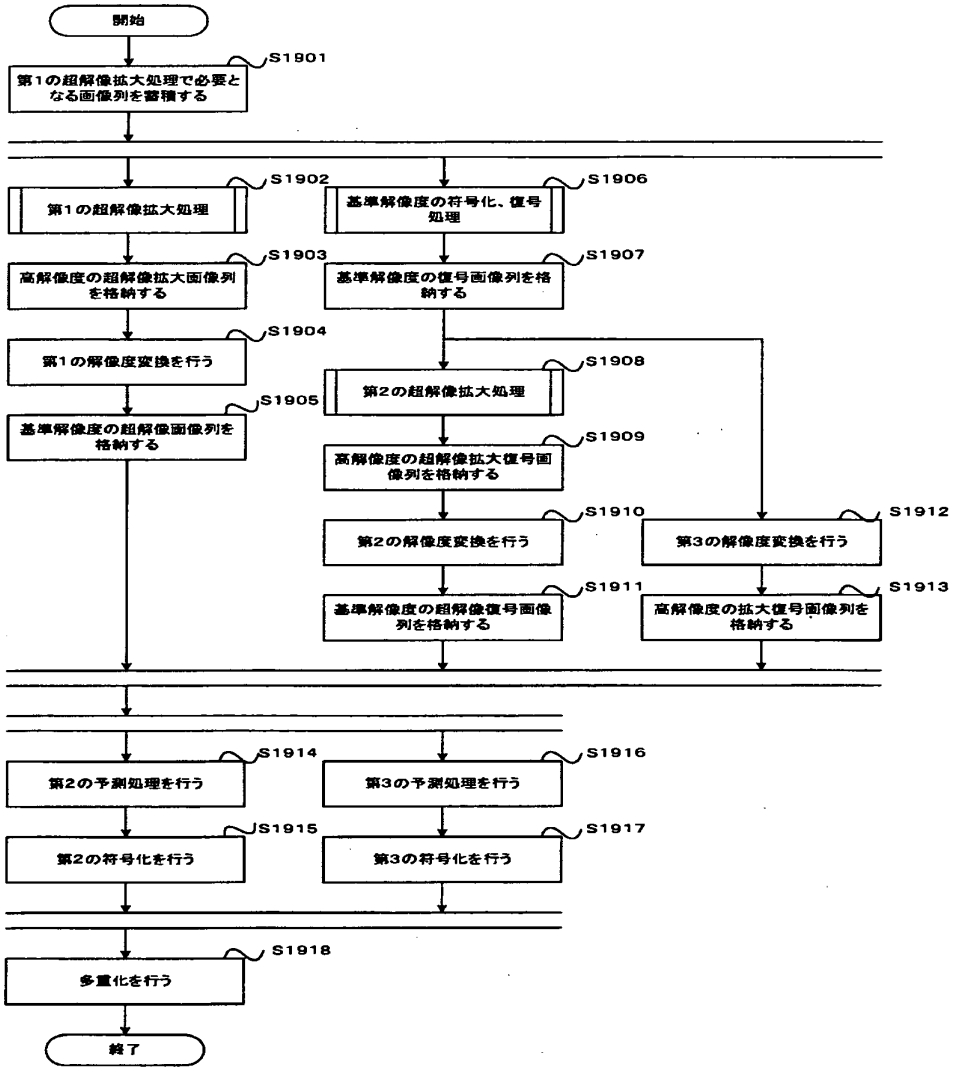


出証特２００９－３０１７００６

【図１９】

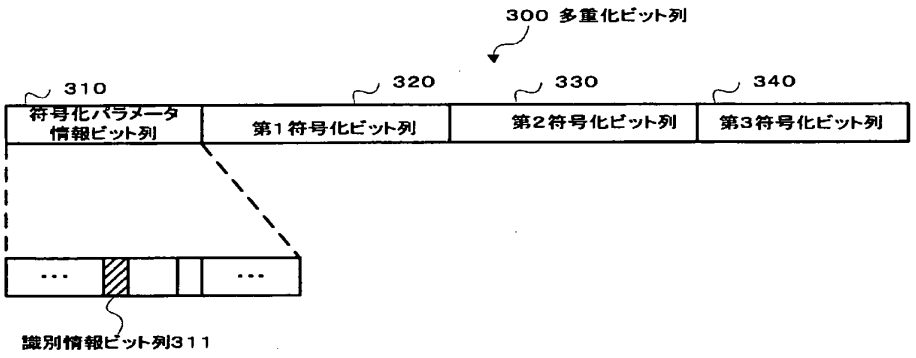

第3
符号化部
108
第3解像度
変換部
110
第2
符号化部
107
第2解像度
変換部
106
第2超解像
拡大部
105
第1解像度
変換部
104
第1超解像
拡大部
103
入力
(動画像列)
第1蓄積
バッファ
101
第1
符号化部
102
多重化部
109
出力
(符号化ビット列)

【図２０】

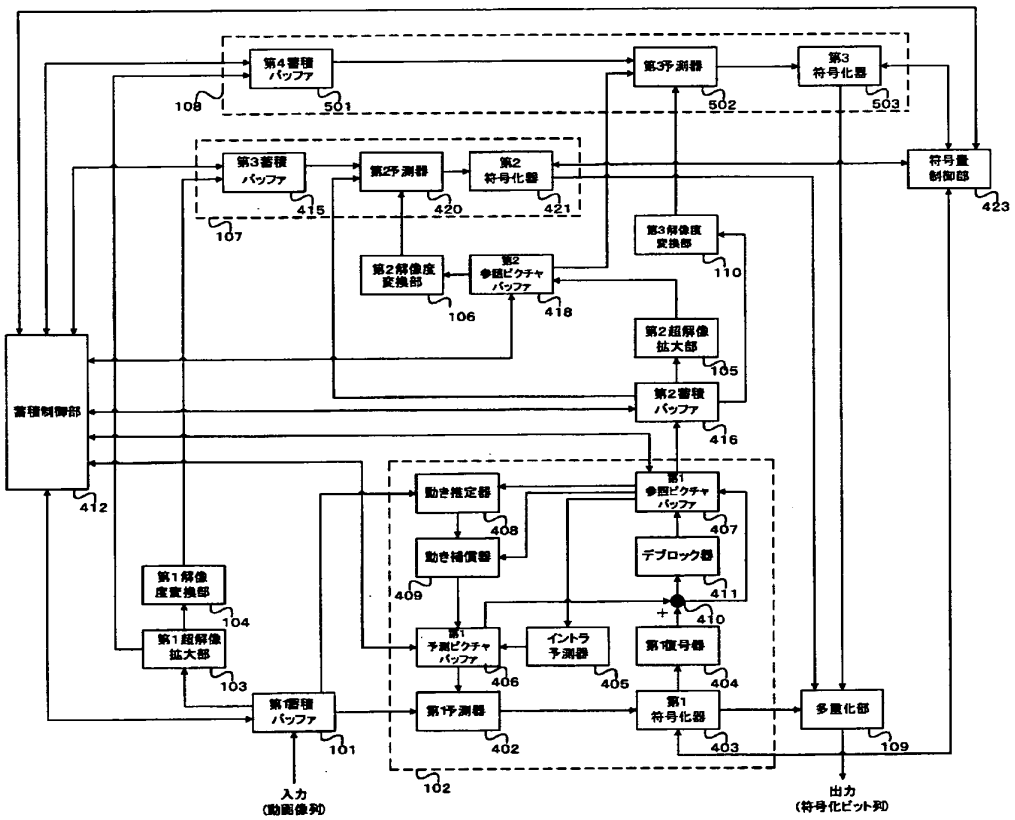


出証特２００９－３０１７００６

【図２１】



【図２２】



出証特２００９－３０１７００６

【書類名】要約書
【要約】
【課題】入力動画像の解像度で表現される空間周波数成分情報より多くのの空間周波数成分情報を符号化し、伝送すること。
【解決手段】第１超解像拡大部１０３は、基準解像度の入力動画像に対し超解像拡大処理を行うことにより、入力動画像中に潜在的に含まれるが基準解像度では十分表現できていなかった空間方向および時間方向の周波数成分情報を含め、第１解像度変換部１０４がその超解像拡大後信号を基準解像度に戻し、第２符号化部１０７はその基準解像度に戻された超解像拡大後信号を符号化する。第１符号化部１０２は基準解像度の入力動画像を符号化し、多重化部１０９は第１符号化部１０２からの符号化ビット列と第２符号化部１０７からの符号化ビット列等とを多重化する。なお、第２符号化部１０７は第１符号化部１０２における局所復号信号またはそれを加工した信号を参照信号として使用しても良い。
【選択図】図１

特願２００８－１４２４３３

出　願　人　履　歴　情　報

識別番号　［０００００４３２９］

１．変更年月日　１９９０年　８月　８日
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氏　名　日本ビクター株式会社

出証番号　出証特２００９－３０１７００６

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World Intellectual Property Organization (WIPO) - Geneva, Switzerland
Organisation Mondiale de la Propriété Intellectuelle (OMPI) - Genève, Suisse

PCT/JP2009/059801

09.06.2009

日本国特許庁
JAPAN PATENT OFFICE

別紙添付の書類に記載されている事項は下記の出願書類に記載されている事項と同一であることを証明する。
This is to certify that the annexed is a true copy of the following application as filed with this Office.

出願年月日 Date of Application:	２００９年　５月２２日
出願番号 Application Number:	特願２００９－１２３９６０
パリ条約による外国への出願に用いる優先権の主張の基礎となる出願の国コードと出願番号 The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is	ＪＰ２００９－１２３９６０
出願人 Applicant(s):	日本ビクター株式会社

２００９年　６月　２日

特許庁長官
Commissioner,
Japan Patent Office

鈴木隆史

出証番号　出証特２００９－３０１７００７

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【国際特許分類】　H04N 7/32
　　H04N 7/30
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　【氏名又は名称】　日本ビクター株式会社
　【代表者】　吉田 秀俊
　【電話番号】　045-450-2423
【先の出願に基づく優先権主張】
　【出願番号】　特願2008-142433
　【出願日】　平成20年 5月30日
【手数料の表示】
　【予納台帳番号】　003654
　【納付金額】　15,000円
【提出物件の目録】
　【物件名】　特許請求の範囲 1
　【物件名】　明細書 1
　【物件名】　図面 1
　【物件名】　要約書 1

出証特２００９－３０１７００７

【書類名】明細書
【発明の名称】動画像符号化装置、動画像符号化方法、動画像符号化プログラム、動画像復号装置、動画像復号方法、動画像復号プログラム、動画像再符号化装置、動画像再符号化方法、動画像再符号化プログラム
【技術分野】
【０００１】
本発明は、動画像列に対し超解像拡大処理等を行う動画像符号化装置、動画像符号化方法、動画像符号化プログラム、動画像復号装置、動画像復号方法、動画像復号プログラム、動画像再符号化装置、動画像再符号化方法、動画像再符号化プログラムに関する。
【背景技術】
【０００２】
映像の空間解像度スケーラビリティを実現する従来技術として、例えば、ベースレイヤとエンハンスメントレイヤの２層の階層符号化装置において、エンハンスメントレイヤと同じ空間解像度の入力映像信号をベースレイヤの空間解像度に縮小（デシメーション）処理した後、ベースレイヤにて符号化し、そのベースレイヤ符号化の際のデコード信号を空間的に補間（インターポレーション）してエンハンスメントレイヤと同じ空間解像度にした信号とエンハンスメントレイヤと同じ空間解像度の入力映像信号との間で相関を利用した予測を行い、その予測誤差信号を符号化して、そこで得た符号化ビットストリームとベースレイヤ符号化で得られたビットストリームを多重化したものを復号装置へ伝送し、復号装置ではその多重化された符号化ビットストリームをその逆に復号するものがある（例えば、特許文献１参照。）。
【特許文献１】特開平７－１６２８７０号公報
【発明の開示】
【発明が解決しようとする課題】
【０００３】
ところで、ISO/IEC SC29 WG11において規格標準化されているMPEG-1、-2、-4/AVC/SVCなどに代表される動画像符号化では、局部復号（ローカルデコード）によって得られる復号ピクチャを参照ピクチャとして利用して動き推定により動きベクトル情報を生成し、動き補償により生成された動きベクトル情報を利用して、符号化対象となっている対象ピクチャに最も近い画像品質を持つような予測ピクチャを生成し、その後、対象ピクチャと予測ピクチャとの残差情報を求め、この残差情報に対して所定の符号化処理を行って、時間方向の相関性の高さを利用して高い符号化効率を実現している。つまり、予測ピクチャの画像品質を向上させ、対象ピクチャとの相関を高めることで、更なる符号化効率の向上が期待できる。しかし、十分な符号量を割り当てることができないと、動きベクトル情報の精度が十分でなくなったり、局部復号結果である参照ピクチャの画像品質が十分得られなくなったりすることによって、予測ピクチャの画像品質が低下し、結果として符号化効率が低下する。
【０００４】
また、上述の特許文献１やMPEG-4 SVCなどに代表される動画像の階層符号化でも、現在符号化を行おうとしている階層よりも下の階層の参照ピクチャから予測ピクチャもしくは予測ブロックを生成し、現在の階層の対象ピクチャもしくは対象ブロックとの間で階層間予測を行うことにより、異なる空間解像度間の相関性の高さを利用して更なる符号化効率の向上を図っている。しかし、時間方向の相関性の高さを利用する場合と同様に、階層間の相関性の高さを利用する場合も、十分な符号量を割り当てることができないと、予測ピクチャもしくは予測ブロックの画像品質は低下し、結果として符号化効率が低下してしまうという課題が生じる。
【０００５】
また、符号化対象として入力した動画像に対して所定の解像度変換処理を行って、入力した動画像の持つ空間解像度(以後、基準解像度)よりも低い空間解像度（以後、低解像度）の動画像を生成し、少なくとも2階層の動画像に対して階層間の相関性の高さを利用し

て階層符号化を行っている。しかし、このような階層符号化では、仮に可逆の符号化処理を行った場合であっても、入力動画像の基準解像度によって、表現できる空間方向の空間周波数成分情報に帯域制限がかかるとともに、階層符号化を行う際に、階層符号化の局部復号、もしくは階層符号化によって得られる符号化ビットストリームを復号して得られる復号画像が、入力動画像に対して、符号化条件の下で最も入力動画像の画像品質に近くなるように符号化処理を行うことから、階層間の相関性を利用して新たな空間周波数成分情報の推定が可能であっても、基準解像度で表現できる空間周波数成分情報より多くのの空間周波数成分情報を符号化し、伝送することができないという課題が生じる。

【０００６】

そこで、本発明は、入力動画像の解像度で表現される空間周波数成分情報より多くのの空間周波数成分情報を符号化し、伝送することができる動画像符号化装置、動画像符号化方法、および動画像符号化プログラムを提供することを目的とする。また、本発明の動画像符号化装置、動画像符号化方法、および動画像符号化プログラムによって生成された符号化ビット列を取得して復号することができる動画像復号装置、動画像復号方法、動画像復号プログラムを提供することを目的とする。更に、復号後、再度符号化し、伝送することができる動画像再符号化装置、動画像再符号化方法、および動画像再符号化プログラムを提供することを目的とする。

【課題を解決するための手段】

【０００７】

前記課題を解決するため、本発明の動画像符号化装置は、例えば図９に示すように、基準解像度の動画像列に対し第１の符号化および復号処理を行って前記基準解像度の第１符号化ビット列および基準解像度の復号画像を生成する第１符号化部と、基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像度をもつ超解像拡大・変換画像を生成する第１解像度変換部と、前記第１解像度変換部からの前記超解像拡大・変換画像を符号化対象画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する第２符号化部と、を有する。

ここで、例えば図７に示すように、前記第２符号化部は、さらに、前記第１符号化部からの前記復号画像を参照画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する、ようにしても良い。

また、例えば図１および図８に示すように、さらに、前記第１符号化部から前記基準解像度の復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、前記超解像拡大復号画像に対し第２の解像度変換処理を行って基準解像度をもつ超解像拡大・変換復号画像を生成する第２解像度変換部と、を有し、前記第２符号化部は、さらに、前記第２解像度変換部からの前記超解像拡大・変換復号画像を参照画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する、ようにしても良い。

また、例えば図４の（ａ）に示すように、前記第１の超解像拡大部は、超解像拡大処理を行う際の基準となる基準画像と、少なくとも１枚の観測画像とに基づいて、所望の高解像度の画素位置への位置合わせを行い、不等間隔にサンプリングされた不均一高解像度画像を生成する位置合わせ器と、前記位置合わせ器にて生成された不均一高解像度画像に対し所定の不均一補間処理を行って、所望の高解像度を持つ補間画像を生成する補間器と、前記補間器にて生成された前記補間画像を取得して、所定の復元処理を行い、所望の解像度を持つ推定画像を生成する推定画像生成器と、前記位置合わせ器から前記不均一高解像度画像を取得するとともに、前記推定画像生成器から前記不均一推定画像を取得して、取得したそれぞれの画像を利用して、所定の判定方法に従って超解像拡大処理の繰り返しが必要か否かを判定し、その判定の結果、繰り返しが必要な場合は、前記補間器に対して処理を継続するための制御情報を供給する一方、繰り返しが必要ない場合には、前記推定画像生成器に対して超解像拡大処理結果である高解像度の推定画像を出力するための制御情報を出力する繰り返し判定器と、を有するようにしても良い。

また、例えば図１等に示すように、さらに、前記第１符号化部からの前記第１符号化ビット列と、前記第２符号化部からの前記第２符号化ビット列と、前記第１符号化部における符号化および前記第２符号化部における符号化の際に使用した各種符号化パラメータ情報とを、所定の構文構造に基づいて多重化する多重化部、を有するようにしても良い。

また、例えば図１０に示すように、さらに、前記第１符号化部および前記第１超解像拡大部の前段に設けられ、基準解像度の前記動画像列を蓄積する第１蓄積バッファと、前記第１符号化部と前記第２符号化部の間に設けられ、前記第１符号化部からの前記復号画像を蓄積する第２蓄積バッファと、前記第１蓄積バッファと、前記第２蓄積バッファと、前記第１符号化部と、前記第２符号化部とにおける各バッファ蓄積量を検出し、各バッファ蓄積量を制御する蓄積制御部と、前記蓄積制御部における前記各バッファ蓄積量に基づいて、前記第１符号化部と前記第２符号化部とにおける符号量制御を行う符号量制御部と、を有するようにしても良い。

また、本発明の動画像符号化装置は、例えば図１３に示すように、基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、前記第１符号化部から前記復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、前記第１符号化部から前記復号画像を取得し、第３の解像度変換処理を行って基準解像度よりも高い解像度をもつ解像度変換拡大復号画像を生成する第３解像度変換部と、前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第２超解像拡大部からの前記超解像拡大復号画像と、前記第３超解像拡大部からの前記解像度変換拡大復号画像とを参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、を有する。

また、本発明の動画像符号化装置は、例えば図１６に示すように、基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、前記第１符号化部から前記復号画像を取得し、第３の解像度変換処理を行って基準解像度よりも高い解像度をもつ解像度変換拡大復号画像を生成する第３解像度変換部と、前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第３解像度変換部からの前記解像度変換拡大復号画像を参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、を有する。

また、本発明の動画像符号化装置は、例えば図１７に示すように、基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、前記第１符号化部から前記復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第２超解像拡大部からの前記超解像拡大復号画像を参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、を有する。

また、本発明の動画像符号化装置は、例えば図１９に示すように、基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像度をもつ超解像拡大・変換画像を生成する第１解像度変換部と、前記第１符号化部から前記復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、前記第２超解像拡大部からの前記超解像拡大復号画像に

対し第２の解像度変換処理を行って基準解像度をもつ超解像拡大・変換復号画像を生成する第２解像度変換部と、前記第１解像度変換部からの前記超解像拡大・変換画像を符号化対象画像として、前記第１符号化部からの前記復号画像と、前記第２解像度変換部からの基準解像度をもつ超解像拡大・変換復号画像とを参照画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する第２符号化部と、前記第１符号化部から前記復号画像を取得し、第３の解像度変換処理を行って基準解像度よりも高い解像度をもつ解像度変換拡大復号画像を生成する第３解像度変換部と、前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第２超解像拡大部からの前記超解像拡大復号画像と、前記第３解像度変換部からの前記解像度変換拡大復号画像とを参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、を有する。

また、本発明の動画像符号化方法は、基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成するステップと、基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成するステップと、前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像度をもつ超解像拡大・変換画像を生成するステップと、前記超解像拡大・変換画像を符号化対象画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成するステップと、を有する。

また、本発明の動画像符号化プログラムは、基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成するステップと、基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成するステップと、前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像度をもつ超解像拡大・変換画像を生成するステップと、前記超解像拡大・変換画像を符号化対象画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成するステップと、をコンピュータに実行させる。

また、本発明の動画像復号装置は、例えば図２６に示すように、入力される符号化ビット列に対して所定の多重化分離処理を行って基準解像度の符号化ビット列を出力する多重化分離部と、前記多重化分離部によって得られる基準解像度の符号化ビット列を取得して所定の復号処理を行うことにより基準解像度の復号画像列を生成する第１復号部と、前記第１復号部によって生成された基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成する第１超解像拡大部と、前記第１超解像拡大部によって生成された超解像拡大復号画像列を取得して所定の解像度変換処理を行うことにより、基準解像度の超解像復号画像列を生成する第１解像度変換部と、前記多重化分離部によって得られる基準解像度拡張符号化ビット列と、前記第１復号部によって生成された基準解像度の復号画像列と、前記第１解像度変換部によって生成された基準解像度の超解像復号画像列とを取得して所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成する第２復号部と、を有する動画像復号装置である。

ここで、さらに、例えば図２３に示すように、前記復号部から基準解像度の復号画像列を取得し、所定の解像度変換処理を行うことにより基準解像度よりも高い解像度をもつ高解像度の拡大復号画像列を生成する第２解像度変換部と、前記多重化分離部によって得られた前記高解像度拡張符号化ビット列と、前記超解像拡大部によって生成された超解像拡大復号画像列と、前記第２解像度変換部から高解像度の拡大復号画像列とを取得し、所定の予測処理および所定の復号処理を行うことにより、復号後の超解像拡大画像列を生成する第３復号部と、を有する動画像復号装置でも良い。

また、本発明の再符号化装置は、例えば図２７に示すように、入力される符号化ビット列に対して所定の多重化分離処理を行って基準解像度の符号化ビット列を出力する多重化分離部と、前記多重化分離部によって得られる基準解像度の符号化ビット列を取得して所定の復号処理を行うことにより基準解像度の復号画像列を生成する復号部と、前記復号部

によって生成された基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成する第１超解像拡大部と、前記第１超解像拡大部によって生成された超解像拡大復号画像列を取得して所定の解像度変換処理を行うことにより、基準解像度の超解像復号画像列を生成する第１解像度変換部と、前記多重化分離部によって得られる基準解像度拡張符号化ビット列と、前記復号部によって生成された基準解像度の復号画像列と、前記第１解像度変換部によって生成された基準解像度の超解像復号画像列とを取得して所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成する第２復号部と、前記復号部から復号途中である直交変換係数情報と、前記第２復号部から復号途中である基準解像度の拡張層における直交変換係数情報とを取得し、それぞれの直交変換係数情報を合成した後に所定のエントロピー符号化処理を行うことにより再符号化後の符号化ビット列を生成する再符号化部と、前記再符号化部によって再符号化された符号化ビット列を取得し、所定の構文構造に基づいて、符号化で利用した各種パラメータ情報や符号化モード情報を特定するための識別情報を挿入しながら多重化処理を行い、多重化後の符号化ビット列を生成する多重化部と、を有する動画像再符号化装置である。

ここで、前記再符号化部は、更に、前記復号部から基準解像度の復号画像列と、第１解像度変換部からの基準解像度の超解像復号画像列と、前記第２復号部から基準解像度の超解像画像列とを取得し、所定の符号化処理を行うことにより再符号化後の符号化ビット列を生成する、動画像再符号化装置でも良い。

また、本発明の動画像復号方法は、入力される符号化ビット列に対して所定の多重化分離処理を行って基準解像度の符号化ビット列を出力するステップと、所定の多重化分離処理によって得られた前記基準解像度の符号化ビット列を取得して所定の復号処理を行うことにより基準解像度の復号画像列を生成するステップと、所定の復号処理によって生成された前記基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成するステップと、所定の超解像拡大処理によって生成された前記超解像拡大復号画像列を取得して所定の解像度変換処理を行うことにより、基準解像度の超解像復号画像列を生成するステップと、所定の多重化分離処理によって得られた前記基準解像度拡張符号化ビット列と、所定の復号処理によって生成された前記基準解像度の復号画像列と、所定の解像度変換処理によって生成された基準解像度の超解像復号画像列とを取得して所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成するステップと、を有する動画像復号方法である。

ここで、さらに、所定の復号処理によって生成された前記基準解像度の復号画像列を取得し、所定の解像度変換処理を行うことにより基準解像度よりも高い解像度をもつ高解像度の拡大復号画像列を生成するステップと、所定の多重化分離処理によって得られた前記高解像度拡張符号化ビット列と、所定の超解像拡大処理によって生成された前記超解像拡大復号画像列と、所定の解像度変換処理によって生成された前記高解像度の拡大復号画像列とを取得し、所定の予測処理および所定の復号処理を行うことにより、復号後の超解像拡大画像列を生成するステップと、を有する動画像復号方法でも良い。

また、本発明の再符号化方法は、入力される符号化ビット列に対して所定の多重化分離処理を行うステップと、所定の多重化分離処理によって得られた前記基準解像度の符号化ビット列を取得して所定の復号処理を行うことにより基準解像度の復号画像列を生成するステップと、所定の復号処理によって生成された前記基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成するステップと、所定の超解像拡大処理によって生成された前記超解像拡大復号画像列を取得して所定の解像度変換処理を行うことにより、基準解像度の超解像復号画像列を生成するステップと、所定の多重化分離処理によって得られた前記基準解像度拡張符号化ビット列と、所定の復号処理によって生成された前記基準解像度の復号画像列と、所定の解像度変換処理によって生成された前記基準解像度の超解像復号画像列とを取得して所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成するステップと、所定の復号処理の復号途中である直交変換係数情報と、所定の基準解像度の

拡張復号である第２復号処理の復号途中である基準解像度の拡張層における直交変換係数情報とを取得し、それぞれの直交変換係数情報を合成した後に所定のエントロピー符号化処理を行うことにより再符号化後の符号化ビット列を生成するステップと、再符号化後の前記符号化ビット列を取得し、所定の構文構造に基づいて、符号化で利用した各種パラメータ情報や符号化モード情報を特定するための識別情報を挿入しながら多重化処理を行い、多重化後の符号化ビット列を生成するステップと、を有する動画像再符号化方法である。

また、本発明の動画像復号プログラムは、入力される符号化ビット列に対して所定の多重化分離処理を行って基準解像度の符号化ビット列を出力するステップと、所定の多重化分離処理によって得られた前記基準解像度の符号化ビット列を取得して所定の復号処理を行うことにより基準解像度の復号画像列を生成するステップと、所定の復号処理によって生成された前記基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成するステップと、所定の超解像拡大処理によって生成された前記超解像拡大復号画像列を取得して所定の解像度変換処理を行うことにより、基準解像度の超解像復号画像列を生成するステップと、所定の多重化分離処理によって得られた前記基準解像度拡張符号化ビット列と、所定の復号処理によって生成された前記基準解像度の復号画像列と、所定の解像度変換処理によって生成された基準解像度の超解像復号画像列とを取得して所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成するステップと、をコンピュータに実行させる動画像復号プログラムである。

また、本発明の動画像再符号化プログラムは、入力される符号化ビット列に対して所定の多重化分離処理を行うステップと、所定の多重化分離処理によって得られた前記基準解像度の符号化ビット列を取得して所定の復号処理を行うことにより基準解像度の復号画像列を生成するステップと、所定の復号処理によって生成された前記基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成するステップと、所定の超解像拡大処理によって生成された前記超解像拡大復号画像列を取得して所定の解像度変換処理を行うことにより、基準解像度の超解像復号画像列を生成するステップと、所定の多重化分離処理によって得られた前記基準解像度拡張符号化ビット列と、所定の復号処理によって生成された前記基準解像度の復号画像列と、所定の解像度変換処理によって生成された前記基準解像度の超解像復号画像列とを取得して所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成するステップと、所定の復号処理の復号途中である直交変換係数情報と、所定の基準解像度の拡張復号である第２復号処理の復号途中である基準解像度の拡張層における直交変換係数情報とを取得し、それぞれの直交変換係数情報を合成した後に所定のエントロピー符号化処理を行うことにより再符号化後の符号化ビット列を生成するステップと、再符号化後の前記符号化ビット列を取得し、所定の構文構造に基づいて、符号化で利用した各種パラメータ情報や符号化モード情報を特定するための識別情報を挿入しながら多重化処理を行い、多重化後の符号化ビット列を生成するステップと、をコンピュータに実行させる動画像再符号化プログラムである。

【発明の効果】

【０００８】

本発明の動画像符号化装置等によれば、第１符号化部が基準解像度の入力動画像を符号化する一方、第１超解像拡大部が基準解像度の入力動画像に対し超解像拡大処理を行うことにより、入力動画像中に潜在的に含まれるが基準解像度では十分表現できていなかった空間方向および時間方向の周波数成分情報を含め、その後、第１解像度変換部によって所定の解像度変換処理等を行ってから第２符号化部にて符号化するようにしたので、第２符号化部では、基準解像度の入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行えるという効果を生じる。ここで、第２符号化部では、第１符号化部での復号信号やその復号信号を第２超解像拡大処理および第２解像度変換処理等の加工をした信号を参照信号として利用して符号化することもできる。

【０００９】
また、本発明の動画像符号化装置等によれば、第１符号化部が基準解像度の入力動画像を符号化する一方、第１超解像拡大部が基準解像度の入力動画像に対し超解像拡大処理を行うことにより、入力動画像中に潜在的に含まれるが基準解像度では十分表現できていなかった空間方向および時間方向の周波数成分情報を含め、その後その信号を第３符号化部にて符号化するようにしたので、第３符号化部では、基準解像度の入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行えるという効果を生じる。ここで、第３符号化部では、第１符号化部での復号信号を第２超解像拡大処理や第３解像度変換処理等の加工をして第１超解像拡大信号と同じ解像度に高解像度化した信号を参照信号として符号化することもできる。また、本発明の動画像復号装置等によれば、このように動画像符号化された動画像を入力して復号することができ、さらに、本発明の動画像再符号化装置等によれば、このように動画像符号化された動画像を入力して復号し再符号化することができる。

【図面の簡単な説明】

【００１０】
【図１】本発明の実施の形態１を適用した動画像符号化装置の基本構成の例を示すブロック図である。
【図２】実施の形態１の動画像符号化装置の動作を示すフローチャートである。
【図３】実施の形態１の多重化部１０９が生成する多重化ビット列の構造の一例を示すデータ構造図である。
【図４】実施の形態１の第１超解像拡大部１０３の詳細構成例を示すブロック図、および第１超解像拡大部１０３で行われる所定の超解像拡大処理の一例を示す概念図である。
【図５】実施の形態１の第１超解像拡大部１０３の動作を示すフローチャートである。
【図６】実施の形態１の第１解像度変換部１０４の詳細構成例を示すブロック図、および第１解像度変換部１０４で行われる所定の解像度変換処理の一例を示す概念図である。
【図７】実施の形態２の動画像符号化装置の構成例を示すブロック図である。
【図８】実施の形態２の動画像符号化装置の他の構成例を示すブロック図である。
【図９】実施の形態２の動画像符号化装置のさらに他の構成例を示すブロック図である。
【図１０】実施の形態３の動画像符号化装置の構成例を示すブロック図である。
【図１１】実施の形態３における第１符号化器４０３の構成例を示すブロック図である。
【図１２】実施の形態３における第１復号器４０４の構成例を示すブロック図である。
【図１３】実施の形態４の動画像符号化装置の構成例を示すブロック図である。
【図１４】実施の形態４の動画像符号化装置の動作例を示すフローチャートである。
【図１５】実施の形態４の多重化部１０９が生成する多重化ビット列の構造の一例を示すデータ構造図である。
【図１６】実施の形態５の動画像符号化装置の構成例を示すブロック図である。
【図１７】実施の形態５の動画像符号化装置の他の構成例を示すブロック図である。
【図１８】実施の形態６の動画像符号化装置の構成例を示すブロック図である。
【図１９】実施の形態７の動画像符号化装置の構成例を示すブロック図である。
【図２０】実施の形態７の動画像符号化装置の動作例を示すフローチャートである。
【図２１】実施の形態７の多重化部１０９が生成する多重化ビット列の構造の一例を示すデータ構造図である。
【図２２】実施の形態８の動画像符号化装置の構成例を示すブロック図である。
【図２３】実施の形態９の動画像復号装置の構成例を示すブロック図である。

【図２４】実施の形態９の動画像復号装置の動作例を示すフローチャートである。
【図２５】、図２４のステップＳ６０２の基準解像度の復号処理の動作手順の一例を示すフローチャートである。
【図２６】実施の形態１０の動画像復号装置の構成例を示すブロック図である。
【図２７】実施の形態１１の動画像再符号化装置の構成例を示すブロック図である。
【図２８】実施の形態１１の動画像再符号化装置の動作例を示すフローチャートである。

【発明を実施するための形態】

【００１１】

実施の形態１．

図１は、本発明の実施の形態１の動画像符号化装置の構成例を示すブロック図である。

【００１２】

図１において、実施の形態１の動画像符号化装置は、第１蓄積バッファ１０１、第１符号化部１０２、第１超解像拡大部１０３、第１解像度変換部１０４、第２超解像拡大部１０５、第２解像度変換部１０６、第２符号化部１０７、多重化部１０９を有している。

【００１３】

第１蓄積バッファ１０１は、入力として入力する動画像に対し、後述される所定の超解像前符号化および第１超解像拡大処理を行う際に必要となる、少なくとも２枚の画像を蓄積し、第１符号化部１０２、第１超解像拡大部１０３等に対し、それぞれにおいて必要とされる画像を供給する機能を有する。

【００１４】

第１符号化部１０２は、第１蓄積バッファ１０１から、所定の符号化処理に必要な、基準解像度をもつ画像を取得して、取得した基準解像度をもつ画像に対して所定の符号化処理（以後、超解像前符号化処理と呼ぶ）を行い、第１符号化ビット列を生成し、生成した第１符号化ビット列を多重化部１０９に供給する機能を有する。また、第１符号化部１０２は、所定の復号処理を行い、復号画像を、第２超解像拡大部１０５および第２符号化部１０７に供給する機能を有する。また、第１符号化部１０２は、復号画像を一時的に格納するための機能を有することが望ましい。ここで、所定の復号処理は、生成した第１符号化ビット列に対して復号処理を行って復号画像を生成するように構成しても良い。また、所定の符号化処理に含まれる局部復号処理によって局部復号結果から復号画像を生成するように構成しても良い。

【００１５】

第１超解像拡大部１０３は、第１蓄積バッファ１０１から、所定の超解像拡大処理に必要となる、少なくとも２枚の基準解像度をもつ画像を取得して、取得した基準解像度をもつ画像に対し、所定の超解像拡大処理を行い、基準解像度よりも高い解像度をもつ、超解像拡大画像を生成し、生成した超解像拡大画像を第１解像度変換部１０４に供給する機能を有する。ここで、所定の超解像拡大処理を行う際の拡大率は、所定の拡大率情報として設定されるか、外部のユーザ等から設定される拡大率情報を取得する機能を有し、取得した拡大率情報に基づいて拡大率が特定されて所定の超解像拡大処理を行うように構成しても良い。更に、所定の拡大率情報は、図示しない所定のエントロピー符号化処理を行って拡大率情報ビット列を生成し、多重化部１０９に供給して、復号装置側に伝送するように構成すると更に良い。この点は、第２超解像拡大部１０５も同様である。なお、第１超解像拡大部１０３および第２超解像拡大部１０５の詳細構成例および動作例は、図４において後述する。

【００１６】

第１解像度変換部１０４は、第１超解像拡大部１０３から超解像拡大画像を取得して、取得した超解像拡大画像に対して所定の解像度変換処理を行い、基準解像度よりも高い解像度をもつ超解像拡大画像から、例えば、基準解像度等をもつ超解像画像（超解像拡大・変換画像）を生成し、第２符号化部１０７に供給する機能を有する。

【００１７】

第２超解像拡大部１０５は、第１符号化部１０２から、所定の超解像拡大処理に必要となる、少なくとも２枚の基準解像度をもつ復号画像を取得して、取得した基準解像度の復号画像に対し、所定の超解像拡大処理を行い、基準解像度よりも高い解像度をもつ、超解像拡大復号画像を生成し、生成した超解像拡大復号画像を第２解像度変換部１０６に供給する機能を有する。ここで、第１超解像拡大部１０３と同様に、所定の超解像拡大処理を行う際の拡大率は、所定の拡大率情報として設定されるか、外部のユーザ等から設定される拡大率情報を取得する機能を有し、取得した拡大率情報に基づいて拡大率が特定されて所定の超解像拡大処理を行うようにしても良い。なお、第２超解像拡大部１０５における拡大後の解像度は、第１超解像拡大部１０３における拡大後の解像度と同じでも、異なっていてもどちらでも良い。

【００１８】

第２解像度変換部１０６は、第２超解像拡大部１０５から超解像拡大復号画像を取得して、取得した超解像拡大復号画像に対して所定の解像度変換処理を行って、基準解像度よりも高い解像度をもつ超解像拡大復号画像から、例えば、基準解像度をもつ超解像復号画像（超解像拡大・変換復号画像）を生成し、第２符号化部１０７に供給する機能を有する。ここで、所定の解像度変換処理を行う際の解像度変換率は、所定の解像度変換率情報として設定されるか、外部のユーザ等から設定される解像度変換率情報を取得する機能を有し、取得した解像度変換率情報に基づいて解像度変換率が特定されて所定の解像度変換処理を行うように構成しても良い。ここで、解像度変換率情報は、図示しない所定のエントロピー符号化処理を行って解像度変換率情報ビット列を生成し、多重化部１０９に供給するように構成すると更に良い構成となる。

【００１９】

第２符号化部１０７は、第１解像度変換部１０４から基準解像度の入力画像の超解像拡大・変換信号を符号化対象ピクチャとし、第１符号化部１０２から前記復号画像を第１参照ピクチャとし、第２解像度変換部１０６から基準解像度の復号画像の超解像拡大・変換復号信号を第２参照ピクチャとして、所定の予測処理および第２の符号化処理を行って、第２符号化ビット列を生成し、生成した第２符号化ビット列を多重化部１０９に供給する機能を有する。

【００２０】

ここで、第２符号化部１０７における所定の予測処理を行う際に利用する参照ピクチャは、復号画像から得られる第１参照ピクチャと、超解像拡大・変換復号画像から得られる第２参照ピクチャとのどちらか一方を利用して予測ピクチャを生成し、対象ピクチャから予測ピクチャを減算することで残差情報を生成するような構成としても良い。

【００２１】

また、第１参照ピクチャ、および第２参照ピクチャのどちらも利用せず、対象ピクチャを残差情報として生成するような構成を含めても良い。

【００２２】

更に、第２符号化部１０７は、各ピクチャ、もしくは所定のピクチャ数ごとに参照ピクチャの選択を制御するために、第１参照ピクチャと第２参照ピクチャのどちらを利用したかを特定するための参照ピクチャ選択情報を生成し、図示しない所定のエントロピー符号化部によってエントロピー符号化処理を行って参照ピクチャ選択情報の符号化ビット列を生成し、多重化部１０９に供給するようにしても良い。なお、後述するように、参照ピクチャ情報の符号化ビット列は、多重化ビット列３００の符号化パラメータ情報ビット列３１０として多重化される。また、対象ピクチャをそれぞれ所定の大きさをもつ領域ごとに隙間なく分割し、第１参照ピクチャと第２参照ピクチャも同様に所定の大きさをもつ領域ごとに隙間なく分割し、対応する領域ごとに第１参照ピクチャと第２参照ピクチャのどちらを利用するかを特定しながら予測ピクチャを生成し、対象ピクチャから予測ピクチャを減算することで残差情報を生成するようにしても良い。ここで、所定の大きさをもつ領域ごとに、どの参照ピクチャを利用したかを特定するための情報を参照ピクチャ選択情報とし、図示しない所定のエントロピー符号化部によってエントロピー符号化処理を行い、生

成された参照ピクチャ選択情報の符号化ビット列を多重化部１０９に供給するようにしても良い。ここで、所定の大きさをもつ領域の形状は、所定の矩形領域、または所定の領域分割によって得られる任意形状領域であることが望ましい。

【００２３】

また、第２符号化部１０７は、符号化対象ピクチャから第１参照ピクチャを予測ピクチャとして減算して得られる残差情報を第１の残差情報として所定の第２の符号化処理を行って第１の第２符号化ビット列を生成するとともに、符号化対象ピクチャから第２参照ピクチャを予測ピクチャとして減算して得られる残差情報を第２の残差情報として所定の第２の符号化処理を行って第２の第２符号化ビット列を生成し、更に、第１参照ピクチャ、および第２参照ピクチャのどちらも利用せず、対象ピクチャのみから残差情報を生成し、第３の残差情報として所定の第２の符号化処理を行って第３の第２符号化ビット列を生成し、生成した第１から第３の第２符号化ビット列を多重化部１０９に供給する機能を有するようにしても良い。ここで、以上のような各種の参照ピクチャの選択方法および符号化方法を、参照ピクチャ選択モード情報、および第２符号化の符号化モード情報とし、図示しない所定のエントロピー符号化部によってエントロピー符号化処理を行い、多重化部１０９に供給するようにしても良い。

【００２４】

また、第２符号化部１０７は、例えば、MPEG-4 SVCにおけるCGS(Coarse Grain Scalability)レイヤの符号化を実行し、第１符号化部１０２の基準解像度の動画像列の空間解像度との間の空間解像度が同一である場合には、MPEGおよびITU-Tとの共同グループであるJVT(Joint Video Team)におけるAVCリライティングにて示される、SVCからAVCに容易に変換できるようにするための抑制条件を満たすような所定の構文構造に基づいて第２符号化を行って第２符号化ビット列を生成するようにしても良い。このようにすれば、第２符号化部１０７にて生成される第２符号化ビット列は、階層符号化であるSVCの符号化形式から単層の符号化であるAVCの符号化形式に、完全な復号と符号化を行うような再符号化を行うことなく変換することができる符号化ビット列を生成することができる。

【００２５】

多重化部１０９は、第１符号化部１０２から第１符号化ビット列を取得すると共に、第２符号化部１０７から第２符号化ビット列を取得して、所定の構文構造に基づいて、符号化の際に利用した動きベクトル情報や量子化パラメータ情報、さらには上述の参照ピクチャ選択情報等の各種符号化パラメータや符号化モード等に対して、図示しないエントロピー符号化部を介して得られる各符号化ビット列と、これらを特定するための識別情報を挿入しながら、第１符号化ビット列と、第２符号化ビット列との多重化処理を行い、後述する図３に示すような多重化ビット列を生成する機能を有する。また、多重化部１０９は、第２符号化部１０７が生成した、参照ピクチャ選択モード情報および参照ピクチャ選択情報に対して、図示しない所定のエントロピー符号化された符号化ビット列を更に取得し、同様の多重化処理によって多重化ビット列を生成する機能を有する構成であると良い。

【００２６】

以上のような構成を本実施の形態として少なくとも有し、入力される動画像に対して所定の超解像拡大処理および所定の解像度変換処理で生成される基準解像度の入力画像の超解像拡大・変換信号を利用する構成にすることで、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行うことができる。ここで、第１超解像拡大部１０３、第２超解像拡大部１０５が利用する拡大率は、必ずしも同じ拡大率である必要はない。同様に、第１解像度変換部１０４、第２解像度変換部１０６で利用する解像度変換率は、必ずしも同じ解像度変換率である必要はない。ただし、図１においては、第１解像度変換部１０４および第２解像度変換部１０６による解像度変換処理後の空間解像度は、基準解像度となるような解像度変換率であるものとする。

【００２７】

次に、図１に示す実施の形態１の動画像符号化装置の動作を、図２のフローチャートを参照しながら説明する。

【００２８】
まず、入力される動画像を、第１超解像拡大部１０３における第１超解像拡大処理で必要とされるピクチャ数の画像を、第１蓄積バッファ１０１に格納する（ステップＳ２０１）。
【００２９】
第１超解像拡大部１０３は、所定の超解像拡大処理を行う際に必要となる少なくとも２枚の画像を、第１蓄積バッファ１０１から取得し、所定の第１超解像拡大処理を行う（ステップＳ２０２）。これにより、入力される動画像がもつ空間解像度である基準解像度よりも高い解像度をもつ、超解像拡大画像を生成し、第１解像度変換部１０４に供給する。なお、第１超解像拡大部１０３の具体的構成および超解像処理の内容については後述する。
【００３０】
その後、第１解像度変換部１０４は、第１超解像拡大部１０３から超解像拡大画像を取得し、所定の解像度変換処理を行う（ステップＳ２０３）。これにより、基準解像度の入力画像の超解像拡大・変換信号を生成し、第２符号化部１０７に生成した基準解像度の入力画像の超解像拡大・変換信号を供給する。
【００３１】
その後、第２符号化部１０７は、第１解像度変換部１０４から基準解像度の入力画像の超解像拡大・変換信号を取得し、一時的に蓄積するための所定のバッファに格納する（ステップＳ２０４）。
【００３２】
その一方、第１符号化部１０２は、第１蓄積バッファ１０１から所定の超解像前符号化処理を行う際に必要となる基準解像度の動画像列を取得し、基準解像度の符号化、復号処理を行う（ステップＳ２０５）。これにより、符号化処理結果である基準解像度の第１符号化ビット列と、復号結果である基準解像度の復号画像を生成する。その後、第１符号化部１０２は、生成した第１符号化ビット列を多重化部１０９に供給し、生成した基準解像度の復号画像を第２超解像拡大部１０５および第２符号化部１０７に供給する。
【００３３】
その後、第２符号化部１０７は、第１符号化部１０２から前記復号画像を取得し、一時的に蓄積するための所定のバッファに格納する（ステップＳ２０６）。
【００３４】
その後、第２超解像拡大部１０５は、第１超解像拡大部１０３と同様に、第１符号化部１０２から前記復号画像を取得し、所定の超解像拡大処理を行う（ステップＳ２０７）。これにより、基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成し、第２解像度変換部１０６に供給する。
【００３５】
その後、第２解像度変換部１０６は、第２超解像拡大部１０５から超解像拡大復号画像を取得し、所定の解像度変換処理を行う（ステップＳ２０８）。これにより、基準解像度の復号画像の超解像拡大・変換復号信号を生成し、第２符号化部１０７に供給する。
【００３６】
その後、第２符号化部１０７は、第２解像度変換部１０６から基準解像度の復号画像の超解像拡大・変換復号信号を取得し、一時的に蓄積するための所定のバッファに格納する（ステップＳ２０９）。
【００３７】
なお、ステップ２０２～２０４の処理と、ステップ２０５～２０９の処理とは、並列に実行しても良いし、どちらか一方を先に実行しても良い。
【００３８】
ステップ２０２～２０９の処理が完了すると、第２符号化部１０７は、入力画像を第１超解像拡大部１０３および第１解像度変換部１０４にて第１の超解像拡大および解像度変換した入力画像の超解像拡大・変換信号を符号化対象ピクチャとし、入力画像を第１符号

化部１０２にてそのまま符号化および復号した復号画像を第１参照ピクチャとし、その復号画像を第２超解像拡大部１０５および第２解像度変換部１０６にて第２超解像拡大および解像度変換した復号画像の超解像拡大・変換復号信号を第２参照ピクチャとして、所定の第２の予測処理を行う（ステップＳ２１０）。これにより、第２符号化部１０７は、基準解像度の残差情報を生成する。その後、生成した残差情報に対して所定の第２の符号化である第２の符号化処理を行う（ステップＳ２１１）。これにより、第２符号化ビット列を生成し、多重化部１０９に供給する。

【００３９】

その後、多重化部１０９は、第１符号化部１０２から第１符号化ビット列、第２符号化部１０７から第２符号化ビット列を取得する。所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化パラメータ情報等に対して、図示しないエントロピー符号化部を介して得られる各符号化ビット列を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、第１符号化ビット列、第２符号化ビット列の多重化処理を行い（ステップＳ２１２）、
多重化ビット列を生成する。以上のようなステップを経ることで、本実施の形態の一連の動作が完了する。

【００４０】

このようなステップを実行することで、本発明の動画像符号化装置を動作させることにより、所望の符号化ビット列を生成することができる。

【００４１】

図３は、多重化部１０９が出力する多重化ビット列３００の一例を示している。

【００４２】

図３に示す多重化ビット列３００では、少なくとも符号化パラメータ情報ビット列３１０、第１符号化部１０２からの第１符号化ビット列３２０、第２符号化部１０７からの第２符号化ビット列３３０を多重化している。

【００４３】

ここで、符号化パラメータ情報ビット列３１０には、第１符号化部１０２や第２符号化部１０７がそれぞれの符号化の際に使用した動きベクトル情報や、量子化パラメータ情報、各種符号化モード情報、上述の参照ピクチャ選択モード情報および参照ピクチャ選択情報等の各種符号化パラメータに関する符号化ビット列が格納されている共に、この多重化ビット列３００に第１符号化ビット列３２０と、第２符号化ビット列３３０とが多重化されていることを示す識別情報ビット列３１１とが挿入されている。このような多重化ビット列３００の構成はあくまで一例であり、別の構成としては、符号化全体に渡って必要な情報は、符号化パラメータ情報ビット列３１０の中に格納し、第１符号化部１０２によって使用された、第１符号化部１０２固有の情報は、第１符号化ビット列３２０の中に格納し、第２符号化部１０７によって使用された、第２符号化部１０７固有の情報は、第２符号化ビット列３３０の中に格納するようにしても良い。

【００４４】

なお、本実施の形態の動作を複数の並列処理によって説明したが、この並列処理部分を連続的に処理するように、本実施の形態の構成を動作させても勿論よい。

【００４５】

また、本実施の形態の動作において、第１超解像拡大部１０３、第１解像度変換部１０４を機能させずに、第１蓄積バッファ１０１に格納されている基準解像度の入力画像を、基準解像度の入力画像の超解像拡大・変換信号として第２符号化部１０７に供給し、第２符号化部１０７において、所定の第２符号化処理を行うように、本実施の形態の構成を動作させても勿論よい。

【００４６】

このように、第１超解像拡大部１０３および第２超解像拡大部１０５を有すると共に、第１解像度変換部１０４および第２解像度変換部１０６を有するので、第１の解像度変換処理により、入力画像と同じ基準解像度であるが、第１超解像拡大処理によって空間方向

および時間方向の周波数成分情報が拡大された超解像拡大画像に対して、所望の周波数成分まで周波数帯域を制限することによって基準解像度の入力画像の超解像拡大・変換信号を生成することができる。

【００４７】

そして、このように生成された基準解像度の入力画像の超解像拡大・変換信号は、入力動画像がもつ周波数成分情報の情報量よりも多くの情報量をもつように生成された超解像拡大画像から、基準解像度の空間周波数で表現できる最大の周波数帯域までの周波数成分情報を、基準解像度の入力画像の超解像拡大・変換信号に含めることができるため、このように入力動画像が持つ周波数成分情報の情報量を拡張した上で動画像符号化処理を行い、基準解像度の第１符号化ビット列および基準解像度の第２符号化ビット列を生成することで、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行うことができる。

【００４８】

また、入力された基準解像度の動画像に対して所定の符号化および復号処理によって基準解像度の復号画像を生成することができる。この基準解像度の復号画像に対して、所定の第２超解像拡大処理によって空間方向および時間方向の周波数成分情報が拡大された、基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成し、この生成した超解像拡大復号画像に対して所定の第２の解像度変換処理によって基準解像度の復号画像の超解像拡大・変換復号信号を生成することができる。そして、この生成した基準解像度の復号画像の超解像拡大・変換復号信号を基準解像度の参照ピクチャとし、基準解像度の入力画像の超解像拡大・変換信号との間で所定の予測処理を行った後に、所定の第２の符号化処理を行って、第２符号化ビット列を生成することができる。このように、基準解像度の復号画像の超解像拡大・変換復号信号を参照ピクチャとして利用し、基準解像度の入力画像の超解像拡大・変換信号との間で、同一解像度間における空間解像度の相関性を利用した階層符号化を行って、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行うことができる。

【００４９】

また、第２符号化部１０７は、予測ピクチャを生成する際に、入力画像を第１符号化部１０２にてそのまま符号化および復号した復号画像を第１参照ピクチャとする一方、その復号画像を第２超解像拡大部１０５および第２解像度変換部１０６にて第２超解像拡大および解像度変換した復号画像の超解像拡大・変換復号信号を第２参照ピクチャとし、第１参照ピクチャと第２参照ピクチャとのどちらか一方を利用して予測ピクチャを生成し、符号化処理を行って、要求に応じて、基準解像度の入力画像の超解像拡大・変換信号と復号画像との間における空間解像度の相関性を利用した場合と、基準解像度の入力画像の超解像拡大・変換信号と超解像拡大・変換復号信号との間における空間解像度の相関性を利用した場合の階層符号化を行うことができ、異なる多重化ビット列を生成し、復号側へ供給、蓄積、または伝送することができる。

【００５０】

また、予測ピクチャを生成する際に、各ピクチャ、もしくは所定のピクチャ数ごとに参照ピクチャの選択を制御することで、復号画像の画像品質に応じて適応的に予測ピクチャを生成することが可能となり、結果として符号化効率を向上させることが可能となる。

【００５１】

更に、第１および第２参照ピクチャのどちらを利用したかを特定するための参照ピクチャ選択情報を生成し、多重化部１０９に供給して、多重化ビット列３００に多重化するように構成することで、符号化時に利用した参照ピクチャを容易に特定することができる。

【００５２】

また、符号化対象ピクチャをそれぞれ所定の大きさをもつ領域ごとに隙間なく分割し、第１参照ピクチャと第２参照ピクチャも同様に所定の大きさをもつ領域ごとに隙間なく分割し、対応する領域ごとに第１参照ピクチャと第２参照ピクチャのどちらを利用するかを特定しながら予測ピクチャを生成すれば、復号画像の画像品質に応じてより適応的に予測

ピクチャを生成することが可能となり、結果として符号化効率を向上させることが可能となる。

【００５３】

また、入力された基準解像度の動画像に対して、所定の符号化および復号処理を行って基準解像度の第１符号化ビット列を生成することができるとともに、第２の符号化処理を行って第２符号化ビット列を生成し、これらの符号化ビット列を、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化モード情報等の符号化パラメータ情報に関する符号化ビット列を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、所定の多重化処理を行うことにより多重化ビット列を生成することができる。このような多重化ビット列を生成することにより、本来入力動画像に対する符号化結果と、超解像拡大処理および解像度変換処理によって得られた超解像画像によって拡大された周波数成分情報との予測誤差に対する符号化結果とを単一の符号化ビット列とし、図示されない外部の蓄積装置に伝送した後に所定の記録媒体に記録したり、図示されない外部の通信装置によってネットワーク配信したりすることにより、本実施の形態の動画像符号化装置によって大量の情報量をもつ動画像を効率よく符号化し、蓄積、および伝送することを可能にする。

【００５４】

また、第１の符号化部１０２からの第１符号化ビット列と、第２符号化部１０７からの第２符号化ビット列とを取得し、符号化モード情報に応じて所定の多重化処理を行って多重化ビット列を生成することで、多様な符号化ビット列を生成できるとともに、復号側で選択的な復号を可能にする。

【００５５】

また、本実施の形態の動作において、第１超解像拡大部１０３、第１解像度変換部１０４を機能させずに、第１蓄積バッファ１０１に格納されている基準解像度の入力画像を、基準解像度の入力画像の超解像拡大・変換信号として第２符号化部１０７に供給し、第２符号化部１０７において、所定の第２符号化処理を行うように、本実施の形態の構成を動作させることで、入力される基準解像度の動画像を第２符号化部１０７における符号化対象とすることを可能とし、第２符号化部１０７において、一般的な階層間の予測処理よりも効率の良い参照ピクチャを利用して予測ピクチャを生成することで、生成される残差情報の情報量を少なくすることで、第２符号化ビット列の符号化効率を向上させることを可能とし、元の基準解像度の動画像により近づけるような符号化処理を可能にする。

【００５６】

次に、本発明および本実施の形態で用いられる所定の超解像拡大処理について説明する。

【００５７】

一般に、超解像拡大処理による画像の高解像度化は、単に位置ずれがある等といった、比較的画像間の相関が高い複数の低解像度画像から１枚の高解像度画像を推定することによって行われるものであり、近年数多くの研究で報告されている。例えば、「Sung C.P.Min K.P.共著、Super-Resolution Image Reconstruction: A Technical Overview, IEEE SignalProc. Magazine, 第26巻, 第3号, p.21-36, 2003年」などがある。

【００５８】

また、「B.C.Tom, A.K.Katsaggelos共著、Reconstruction of a high-resolution image by simultaneous registration, restoration, and interpolation of low-resolution images, Proc. IEEE Int. Conf. Image Processing, 第２巻、p.539-542, 1995年」に開示されているＭＬ（Maximum-likelihood）法というものが提案されている。このＭＬ法では、高解像度画像から推定された低解像度画像の画素値と実際に観測された画素値の二乗誤差を評価関数とし、評価関数を最小化するような高解像度画像を推定画像としている。この方法は、最尤推定の原理に基づいて超解像処理を行う方法である。

【００５９】

また、「R.R.Schulz, R.L.Stevenson共著、Extraction of high-resolution frames fr

om video sequences, IEEE Trans. Image Processing, 第５巻, p.996-1011, 1996年」に開示されているＭＡＰ（Maximum A Posterior）法というものが提案されている。ＭＡＰ法では、二乗誤差に高解像度画像の確率情報を付加した評価関数を最小化するような高解像度画像の推定を行う。この方法は、高解像度画像に対する何らかの先見情報を利用して、事後確率を最大化する最適化課題として高解像度画像の推定を行う超解像処理方法である。

【００６０】

更に、「H.Stark, P.Oskoui共著、High resolution image recovery from image-plane arrays, using convex projections, J.Opt. Soc. Am. A, 第６巻, p.1715-1726, 1989年」に開示されているＰＯＣＳ（Projection Onto Convex Sets）法というものが提案されている。このＰＯＣＳ法では、高解像度画像と低解像度画像の画素値に関して連立方程式を作成し、その方程式を逐次的に解くことにより、高解像度画像を得る超解像処理方法である。

【００６１】

本実施の形態における所定の超解像拡大処理は、例えば、上述のような超解像処理を適用したものである。

【００６２】

以下、図４、および図５を参照して、本発明および本実施の形態で用いる超解像拡大処理の基本構成例を説明する。

【００６３】

図４の（ａ）は、本発明の実施の形態１における第１超解像拡大部１０３の詳細構成を示すブロック図、図４の（ｂ）は、超解像処理を示す概念図、図５は、超解像処理の動作例を示すフローチャートである。

【００６４】

図４の（ａ）において、本実施の形態１の第１超解像拡大部１０３は、位置合わせ器１０３１、補間器１０３２、推定画像生成器１０３３、繰り返し判定器１０３４を有している。なお、第２超解像拡大部１０５も同様の構成を有している。

【００６５】

位置合わせ器１０３１は、図４（ｂ）（I）に示すような、超解像拡大処理を行う際の基準となる基準画像と、少なくとも１枚の観測画像を取得する。ここでは、図４（ｂ）（I）に示すような基準画像と、観測画像１と、観測画像２とを取得するものとする。位置合わせ器１０３１は、図４（ｂ）（II）に示すように、取得した基準画像と観測画像１，２の解像度よりも高解像度の画素位置への位置合わせを行い、不等間隔にサンプリングされた不均一高解像度画像を生成する機能を有する。また、生成した不均一高解像度画像を補間器１０３２、繰り返し判定器１０３４に供給する機能を有する。ここで、生成される不均一高解像度画像は、例えば図４（ｂ）（II）で示すように、基準画像の各画素を基準として観測画像の位置合わせを行い、基準画像との間の相関が最も高くなる位置に配置するようにすることが望ましい。また、位置合わせで適用される解像度は、超解像拡大処理後に得られる解像度よりも高い解像度で位置合わせを行うようにすることが望ましい。なお、図４（ｃ）については、図６（ｃ）と対比して後述する。

【００６６】

補間器１０３２は、位置合わせ器１０３１にて生成された不均一高解像度画像を取得して、また、取得した不均一高解像度画像から所定の不均一補間処理を行って、所望の高解像度を持つ補間画像を生成し、推定画像生成器１０３３に供給する機能を有する。また、補間器１０３２は、繰り返し判定器１０３４から処理を継続するための制御情報を取得する。ここで、処理を継続するための制御情報には、推定画像生成器１０３３によって生成された不均一推定画像が含まれると良い。また、補間器１０３２は、制御情報に応じて繰り返し処理を行う場合には、所定の更新方法に従って不均一推定画像を利用し、位置合わせ器１０３１から取得した不均一高解像度画像を更新するとともに、それぞれの補間画素を修正しても良い。

【００６７】
推定画像生成器１０３３は、補間器１０３２にて生成された補間画像を取得し、所定のカメラモデルから得られる点広がり関数（ＰＳＦ関数）を考慮して所定の復元処理を行い、必要であれば所定のノイズ除去処理を行って、図４（ｂ）（III）で示すような所望の解像度を持つ推定画像を生成する機能を有する。また、推定画像に対してリサンプル処理を行って、不均一高解像度画像の各画素に対応する、不均一推定画像を生成し、繰り返し判定器１０３４に供給する機能を有する。また、繰り返し判定器１０３４から制御情報を取得するとともに、制御情報に応じて、生成した所望の解像度を持つ推定画像を高解像度画像として外部に対して出力する機能を有する。
【００６８】
繰り返し判定器１０３４は、位置合わせ器１０３１から不均一高解像度画像を取得するとともに、推定画像生成器１０３３から不均一推定画像を取得して、取得したそれぞれの画像を利用して、所定の判定方法に従って超解像拡大処理の繰り返しが必要か否かを判定し、その判定の結果、繰り返しが必要な場合は、補間器１０３２に対して処理を継続するための制御情報を供給する一方、繰り返しが必要ない場合には、推定画像生成器１０３３に対して超解像拡大処理結果である高解像度の推定画像を出力するための制御情報を供給する機能を有する。
【００６９】
ここで、更に高速な超解像拡大処理を行う必要がある場合には、例えば、特許第３８３７５７５号で開示されているような、超解像処理の高速化方法を、本発明の画像処理装置に適用するようにすると、更に良い構成を実現することができる。
【００７０】
次に、図４の（ａ）に示す超解像拡大部１０３の動作を、図５のフローチャートを参照しながら説明する。
【００７１】
まず、位置合わせ器１０３１は、超解像拡大処理を行う際の基準となる基準画像と、少なくとも１枚の観測画像とを取得する（Ｓ５００）。その後、所望の解像度よりも高い解像度によって、取得したそれぞれの画像の位置合わせを行う（Ｓ５１０）。その際、基準画像の各画素を対応する位置に配置した後、この基準画像との相関が最も高くなるように観測画像の各画素を配置することで、不等間隔にサンプリングされた不均一高解像度画像を生成する。
【００７２】
その後、補間器１０３２は、生成された不均一高解像度画像を取得し、所定の不均一補間処理を行って画素の補間を行う（Ｓ５２０）。これにより、所望の高解像度を持つ補間画像を生成する。
【００７３】
次に、推定画像生成器１０３３は、補間画像を取得し、所定の復元処理を行い、必要であれば所定のノイズ除去処理を行って、所望の解像度を持つ推定画像を生成する（Ｓ５３０）。また、推定画像に対してリサンプル処理を行って、不均一解像度画像の各画素に対応する、不均一推定画像を生成する。
【００７４】
次に、繰り返し判定器１０３４は、位置合わせ器１０３１から不均一解像度画像を取得するとともに、推定画像生成器１０３３から不均一推定画像を取得する。取得したそれぞれの画像を利用して、所定の判定方法に従って超解像拡大処理の繰り返しが必要か否かを判定する（Ｓ５４０）。
【００７５】
超解像拡大処理の繰り返しが必要であると判定された場合（Ｓ５４０　ＹＥＳ）は、補間器１０３２に対して処理を継続するための制御情報を供給する。また、超解像拡大処理の繰り返しが必要でないと判定された場合（Ｓ５４０　ＮＯ）は、推定画像生成器１０３３に対して超解像拡大処理結果である高解像度の推定画像を出力するための制御情報を供

給し、推定画像生成器１０３３は制御情報に応じて、生成した所望の解像度を持つ推定画像を、超解像拡大処理によって得られた高解像度画像として出力する（Ｓ５５０）。これにより、本実施の形態１の超解像拡大処理が完了する。

【００７６】

次に、第１解像度変換部１０４および第２解像度変換部１０６における所定の解像度変換処理の一例について説明する。

【００７７】

図６（ａ）は、第１解像度変換部１０４の構成例を示すブロック図である。

【００７８】

図６（ａ）において、第１解像度変換部１０４は、画素挿入器１０４１、フィルタリング処理器１０４２、画素間引き器１０４３を有する。なお、第２解像度変換部１０６や後述する他の実施の形態の第３解像度変換部１１０も同様に構成されている。

【００７９】

画素挿入器１０４１は、入力された画像の解像度を拡大し、扱うことができる空間周波数帯域を拡張するために、画素間に新たな画素を挿入することで入力画像のアップサンプル画像を生成し、フィルタリング処理器１０４２に供給する。

【００８０】

フィルタリング処理器１０４２は、画素挿入器１０４１からアップサンプル画像を取得し、所定のローパスフィルタを利用してフィルタリング処理を行うことにより帯域制限画像を生成し、画素間引き器１０４３に供給する。ここで、所定のローパスフィルタを利用したフィルタリング処理は、解像度変換部が最終的に出力する画像の空間解像度が表現できる空間周波数帯域の範囲内に、帯域制限および補間ができるローパスフィルタを用いて、アップサンプル画像に対するフィルタリング処理を行えばよく、利用するフィルタは、例えば、sinc関数やLanczos関数に基づいたフィルタ、周波数応答が全帯域にわたって平坦かつ急峻な遮断周波数特性を持つように設計されたFIRおよびIIRフィルタを用いると良い。また、Nearest-neighbor法、Bilinear法、Bicubic法、Spline法、などに基づいたフィルタを用いて処理を軽減させても構わない。

【００８１】

画素間引き器１０４３は、フィルタリング処理器１０４２から帯域制限画像を取得し、解像度変換部が最終的に出力する画像の解像度に合わせるために、所定の画素間引き処理を行い、出力画像を生成する。

【００８２】

図６（ｂ）は、第１解像度変換部１０４のような解像度変換部の解像度変換によって画像の拡大処理を行った後に、縮小処理を行った場合に、画像内の信号成分がどのように変化するかを示した概念図である。

【００８３】

図６（ｂ）（I）に示すように、入力画像に本来含まれる空間周波数成分はｆａまでであるとすると、解像度変換部における解像度変換処理では、仮に扱うことのできる空間周波数成分を拡大するために解像度を高めて画像の拡大処理を行ったとしても、画像の画素数は増大するものの、含まれる空間周波数成分自体を増やすことはできない。よって、図６（ｂ）（II）のような元のままの空間周波数成分のみを含む状態となり、その後、ローパスフィルタリング処理によってｆｍａｘまで帯域制限し、元の空間解像度をもつ画素数まで画素間引き処理をしても、元のままの空間周波数成分を含む画像が生成される。

【００８４】

これに対し、図４（ｃ）は、第１超解像拡大部１０３のような超解像拡大部の超解像拡大処理を行った後に、縮小処理を行った場合に、画像内の信号成分がどのように変化するかを示した概念図である。

【００８５】

図４（ｃ）（I）に示すように、入力画像に本来含まれる空間周波数成分はｆａまでであるとすると、超解像拡大部における超解像拡大処理では、図４（ｂ）のような処理に基

づいて、含まれる空間周波数成分自体が増加する。仮にこのような処理によって図４（ｃ）（II）に示すように、含まれる空間周波数成分はｆｂまで拡張されたとすると、その後、ローパスフィルタリング処理によってｆｍａｘまで帯域制限を行うと、本来含まれていたｆａまでの空間周波数成分以上の成分を、空間周波数ｆｍａｘまで表現できる画像内に含めた画像が生成される。

【００８６】

従って、第１超解像拡大部１０３がこのような超解像拡大処理を行うことにより、同じ解像度の画像であっても、本来含まれるべき画像成分を補った画像を生成して利用できるという点が、第１解像度変換部１０４における解像度変換処理との大きな違いである。このことは、第２超解像拡大部１０５と第３解像度変換部１１０等との関係でも同様である。

【００８７】

ここで、所定の解像度変換処理を行う際の解像度変換率は、所定の解像度変換率情報として設定されるか、外部のユーザ等から設定される解像度変換率情報を取得する機能を有し、取得した解像度変換率情報に基づいて解像度変換率が特定されて所定の解像度変換処理を行うようにしても良い。

【００８８】

例えば、図６（ａ）に示すように第１解像度変換部１０４や第２解像度変換部１０６を構成すると、基準解像度よりも高い解像度となっている超解像拡大画像から、基準解像度の超解像拡大・変換画像となるように画像の縮小処理を行う場合には、画素挿入器１０４１における画素間に新たな画素を挿入する割合と、画素間引き器１０４３における画素間引きを行う割合を解像度変換率に応じて設定する。

【００８９】

ここで、解像度変換率は、解像度変換率＝画素挿入率／画素間引き率と表せ、画素挿入率は、画素挿入率＝入力画素／出力画素、画素間引き率は、画素間引き率＝入力画素／出力画素である。

【００９０】

例えば、解像度変換率２で基準解像度から超解像拡大画像が生成されている場合を考えると、基準解像度に戻すための解像度変換率は１／２であることから、画素挿入器１０４１では入力画素：出力画素＝１：１、つまり入力画像をそのままアップサンプル画像としてフィルタリング処理器１０４２に供給するように設定する。画素間引き器１０４３では入力画素：出力画素＝２：１、つまり２画素につき１画素の間引き処理を行って出力画像を生成する。

【００９１】

また、図６（ａ）に示す第１解像度変換部１０４の構成を利用して画像の拡大処理を行う場合には、例えば、解像度変換率２＝２／１で基準解像度の２倍の拡大画像を生成する場合を考えると、画素挿入器１０４１では入力画素：出力画素＝１：２、つまり１画素につき１画素の挿入を行ってアップサンプル画像を生成してフィルタリング処理器１０４２に供給するように設定する。画素間引き器１０４３では入力画素：出力画素＝１：１、つまり間引き処理を行わずにそのまま出力画像として出力するように設定する。

【００９２】

なお、図６（ａ）に示す第１解像度変換部１０４の構成は、あくまで一例であり、より自由な解像度への画像の拡大・縮小処理が必要な場合には、Spline法などを利用することで、実数の位置精度で自由な位置の画素を、入力画像から生成し、所望の解像度を持つ画像を生成することができるように構成することもできる。

【００９３】

従って、本実施の形態１の動画像符号化装置によれば、入力動画像がもつ空間解像度を基準解像度とし、入力動画像中に潜在的に含まれるが基準解像度では十分表現できていなかった空間方向および時間方向の周波数成分情報を、第１超解像拡大部１０３による所定の超解像処理に基づいて復元した上で基準解像度よりも高い解像度で表現し、入力動画像

が持つ周波数成分情報の情報量を拡張した超解像拡大画像を生成した上で動画像符号化処理を行って、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行えるという効果を生じる。

【００９４】

また、本実施の形態１の動画像符号化装置では、第１超解像拡大部１０３にて生成した超解像拡大画像に対して、第１解像度変換部１０４にて所定の解像度変換処理を行い、基準解像度で表現された超解像拡大・変換画像を生成するようにしているので、入力動画像中に潜在的に含まれるが基準解像度では十分表現できていなかった空間方向および時間方向の周波数成分情報を生成し、本来含まれていなかった周波数成分情報を、基準解像度で表現できる周波数成分情報の範囲内に制限した上で超解像画像に含ませることにより、入力動画像では表現できていなかった周波数成分情報を超解像画像に反映し、この超解像画像に基づいて動画像符号化処理を行って、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行えるという効果を生じる。

【００９５】

更に、本実施の形態１の動画像符号化装置では、第１の符号化部１０２にて符号化および復号されて生成された基準解像度の復号画像に対し、第２超解像拡大部１０５および第２解像度変換部１０６にて所定の超解像処理および解像度変換処理を行って、超解像拡大復号画像および基準解像度の復号画像の超解像拡大・変換復号信号を生成し、第２符号化部１０７は、入力画像を第１超解像拡大部１０３および第１解像度変換部１０４にて第１の超解像拡大および解像度変換した入力画像の超解像拡大・変換信号を符号化対象ピクチャとし、入力画像を第１符号化部１０２にてそのまま符号化および復号した復号画像を第１参照ピクチャとし、その復号画像を第２超解像拡大部１０５および第２解像度変換部１０６にて第２超解像拡大および解像度変換した復号画像の超解像拡大・変換復号信号を第２参照ピクチャとして、所定の第２の予測処理を行って符号化するようにしたので、従来の動画像符号化で得られる予測ピクチャもしくは予測ブロックの画像品質よりも良い画像品質の予測ピクチャもしくは予測ブロックを得ることができ、結果として符号化効率を向上させる効果を生じる。

【００９６】

実施の形態２．

上記実施の形態１では、図１に示すように第２符号化部１０７に２つの参照ピクチャ、すなわち入力画像を第１符号化部１０２にてそのまま符号化および復号した復号画像である第１参照ピクチャと、その復号画像を第２超解像拡大部１０５および第２解像度変換部１０６にて第２超解像拡大および解像度変換した復号画像の超解像拡大・変換復号信号である第２参照ピクチャとを入力して、予測効率の高い参照ピクチャを利用して予測ピクチャを生成するように説明したが、例えば、図７に示すように、第２符号化部１０７に入力画像を第１符号化部１０２にてそのまま符号化および復号した復号画像である第１参照ピクチャのみ入力させるか、あるいは図８に示すように、第２符号化部１０７に第１符号化部１０２からの復号画像を第２超解像拡大部１０５および第２解像度変換部１０６にて第２超解像拡大および解像度変換した復号画像の超解像拡大・変換復号信号である第２参照ピクチャのみ入力させて、第２符号化部１０７は、第１または第２参照ピクチャのみを利用して、第１の超解像拡大および解像度変換した入力画像の超解像拡大・変換信号を符号化対象ピクチャとして予測符号化するようにしても勿論よい。

【００９７】

また、さらに、図９に示すように、第２符号化部１０７に２つの参照ピクチャ、すなわち入力画像を第１符号化部１０２にてそのまま符号化および復号した復号画像である第１参照ピクチャと、その復号画像を第２超解像拡大部１０５および第２解像度変換部１０６にて第２超解像拡大および解像度変換した復号画像の超解像拡大・変換復号信号である第２参照ピクチャとのいずれも入力させず、第２符号化部１０７は、第１の超解像拡大および解像度変換した入力画像の超解像拡大・変換信号を符号化対象ピクチャとして予測符号化するようにしても勿論よい。

【００９８】
実施の形態３．
次に、本発明の実施の形態３の動画像符号化装置について説明する。
【００９９】
図１０は、実施の形態３の動画像符号化装置の構成例を示すブロック図である。
【０１００】
図１０に示す実施の形態３の動画像符号化装置は、図１に示す実施の形態１の動画像符号化装置の構成を更に詳細にし、さらに、蓄積制御部４１２、第２蓄積バッファ４１６、第２参照ピクチャバッファ４１８、符号量制御部４２３を新たに追加したものである。
【０１０１】
また、図１０において、第１符号化部１０２は、第１予測器４０２、第１符号化器４０３、第１復号器４０４、イントラ予測器４０５、第１予測ピクチャバッファ４０６、第１参照ピクチャバッファ４０７、動き推定器４０８、動き補償器４０９、加算器４１０、デブロック器４１１を有している。これにより、一般的な動画像符号化であるISO/IEC SC29 WG11において規格標準化されているMPEG-4 AVCと同等の機能を実現できる。ただし、ここでの第１符号化部１０２の詳細構成は一例であり、第１符号化部１０２の機能を実現できる、別の異なる構成であっても勿論よい。例えば、ディジタル放送などで利用されているMPEG-2であっても構わないし、MPEG-4 AVCのスケーラブル拡張であるMPEG-4 SVCであっても構わない。また、JPEG2000に代表される、ウェーヴレット変換に基づく超解像前符号化器を採用しても構わない。
【０１０２】
また、図１０において、第２符号化部１０７は、第３蓄積バッファ４１５、第２予測器４２０、第２符号化器４２１を有している。
【０１０３】
次に、図１０に示す実施の形態３の動画像符号化装置について、図１に示す実施の形態１の構成要素とは、異なる機能や新たな機能を有する構成要素について説明する。
【０１０４】
第１予測器４０２は、第１蓄積バッファ１０１から、所定の符号化処理に必要な、基準解像度をもつ画像を取得するとともに、第１予測ピクチャバッファ４０６から格納された予測ピクチャもしくは予測ブロックを取得して、第１予測器４０２は、取得した画像および予測ピクチャに対して所定の予測処理を行って残差情報を生成し、第１符号化器４０３に供給する機能を有する。ここで、第１予測器４０２における予測処理は、取得した基準解像度をもつ画像の各画像を符号化対象ピクチャとし、取得した予測ピクチャもしくは予測ブロックを対象ピクチャから減算することで、残差情報を生成し、第１符号化器４０３に供給するような処理であると良い。
【０１０５】
第１符号化器４０３は、第１予測器４０２から予測処理後の残差情報を取得し、所定の符号化処理によって前記基準解像度の第１符号化ビット列を生成し、第１復号器４０４および多重化部１０９に供給する機能を有する。ここで、第１符号化器４０３は、図１１（ａ）に示すように第１復号器４０４に対して第１符号化ビット列を供給するようにしても良いし、図１１（ｂ）に示すように所定の符号化処理の過程で量子化後情報を生成し、第１復号器４０４に供給するようにしても良い。また、第１符号化器４０３は、符号量制御部４２３からの制御情報に基づいて、符号化処理によって生成される第１符号化ビット列の符号量を変動させる機能を有する。
【０１０６】
第１復号器４０４は、図１１（ａ），（ｂ）に示す第１符号化器４０３の出力に応じて、図１２（ａ）に示すように第１符号化器４０３から第１符号化ビット列を取得するか、あるいは図１２（ｂ）に示すように第１符号化器４０３から量子化後情報を取得して、第１符号化ビット列もしくは量子化後情報に対して所定の復号処理を行って復号残差情報を生成し、加算器４１０に供給する機能を有する。

【０１０７】
イントラ予測器４０５は、所定のイントラ予測処理を行う際に必要となる、復号済みの画像情報を取得し、所定のイントラ予測処理を行ってイントラ予測情報を生成し、第１予測ピクチャバッファ４０６に供給する機能を有する。ここで、イントラ予測器４０５が生成するイントラ予測情報は、予測対象となっているブロックの周囲のブロックで、かつ復号済みのブロックから所定のイントラ予測処理に基づいて生成したイントラ予測ブロックであることが望ましい。
【０１０８】
第１予測ピクチャバッファ４０６は、イントラ予測器４０５からイントラ予測情報、動き補償器４０９から動き補償予測情報を取得し、予測ピクチャもしくは予測ブロックとして蓄積し、第１予測器４０２および加算器４１０に予測ピクチャもしくは予測ブロックを供給する機能を有する。ここで、第１予測ピクチャバッファ４０６は、蓄積制御部４１２から蓄積制御情報を取得し、この蓄積制御情報に基づいて予測ピクチャもしくは予測ブロックの取得、蓄積、供給を制御しても良い。
【０１０９】
第１参照ピクチャバッファ４０７は、デブロック器４１１からデブロック処理後の復号ピクチャもしくは復号ブロック、加算器４１０から復号ピクチャもしくは復号ブロックを取得し、参照ピクチャもしくは参照ブロックとして蓄積し、蓄積した参照ピクチャもしくは参照ブロックを、要求に応じて少なくともイントラ予測器４０５、動き推定器４０８、動き補償器４０９、第２蓄積バッファ４１６に供給する機能を有する。ここで、第１参照ピクチャバッファ４０７は、蓄積制御部４１２から蓄積制御情報を取得し、この蓄積制御情報に基づいて参照ピクチャもしくは参照ブロックの取得、蓄積、供給を制御しても良い。
【０１１０】
動き推定器４０８は、第１蓄積バッファ１０１から符号化対象ピクチャと、第１参照ピクチャバッファ４０７から参照ピクチャを取得し、所定の動き推定を行って動きベクトル情報を生成する機能を有する。動き推定器４０８は、生成した動きベクトル情報を少なくとも動き補償器４０９に供給する機能を有する。ここで、動き推定器４０８によって生成された動きベクトル情報は、図示されていないエントロピー符号化器によって所定のエントロピー符号化処理が行われ、多重化部１０９に供給されるように構成すると更に良い構成となる。
【０１１１】
動き補償器４０９は、第１参照ピクチャバッファ４０７から参照ピクチャを取得するとともに、動き推定器４０８から動きベクトル情報を取得して、動き補償器４０９は、取得した参照ピクチャと動きベクトル情報に基づいて所定の動き補償を行って予測ピクチャを生成し、第１予測ピクチャバッファ４０６に供給する機能を有する。
【０１１２】
加算器４１０は、第１復号器４０４から復号残差情報、第１予測ピクチャバッファ４０６から予測ピクチャまたは予測ブロックを取得して加算することで復号画像を生成し、第１参照ピクチャバッファ４０７およびデブロック器４１１に供給する機能を有する。
【０１１３】
デブロック器４１１は、加算器４１０から復号画像を取得し、所定のデブロック処理を行ってデブロック後の復号画像を生成し、第１参照ピクチャバッファ４０７に供給する機能を有する。
【０１１４】
図１１（ａ），（ｂ）は、実施の形態３の第１符号化器４０３の構成例を示している。
【０１１５】
第１符号化器４０３は、例えば、直交変換器４０３１、量子化器４０３２、エントロピー符号化器４０３３を有している。
【０１１６】

直交変換器４０３１は、残差情報を取得し、所定の直交変換処理を行って直交変換係数情報を生成して量子化器に供給する機能を有する。

【０１１７】

量子化器４０３２は、直交変換器４０３１から直交変換係数情報を取得し、所定の量子化処理を行って量子化後情報を生成し、エントロピー符号化器４０３３に供給する機能を有する。ここで、第１復号器４０４において、符号化ビット列に対してエントロピー復号をせずに局部復号結果である量子化後情報を取得して所定の復号処理を行う構成の場合には、図１１（ｂ）に示すように、量子化器４０３２は、量子化後情報を第１復号器４０４に供給するように構成しても良い。

【０１１８】

エントロピー符号化器４０３３は、量子化器４０３２から量子化後情報を取得し、所定のエントロピー符号化処理を行って第１符号化ビット列を生成し、多重化部１０９に供給する機能を有する。また、第１復号器４０４において、第１符号化ビット列に対してエントロピー復号を行って量子化後情報を取得して所定の復号処理を行う構成の場合には、図１１（ａ）に示すように、エントロピー符号化器４０３３は、第１符号化ビット列を生成し、第１復号器４０４に供給するように構成しても良い。

【０１１９】

図１２（ａ），（ｂ）は、実施の形態３の第１復号器４０４の構成例を示している。

【０１２０】

第１復号器４０４は、局部復号処理を行うために、少なくとも図１２（ａ），（ｂ）に示すように逆量子化器４０４２、逆直交変換器４０４３を有している。また、第１符号化ビット列を取得して完全な復号処理を行うような構成であれば、図１２（ａ）に示すように更にエントロピー復号器４０４１を備えるようにしても良い。

【０１２１】

エントロピー復号器４０４１は、第１符号化器４０３から第１符号化ビット列を取得し、所定のエントロピー復号処理を行って量子化後情報を生成し、逆量子化器４０４２に供給する機能を有する。

【０１２２】

逆量子化器４０４２は、エントロピー復号器４０４１もしくは量子化器４０３２から量子化後情報を取得し、所定の逆量子化処理を行って、逆量子化後の直交変換係数情報を生成し、逆直交変換器４０４３に供給する機能を有する。

【０１２３】

逆直交変換器４０４３は、逆量子化器４０４２から逆量子化後の直交変換係数情報を取得し、所定の直交変換処理を行って復号残差情報を生成し、加算器４１０に供給する機能を有する。

【０１２４】

図１０に戻り、実施の形態３の第２符号化部１０７は、第３蓄積バッファ４１５、第２予測器４２０、第２符号化器４２１を有している。

【０１２５】

第３蓄積バッファ４１５は、第１解像度変換部１０４から基準解像度の入力画像の超解像拡大・変換信号を取得して蓄積するとともに、第２予測器４２０に供給する機能を有する。また、第３蓄積バッファ４１５は、蓄積制御部４１２から蓄積制御情報を取得し、この蓄積制御情報に基づいて前記基準解像度の入力画像の超解像拡大・変換信号の取得、蓄積、供給を制御する機能を有する。

【０１２６】

第２予測器４２０は、第３蓄積バッファ４１５から基準解像度の入力画像の超解像拡大・変換信号と、第２蓄積バッファ４１６から基準解像度の復号画像、第２解像度変換部１０６から基準解像度の復号画像の超解像拡大・変換復号信号を取得して、入力画像の超解像拡大・変換信号を符号化対象ピクチャとし、第１符号化部１０２からの復号画像を第１参照ピクチャとし、基準解像度の復号画像の超解像拡大・変換復号信号の各超解像拡大・

変換復号画像を第２参照ピクチャとした上で、所定の予測処理を行って予測ピクチャを生成し、対象ピクチャから予測ピクチャを減算することで残差情報を生成して第２符号化器４２１に供給する機能を有する。

【０１２７】

第２符号化器４２１は、第２予測器４２０から残差情報を取得し、所定の符号化処理を行って前記第２符号化ビット列を生成し、多重化部１０９に供給すると共に、符号量制御部４２３からの制御情報に基づいて、符号化処理によって生成される第２符号化ビット列の符号量を変動させる機能を有する。

【０１２８】

蓄積制御部４１２は、各蓄積バッファに対して蓄積制御情報を供給することで、各蓄積バッファの蓄積状態やピクチャの取得や供給のタイミングを制御する機能を有する。

【０１２９】

第２蓄積バッファ４１６は、第１参照ピクチャバッファ４０７から前記復号画像を取得して、取得した基準解像度の復号画像を第２超解像拡大部１０５および第２予測器４２０に供給する機能を有する。

【０１３０】

また、第２蓄積バッファ４１６は、蓄積制御部４１２から蓄積制御情報を取得し、この蓄積制御情報に基づいて前記復号画像の取得、蓄積、供給を制御する機能を有する。

【０１３１】

第２参照ピクチャバッファ４１８は、第２超解像拡大部１０５から超解像拡大復号画像を取得して蓄積し、取得した超解像拡大復号画像を第２解像度変換部１０６に供給する機能を有する。その際、第２参照ピクチャバッファ４１８は、蓄積制御部４１２から蓄積制御情報を取得し、この蓄積制御情報に基づいて前記基準解像度の入力画像の超解像拡大・変換信号の取得、蓄積、供給を制御する。

【０１３２】

符号量制御部４２３は、各符号化器が生成する符号化ビット列の符号量を監視し、所定の範囲の符号量に収まるように、各符号化器の動作を制御すると共に、符号量の状態や、蓄積制御部４１２から得られる各蓄積バッファの状態に応じて、各蓄積バッファの動作を変更するように蓄積制御部４１２を制御する機能を有する。ここで、符号量制御部４２３は、各符号化器の動作を制御して符号量の制御を行う際に、各符号化器の量子化パラメータ情報を変更することで、符号量の制御を行う。また、必要に応じて、各符号化器の残差情報の信号振幅の状態や、各予測器でどちらの参照ピクチャが利用されたかを特定することができる参照ピクチャ選択情報に基づいて、復号画像に対する超解像拡大処理が有効であったか、有効でなかったかを判定し、有効でなかった場合には、蓄積制御部４１２に第２蓄積バッファ４１６に対して、第２超解像拡大部１０５に対する復号画像の供給を停止するように指示するとともに、超解像拡大処理が有効であった場合に利用していた量子化パラメータ情報とは異なる、第１参照ピクチャに基づいて生成された予測残差情報用の量子化パラメータ情報を利用するように切り替えることで、符号量を制御できるようにすると良い構成となる。

【０１３３】

従って、本実施の形態３の動画像符号化装置によれば、図１に示す実施の形態１の動画像符号化装置と同様の効果が得られると共に、蓄積制御部４１２と、符号量制御部４２３等とを有し、各バッファにおける蓄積制御や、第１符号化部１０２と第２符号化部１０７とにおける符号量制御を行うようにしたので、第１符号化部１０２と第２符号化部１０７とにおける符号量や、各バッファにおける蓄積量を考慮した符号化を実行することができる。

【０１３４】

なお、本実施の形態３では、図１に示す実施の形態１の動画像符号化装置に対し、蓄積量制御部４１２と符号量制御部４２３等を設け、各バッファにおける蓄積量制御や第１符号化部１０２と第２符号化部１０７とにおける符号量制御を行うように説明したが、図７

や、図８、図９に示す実施の形態２の動画像符号化装置に対し、蓄積量制御部４１２と符号量制御部４２３等を設けて同様に蓄積量制御や符号量制御を行うようにしても勿論よい。

【０１３５】

実施の形態４．

次に、本発明の実施の形態４の動画像符号化装置について説明する。

【０１３６】

図１３は、実施の形態４の動画像符号化装置の構成例を示すブロック図である。

【０１３７】

図１３において、実施の形態４の動画像符号化装置は、第１蓄積バッファ１０１、第１符号化部１０２、第１超解像拡大部１０３、第２超解像拡大部１０５、第３解像度変換部１１０、第３符号化部１０８、多重化部１０９を有している。

【０１３８】

第１蓄積バッファ１０１は、図１における実施の形態と同等の機能を有するため、ここでは説明を省略する。

【０１３９】

第１符号化部１０２は、図１における実施の形態と同等の機能を有する。ここで、実施の形態４では、生成された復号画像は、第２超解像拡大部１０５および第３解像度変換部１１０に供給するように構成する。

【０１４０】

第１超解像拡大部１０３は、図１における実施の形態と同等の機能を有する。ここで、実施の形態４の第１超解像拡大部１０３は、生成した基準解像度よりも高い解像度をもつ超解像拡大画像を第３符号化部１０８に供給する機能を有する。

【０１４１】

第２超解像拡大部１０５は、図１における実施の形態と同等の機能を有する。ここで、実施の形態４の第２超解像拡大部１０５は、生成した基準解像度よりも高い解像度をもつ超解像拡大復号画像を、第３符号化部１０８に供給する機能を有する。

【０１４２】

第３解像度変換部１１０は、第１符号化部１０２から基準解像度の復号画像を取得し、取得した基準解像度の復号画像に対して所定の解像度変換処理を行って、第１超解像拡大部１０３が生成する超解像拡大画像、および第２超解像拡大部１０５が生成する超解像拡大復号画像の空間解像度と同じ解像度をもつ、高解像度の拡大復号画像である解像度変換拡大復号画像を生成し、第３符号化部１０８に供給する機能を有する。ここで、所定の解像度変換処理を行う際の解像度変換率は、所定の解像度変換率情報として設定されるか、外部のユーザ等から設定される解像度変換率情報を取得する機能を有し、取得した解像度変換率情報に基づいて解像度変換率が特定されて所定の解像度変換処理を行うように構成しても良い。

【０１４３】

第３符号化部１０８は、第１超解像拡大部１０３から超解像拡大画像を取得すると共に、第３解像度変換部１１０からは高解像度の解像度変換拡大復号画像を、第２超解像拡大部１０５からは高解像度の超解像拡大復号画像を取得して、取得した超解像拡大画像を符号化対象ピクチャとし、第３解像度変換部１１０からの解像度変換拡大復号画像を第１参照ピクチャ、第２超解像拡大部１０５からの超解像拡大復号画像を第２参照ピクチャとして、所定の予測処理および符号化処理を行い、第３符号化ビット列を生成し、生成した第３符号化ビット列を多重化部１０９に供給する機能を有する。

【０１４４】

ここで、第３符号化部１０８における所定の予測処理を行う際に利用する参照ピクチャは、解像度変換拡大復号画像から得られる第１参照ピクチャと、超解像拡大復号画像から得られる第２参照ピクチャとのどちらか一方を利用して予測ピクチャを生成し、対象ピクチャから予測ピクチャを減算することで残差情報を生成する。

【０１４５】
また、第１参照ピクチャ、および第２参照ピクチャのどちらも利用せず、対象ピクチャを残差情報として生成するような構成を含めても良い。
【０１４６】
更に、第３符号化部１０８は、各ピクチャ、もしくは所定のピクチャ数ごとに参照ピクチャの選択を制御するために、第１参照ピクチャと第２参照ピクチャのどちらを利用したかを特定するための参照ピクチャ選択情報を生成し、図示しない所定のエントロピー符号化部によってエントロピー符号化処理を行って参照ピクチャ選択情報の符号化ビット列を生成し、多重化部１０９に供給するようにしても良い。
【０１４７】
また、対象ピクチャをそれぞれ所定の大きさをもつ領域ごとに隙間なく分割し、第１参照ピクチャと第２参照ピクチャも同様に所定の大きさをもつ領域ごとに隙間なく分割し、対応する領域ごとに第１参照ピクチャと第２参照ピクチャのどちらを利用するかを特定しながら予測ピクチャを生成し、対象ピクチャから予測ピクチャを減算することで残差情報を生成するようにしても良い。ここで、所定の大きさをもつ領域ごとに、どの参照ピクチャを利用したかを特定するための情報を参照ピクチャ選択情報とし、図示しない所定のエントロピー符号化部によってエントロピー符号化処理を行い、生成された参照ピクチャ選択情報の符号化ビット列を多重化部１０９に供給するようにしても良い。ここで、所定の大きさをもつ領域の形状は、所定の矩形領域、または所定の領域分割によって得られる任意形状領域であることが望ましい。
【０１４８】
また、第３符号化部１０８は、符号化対象ピクチャから第１参照ピクチャを予測ピクチャとして減算して得られる残差情報を、第１の残差情報として所定の第３符号化処理を行って第１の第３符号化ビット列を生成するとともに、対象ピクチャから第２参照ピクチャを予測ピクチャとして減算して得られる残差情報を第２の残差情報として所定の第３符号化処理を行って第２の第３符号化ビット列を生成し、更に、第１参照ピクチャ、および第２参照ピクチャのどちらも利用せず、対象ピクチャのみから残差情報を生成し、第３の残差情報として所定の第３の符号化処理を行って第３の第３符号化ビット列を生成し、生成した第１から第３の第３符号化ビット列を多重化部１０９に供給する機能を有するようにしても良い。ここで、以上のような各種の参照ピクチャの選択方法および符号化方法を、参照ピクチャ選択モード情報、および第３符号化の符号化モード情報とし、図示しない所定のエントロピー符号化部によってエントロピー符号化処理を行い、多重化部１０９に供給するようにしても良い。
【０１４９】
多重化部１０９は、第１符号化部１０２から第１符号化ビット列を取得すると共に、第３符号化部１０８から第３符号化ビット列を取得して、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化パラメータ情報等に対して、図示しないエントロピー符号化部を介して得られる各符号化ビット列を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、第１符号化ビット列、第３符号化ビット列の多重化処理を行い、出力である多重化ビット列を生成する機能を有する。また、多重化部１０９は、第３符号化部１０８が生成した、参照ピクチャ選択モード情報および参照ピクチャ選択情報に対して、図示しない所定のエントロピー符号化された符号化ビット列を更に取得し、同様の多重化処理によって多重化ビット列を生成する機能を有する構成であると良い。
【０１５０】
また、多重化部１０９は、第１符号化部１０２からの第１符号化ビット列、第３符号化部１０８から第１および第２の第３符号化ビット列を取得するようにしても良い。ここで、多重化部１０９は、取得した基準解像度の第１符号化ビット列を複製し、基準解像度の第１から第３の第１符号化ビット列を生成しても良い。多重化部１０９は、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピ

クチャ選択情報、符号化パラメータ情報等に対して、図示しないエントロピー符号化部を介して得られる各符号化ビット列を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、基準解像度の第１の第１符号化ビット列と第１の第３符号化ビット列、基準解像度の第２の第１符号化ビット列と第２の第３符号化ビット列、基準解像度の第３の第１符号化ビット列と第３の第３符号化ビット列に対して多重化処理を行い、出力である多重化後の第１から第３の符号化ビット列を生成しても良い。ここで、多重化部１０９は、符号化モード情報などからの要求に応じて選択的に多重化後の第１から第３の符号化ビット列を生成するようにしても構わない。また、ここで利用する符号化モード情報には、少なくとも多重化を制御するための情報が含まれているように構成しても良い。

【０１５１】

本実施の形態４の動画像符号化装置は、以上のような機能を有し、入力される動画像に対して所定の超解像拡大処理および所定の解像度変換処理で生成される超解像拡大画像や超解像拡大・変換画像を利用することで、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行うことができる。なお、図１３の構成において、第１超解像拡大部１０３、第２超解像拡大部１０５が利用する拡大率は、同一の拡大率であることが望ましいが、同一の拡大率でなくても良い。また、第３解像度変換部１１０で利用する解像度変換率は、第１超解像拡大部１０３が生成する超解像拡大画像、および第２超解像拡大部１０５が生成する超解像拡大復号画像がもつ空間解像度と同じ解像度となるような解像度変換率であることが望ましいが、同一の拡大率でなくても良い。

【０１５２】

次に、図１３に示す実施の形態４の動画像符号化装置の動作を、図１４のフローチャートを参照しながら説明する。

【０１５３】

図１４は、実施の形態４の動画像符号化装置の動作を示すフローチャートである。

【０１５４】

まず、図１３に示す実施の形態４の動画像符号化装置では、入力される動画像から第１超解像拡大部１０３における第１超解像拡大処理で必要とされるピクチャ数の画像を、第１蓄積バッファ１０１に格納する（Ｓ１４０１）。

【０１５５】

第１超解像拡大部１０３は、所定の超解像拡大処理を行う際に必要となる少なくとも２枚の画像を、第１蓄積バッファ１０１から取得し、所定の第１超解像拡大処理を行う（Ｓ１４０２）。これにより、入力される動画像がもつ空間解像度である基準解像度よりも高い解像度をもつ、超解像拡大画像を生成し、第３符号化部１０８に供給する。

【０１５６】

第３符号化部１０８は、第１超解像拡大部１０３から超解像拡大画像を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１４０３）。

【０１５７】

その一方、第１符号化部１０２は、第１蓄積バッファ１０１から所定の超解像前符号化処理を行う際に必要となる基準解像度の動画像列を取得し、基準解像度の符号化、復号処理を行う（Ｓ１４０４）。これにより、符号化処理結果である基準解像度の第１符号化ビット列と、復号結果である基準解像度の復号画像を生成する。

【０１５８】

その後、第１符号化部１０２は、生成した第１符号化ビット列を多重化部１０９に供給し、生成した基準解像度の復号画像を、一時的に蓄積するための所定のバッファに格納する（Ｓ１４０５）。

【０１５９】

第２超解像拡大部１０５は、第１符号化部１０２から前記復号画像を取得し、所定の超解像拡大処理を行う（Ｓ１４０６）。これにより、基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成し、第３符号化部１０８に供給する。

【０１６０】

その後、第３符号化部１０８は、第２超解像拡大部１０５から超解像拡大復号画像を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１４０７）。

【０１６１】

また、第３解像度変換部１１０は、第１符号化部１０２から前記復号画像を取得し、所定の解像度変換処理を行う（Ｓ１４０８）。これにより、基準解像度よりも高い解像度をもつ高解像度の拡大復号画像である解像度変換拡大復号画像を生成し、第３符号化部１０８に供給する。

【０１６２】

その後、第３符号化部１０８は、第３解像度変換部１１０から高解像度の解像度変換拡大復号画像を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１４０９）。

【０１６３】

なお、Ｓ１４０２～Ｓ１４０２の処理と、Ｓ１４０４～Ｓ１４０７の処理と、Ｓ１４０２～Ｓ１４０２の処理は、並列処理でも、順番に処理しても良い。

【０１６４】

以上の処理が完了すると、第３符号化部１０８は、第１超解像拡大部１０３から取得した超解像拡大画像を符号化対象ピクチャとし、第３解像度変換部１１０から取得した解像度変換拡大復号画像を第１参照ピクチャとし、第２超解像拡大部１０５から取得した超解像拡大復号画像を第２参照ピクチャとして、所定の第３の予測処理を行う（Ｓ１４１０）。これにより、高解像度の残差情報を生成する。その後、生成した残差情報に対して所定の第３の符号化である第３符号化処理を行う（Ｓ１４１１）。これにより、第３符号化ビット列を生成し、多重化部１０９に供給する。

【０１６５】

その後、多重化部１０９は、第１符号化部１０２から第１符号化ビット列、第３符号化部１０８から第３符号化ビット列を取得し、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化パラメータ情報等に対して、図示しないエントロピー符号化部を介して得られる各符号化ビット列を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら多重化処理を行い（Ｓ１４１２）、図１５に示すような多重化ビット列を生成する。以上のようなステップを経ることで、本実施の形態の一連の動作が完了する。

【０１６６】

図１５は、実施の形態４の多重化部１０９が生成する多重化ビット列３００の構造の一例を示すデータ構造図である。

【０１６７】

多重化ビット列３００に、符号化パラメータ情報ビット列３１０と、第１符号化部１０２からの第１符号化ビット列３２０と、第３符号化部１０８からの第３符号化ビット列３４０とが多重化される。

【０１６８】

なお、本実施の形態４の動作を複数の並列処理によって説明したが、この並列処理部分を連続的に処理するように、本実施の形態の構成を動作させても勿論よい。

【０１６９】

従って、本実施の形態４の動画像符号化装置によれば、上記実施の形態１等と同様に、第１超解像拡大部１０３および第２超解像拡大部１０５により、第１および第２超解像拡大処理を行うような構成とすることで、入力動画像がもつ空間解像度を基準解像度とし、第１超解像拡大処理により、基準解像度よりも高い解像度をもつ超解像拡大画像を生成することができる。

【０１７０】

その結果、この第１超解像拡大処理により、入力動画像から、入力動画像中に潜在的に含まれるが基準解像度では十分表現できていなかった空間方向および時間方向の周波数成分情報を、所定の超解像処理に基づいて復元した上で基準解像度よりも高い解像度で表現

することができる。このように入力動画像が持つ周波数成分情報の情報量を拡張した上で動画像符号化処理を行って、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行うことができる。

【０１７１】

また、入力された基準解像度の動画像に対して、所定の符号化および復号処理を行って基準解像度の復号画像を生成し、この復号画像に対して所定の第２超解像拡大処理によって空間方向および時間方向の周波数成分情報が拡大された、基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成し、この生成された超解像拡大復号画像を、高解像度の参照ピクチャとし、超解像拡大画像との間で所定の予測処理を行った後に、所定の第３符号化処理を行って、第３符号化ビット列を生成することができる。このように、超解像拡大復号画像を参照ピクチャとして利用し、超解像拡大画像との間で、空間解像度の相関性を利用した階層符号化を行って、入力された動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行うことができる。

【０１７２】

つまり、本実施の形態４では、上記実施の形態１等と同様に、入力された本来の基準解像度の空間解像度で表現できる範囲内でしか表現できなかった画像の周波数成分情報を、画像自体に潜在的に含まれる相関性を利用して復元するために、所定の超解像拡大処理を行い、新たに生み出された、基準解像度よりも高い空間解像度でしか表現できない周波数成分情報を、超解像拡大画像として反映させ、このようにして生成された、新たな最終的な符号化対象である、超解像拡大画像と、本来の基準解像度の動画像列のそれぞれに含まれる空間解像度の周波数成分情報の違いを、本発明により符号化および伝送することが可能となる点が重要である。仮に、第２超解像拡大処理のみを行い、超解像拡大復号画像を生成して外部の表示装置に出力するような動画像復号装置があったとしても、復号対象となる基準解像度の第１符号化ビット列に対して所定の復号処理を行って生成された基準解像度の復号画像には、少なからず符号化時の劣化が含まれており、この復号画像に対して所定の第２超解像拡大処理を行ったとしても、符号化劣化を含んだ状態の基準解像度の復号画像に対して超解像拡大処理を行うため、一定の効果を得られるものの、必ずしも正しい超解像拡大処理を行うことができるとは限らない。このように必ずしも十分ではない超解像拡大復号画像に対して、本来あるべき超解像拡大画像に含まれる周波数成分情報との違いを、所定の拡張符号化処理によって符号化、および伝送することで、本発明では、超解像拡大画像に含まれる周波数成分情報を、より多く正確に、復号側に供給できるような構成となっている。

【０１７３】

また、本実施の形態４では、予測ピクチャを生成する際に、第３解像度変換部１１０からの第１参照ピクチャと、第２超解像拡大部１０５からの第２参照ピクチャとのどちらか一方を利用して第３の符号化である第３符号化処理を行って、要求に応じて、超解像拡大画像と第１参照ピクチャである解像度変換拡大復号画像との間における空間解像度の相関性を利用した場合と、超解像拡大画像と第２参照ピクチャである超解像拡大復号画像との間における空間解像度の相関性を利用した場合の階層符号化を行うことができ、異なる多重化ビット列を生成し、復号側へ供給、蓄積、または伝送することができる。

【０１７４】

また、本実施の形態４では、予測ピクチャを生成する際に、各ピクチャ、もしくは所定のピクチャ数ごとに参照ピクチャの選択を制御することで、復号画像の画像品質に応じて適応的に予測ピクチャを生成することが可能となり、結果として符号化効率を向上させることが可能となる。

【０１７５】

更に、本実施の形態４では、第１および第２参照ピクチャのどちらを利用したかを特定するための参照ピクチャ選択情報を生成し、多重化部１０９に供給するように構成することで、本発明の符号化時に利用した参照ピクチャを容易に特定することができるようになる。

【０１７６】
また、本実施の形態４では、符号化対象ピクチャをそれぞれ所定の大きさをもつ領域ごとに隙間なく分割し、第１参照ピクチャと第２参照ピクチャも同様に所定の大きさをもつ領域ごとに隙間なく分割し、対応する領域ごとに第１参照ピクチャと第２参照ピクチャのどちらを利用するかを特定しながら予測ピクチャを生成することで、復号画像の画像品質に応じてより適応的に予測ピクチャを生成することが可能となり、結果として符号化効率を向上させることが可能となる。
【０１７７】
また、入力された基準解像度の動画像に対して、所定の符号化および復号処理を行って基準解像度の第１符号化ビット列を生成するとともに、第３符号化処理を行って高解像度の第３符号化ビット列を生成し、これらの符号化ビット列を所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化パラメータ情報等に対して、図示しないエントロピー符号化部を介して得られる各符号化ビット列を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、所定の多重化処理を行うことにより多重化ビット列を生成することができる。このような多重化ビット列を生成することにより、本来入力動画像に対する符号化結果と、超解像拡大処理によって得られた超解像拡大画像によって拡大された周波数成分情報との予測誤差に対する符号化結果とを単一の符号化ビット列とし、図示されない外部の蓄積装置に伝送した後に所定の記録媒体に記録したり、図示されない外部の通信装置によってネットワーク配信したりすることにより、本実施の形態の動画像符号化装置によって大量の情報量をもつ動画像を効率よく符号化し、蓄積、および伝送することを可能にする。
【０１７８】
また、第１、第２の第３符号化ビット列を取得し、符号化モード情報に応じて多重化する符号化ビット列の組み合わせを特定し、特定された複数の符号化ビット列に対して所定の多重化処理を行って多重化ビット列を生成することで、多様な符号化ビット列を生成できるとともに、復号側で選択的な復号を可能にする。
【０１７９】
実施の形態５．
上記実施の形態４では、図１３に示すように第３符号化部１０８では、２つの参照ピクチャ、すなわち第１符号化部１０２からの復号画像を第３解像度変換部１１０にて第３解像度変換処理をした解像度変換拡大復号画像を第１参照ピクチャ、第１符号化部１０２からの復号画像を第２超解像拡大部１０５にて第２超解像拡大処理をした超解像拡大復号画像を第２参照ピクチャとして入力し、予測効率の高い参照ピクチャを予測ピクチャとして利用するように説明したが、例えば、図１６に示すように、第３解像度変換部１１０からの解像度変換拡大復号画像のみが参照ピクチャとして入力するか、あるいは、例えば、図１７に示すように、第２超解像拡大部１０５からの超解像拡大復号画像のみが参照ピクチャとして入力し、第１超解像拡大部１０３からの超解像拡大画像を符号化対象ピクチャとして予測符号化するようにしても勿論よい。
【０１８０】
実施の形態６．
次に、本発明の実施の形態６の動画像符号化装置について説明する。
【０１８１】
図１８は、実施の形態６の動画像符号化装置の構成例を示すブロック図である。
【０１８２】
図１８に示す実施の形態６の動画像符号化装置は、図１３に示す実施の形態４の動画像符号化装置の構成を更に詳細にし、さらに、蓄積制御部４１２、第２蓄積バッファ４１６、第２参照ピクチャバッファ４１８、符号量制御部４２３を新たに追加したものである。
【０１８３】
以下に、図１８において、図１３に示す実施の形態４の構成要素とは異なる機能や新たな機能を有する構成要素について説明する。

【０１８４】
第４蓄積バッファ５０１は、第１超解像拡大部１０３から超解像拡大画像を取得して蓄積し、蓄積した超解像拡大画像を第３予測器５０２に供給する機能を有する。なお、第４蓄積バッファ５０１は、蓄積制御部４１２から蓄積制御情報を取得し、この蓄積制御情報に基づいて超解像拡大画像の取得、蓄積、供給を制御しても良い。
【０１８５】
第３予測器５０２は、第４蓄積バッファ５０１から超解像拡大画像、第２参照ピクチャバッファ４１８から超解像拡大復号画像、第３解像度変換部１１０から解像度変換拡大復号画像を取得して、第３予測器５０２は、取得した超解像拡大画像の各超解像拡大画像を符号化対象ピクチャとし、解像度変換拡大復号画像から得られる各解像度変換拡大復号画像を解像度変換拡大復号画像から得られる第１参照ピクチャとし、超解像拡大復号画像の各超解像拡大復号画像を、超解像拡大復号画像から得られる第２参照ピクチャとした上で、所定の予測処理を行って予測ピクチャを生成し、符号化対象ピクチャから予測ピクチャを減算することで残差情報を生成して第３符号化器５０３に供給する機能を有すると更に良い構成となる。
【０１８６】
第３符号化器５０３は、第３予測器５０２から残差情報を取得し、所定の符号化処理を行って第３符号化ビット列を生成し、多重化部１０９に供給する機能を有する。また、第３符号化器５０３は、符号量制御部４２３からの制御情報に基づいて、符号化処理によって生成する第３符号化ビット列の符号量を変動させる機能を有することが望ましい。
【０１８７】
第３解像度変換部１１０は、第２蓄積バッファ４１６から前記復号画像を取得し、所定の解像度変換処理を行って、高解像度の拡大復号画像である解像度変換拡大復号画像を生成し、第３予測器５０２に供給する機能を有する。ここで、高解像度の解像度変換拡大復号画像は、第１超解像拡大部１０３が生成する超解像拡大画像、および第２超解像拡大部１０５が生成する超解像拡大復号画像がもつ空間解像度と同じ解像度となるように、第３解像度変換部１１０において所定の解像度変換処理が行われるようにしても良い。
【０１８８】
また、以下に、蓄積制御部４１２、第２蓄積バッファ４１６、第２参照ピクチャバッファ４１８、符号量制御部４２３に関して説明する。
【０１８９】
蓄積制御部４１２が備える機能は、図１０における実施の形態３の蓄積制御部４１２が備える機能と同等であれば良いことから、ここでは説明を省略する。
【０１９０】
第２蓄積バッファ４１６が備える機能は、図１０における実施の形態３の第２蓄積バッファ４１６が備える機能と同等であれば良いことから、ここでは説明を省略する。
【０１９１】
第２参照ピクチャバッファ４１８は、更に、第２超解像拡大部１０５から取得した超解像拡大復号画像を第３予測器５０２に供給する機能を有する。
【０１９２】
符号量制御部４２３が備える機能も、図１０における実施の形態３の符号量制御部４２３が備える機能と同等である。
【０１９３】
このように、図１８に示す本実施の形態６の動作は、図１０に示す実施の形態４の動作と同様であるため、ここでは説明を省略する。
【０１９４】
従って、本実施の形態６の動画像符号化装置によれば、図１３に示す実施の形態４の動画像符号化装置と同様の効果が得られると共に、図１０に示す実施の形態３と同様に、さらに、蓄積量制御部４１２と符号量制御部４２３等とを有し、各バッファにおける蓄積量制御や、第１符号化部１０２と第３符号化部１０８とにおける符号量制御を行うようにし

たので、第１符号化部１０２と第３符号化部１０８とにおける符号量や、各バッファにおける蓄積量を考慮した符号化を実行することができる。

【０１９５】

なお、本実施の形態６では、図１３に示す実施の形態４の動画像符号化装置に対し、蓄積量制御部４１２と符号量制御部４２３等を設け、各バッファにおける蓄積量制御や第１符号化部１０２と第３符号化部１０８とにおける符号量制御を行うように説明したが、図１６や図１７に示す実施の形態５の動画像符号化装置に対し、蓄積量制御部４１２と符号量制御部４２３等を設けて、同様に蓄積量制御や符号量制御を行うようにしても勿論よい。

【０１９６】

実施の形態７．

次に、本発明の実施の形態７の動画像符号化装置について説明する。

【０１９７】

図１９は、実施の形態７の動画像符号化装置の構成例を示すブロック図である。

【０１９８】

図１９に示す実施の形態７の動画像符号化装置は、図１に示す実施の形態１の動画像符号化装置と、図１３に示す実施の形態４の動画像符号化装置とを統合した構成となっており、各構成要素の基本的な機能において、同一であるものに関しては説明を省略し、異なる部分に関して以下に説明する。

【０１９９】

多重化部１０９は、更に、第１符号化部１０２からの第１符号化ビット列を取得すると共に、第２符号化部１０７から第２符号化ビット列を、第３符号化部１０８から第３符号化ビット列を取得して、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択モード情報および参照ピクチャ選択情報、符号化パラメータ情報等に対して、図示しないエントロピー符号化部を介して得られる各符号化ビット列を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、第１符号化ビット列、第２符号化ビット列、第３符号化ビット列の多重化処理を行い、多重化ビット列を生成する機能を有する。ここで、多重化部１０９は、第１符号化部１０２から取得した基準解像度の第１符号化ビット列を複製して第１の第１符号化ビット列と第２の第１符号化ビット列として、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択モード情報および参照ピクチャ選択情報、符号化パラメータ情報等に対して、図示しないエントロピー符号化部を介して得られる各符号化ビット列を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、複製した基準解像度の第１の第１符号化ビット列と、取得した第２符号化ビット列の多重化処理を行い、出力である多重化後の符号化ビット列を生成しても良い。また、多重化部１０９は、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択モード情報および参照ピクチャ選択情報、符号化パラメータ情報等に対して、図示しないエントロピー符号化部を介して得られる各符号化ビット列を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、複製した基準解像度の第２の第１符号化ビット列と、取得した第３符号化ビット列の多重化処理を行い、出力である多重化後の第２の符号化ビット列を生成しても良い。

【０２００】

また、多重化部１０９は、更に、第２符号化部１０７から第１および第２の第２符号化ビット列を取得し、第３符号化部１０８から第１および第２の第３符号化ビット列を取得しても良い。その上で、多重化部１０９は、取得した基準解像度の第１符号化ビット列を複製して、基準解像度の第１から第６の第１符号化ビット列を生成し、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択モード情報および参照ピクチャ選択情報、符号化パラメータ情報等に対して、図示しないエントロピー符号化部を介して得られる各符号化ビット列を、後に続く符号化ビッ

ト列の組を識別するための識別情報等を挿入しながら、基準解像度の第１の第１符号化ビット列と第１の第２符号化ビット列、基準解像度の第２の第１符号化ビット列と第２の第２符号化ビット列、基準解像度の第３の第１符号化ビット列と第３の第２符号化ビット列、基準解像度の第４の第１符号化ビット列と第１の第３符号化ビット列、基準解像度の第５の第１符号化ビット列と第２の第３符号化ビット列、基準解像度の第６の第１符号化ビット列と第３の第３符号化ビット列との多重化処理を行って、多重化後の第１から第６の符号化ビット列を生成し、要求に応じて出力する機能を有すると更に良い構成となる。ここで、多重化部１０９は、要求に応じて選択的に多重化後の第１から第６の符号化ビット列を生成するようにしても構わない。

【０２０１】

以上のような機能を本実施の形態７は少なくとも有し、入力される動画像に対して所定の超解像拡大処理および所定の解像度変換処理で生成される基準解像度の入力画像の超解像拡大信号や超解像拡大・変換信号を利用する構成にすることで、入力動画像がもつ情報量よりも多くの情報量に基づいた動画像符号化を行うことができる。ここで、図１９において、第１超解像拡大部１０３、第２超解像拡大部１０５が利用する拡大率は、同一の拡大率であることが望ましいが、異なる拡大率でもかまわない。また、第１解像度変換部１０４、第２解像度変換部１０６で利用する解像度変換率は、同一の解像度変換率であり、解像度変換処理後の空間解像度は、基準解像度となるような解像度変換率であることが望ましいが、異なる拡大率でもかまわない。更に、第３解像度変換部１１０で利用する解像度変換率は、第１超解像拡大部１０３が生成する超解像拡大画像、および第２超解像拡大部１０５が生成する超解像拡大復号画像がもつ空間解像度と同じ解像度となるような解像度変換率であることが望ましいが、異なる拡大率でもかまわない。

【０２０２】

次に、図１９に示す実施の形態７の動作を、図２０のフローチャートを参照しながら説明する。

【０２０３】

まず、入力される動画像を、第１超解像拡大部１０３における第１超解像拡大処理で必要とされるピクチャ数の画像を、第１蓄積バッファ１０１に格納する（Ｓ１９０１）。

【０２０４】

第１超解像拡大部１０３は、所定の超解像拡大処理を行う際に必要となる少なくとも２枚の画像を、第１蓄積バッファ１０１から取得し、所定の第１超解像拡大処理を行う（Ｓ１９０２）。これにより、入力される動画像がもつ空間解像度である基準解像度よりも高い解像度をもつ、超解像拡大画像を生成し、第１解像度変換部１０４および第３符号化部１０８に供給する。

【０２０５】

その後、第３符号化部１０８は、第１超解像拡大部１０３から超解像拡大画像を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１９０３）。

【０２０６】

その後、第１解像度変換部１０４は、第１超解像拡大部１０３から超解像拡大画像を取得し、所定の解像度変換処理を行う（Ｓ１９０４）。これにより、基準解像度の入力画像の超解像拡大・変換信号を生成し、第２符号化部１０７に生成した基準解像度の入力画像の超解像拡大・変換信号を供給する。

【０２０７】

その後、第２符号化部１０７は、第１解像度変換部１０４から基準解像度の入力画像の超解像拡大・変換信号を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１９０５）。

【０２０８】

一方、第１符号化部１０２は、第１蓄積バッファ１０１から所定の超解像前符号化処理を行う際に必要となる基準解像度の動画像列を取得し、基準解像度の符号化、復号処理を行う（Ｓ１９０６）。これにより、符号化処理結果である基準解像度の第１符号化ビット

列と、復号結果である基準解像度の復号画像を生成する。その後、第１符号化部１０２は、生成した第１符号化ビット列を多重化部１０９に供給し、生成した基準解像度の復号画像を第２超解像拡大部１０５、第２符号化部１０７、および第３解像度変換部１１０に供給する。

【０２０９】

次に、第２符号化部１０７は、第１符号化部１０２から前記復号画像を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１９０７）。

【０２１０】

また、第２超解像拡大部１０５は、第１符号化部１０２から基準解像度の復号画像を取得し、所定の超解像拡大処理を行う（Ｓ１９０８）。これにより、基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成し、第２解像度変換部１０６、および第３符号化部１０８に供給する。

【０２１１】

すると、第３符号化部１０８は、第２超解像拡大部１０５から超解像拡大復号画像を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１９０９）。

【０２１２】

また、第２解像度変換部１０６は、第２超解像拡大部１０５から超解像拡大復号画像を取得し、所定の解像度変換処理を行う（Ｓ１９１０）。これにより、基準解像度の超解像拡大・変換復号信号を生成し、第２符号化部１０７に供給する。

【０２１３】

そして、第２符号化部１０７は、第２解像度変換部１０６から基準解像度の超解像拡大・変換復号信号を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１９１１）。

【０２１４】

また、第３解像度変換部１１０は、第１符号化部１０２から前記復号画像を取得し、所定の解像度変換処理を行う（Ｓ１９１２）。これにより、高解像度の拡大復号画像である解像度変換拡大復号画像を生成し、第３符号化部１０８に供給する。

【０２１５】

その後、第３符号化部１０８は、第３解像度変換部１１０から高解像度の解像度変換拡大復号画像を取得し、一時的に蓄積するための所定のバッファに格納する（Ｓ１９１３）。

【０２１６】

なお、Ｓ１９０２～Ｓ１９０５との処理と、Ｓ１９０６～Ｓ１９１１の処理と、Ｓ１９１２～Ｓ１９１３の処理は、並列処理しても、順番に処理してもどちらでも良い。

【０２１７】

そして、以上の処理が完了すると、第２符号化部１０７は、第１解像度変換部１０４から取得した入力画像の超解像拡大・変換画像を符号化対象ピクチャとし、第１符号化部１０２から取得した復号画像を第１参照ピクチャとし、第２解像度変換部１０６から取得した超解像拡大・変換復号画像を第２参照ピクチャとして、所定の第２の予測処理を行って基準解像度の残差情報を生成し（Ｓ１９１４）、生成した残差情報に対して所定の第２の符号化である第２の符号化処理を行う（Ｓ１９１５）。これにより、第２符号化ビット列を生成し、多重化部１０９に供給する。

【０２１８】

また、第３符号化部１０８は、第１超解像拡大部１０３から取得した入力画像の超解像拡大画像を符号化対象ピクチャとし、第３解像度変換部１１０から取得した解像度変換拡大復号画像を第１参照ピクチャとし、第２超解像拡大部１０５から取得した超解像拡大復号画像を第２参照ピクチャとして、所定の第３の予測処理を行って高解像度の残差情報を生成し（Ｓ１９１６）、生成した残差情報に対して所定の第３の符号化である第３符号化処理を行う（Ｓ１９１７）。これにより、第３符号化ビット列を生成し、多重化部１０９に供給する。その後、他の並列処理が完了するまで待機する。

出証特２００９－３０１７００７

【０２１９】
そして、多重化部１０９は、第１符号化部１０２から第１符号化ビット列、第２符号化部１０７から第２符号化ビット列、および第３符号化部１０８から第３符号化ビット列を取得し、所定の構文構造に基づいて、符号化の際に使用した動きベクトル情報や量子化パラメータ情報、参照ピクチャ選択情報、符号化パラメータ情報等に対して、図示しないエントロピー符号化部を介して得られる各符号化ビット列を、後に続く符号化ビット列の組を識別するための識別情報等を挿入しながら、第１符号化ビット列、第２符号化ビット列および第３符号化ビット列の多重化処理を行い（Ｓ１９１８）、多重化ビット列を生成する。以上のようなステップを経ることで、本実施の形態の一連の動作が完了する。
【０２２０】
図２１は、実施の形態７の多重化部１０９が生成する多重化ビット列３００の構造の一例を示すデータ構造図である。
【０２２１】
多重化ビット列３００に、符号化パラメータ情報ビット列３１０と、第１符号化部１０２からの第１符号化ビット列３２０と、第２符号化部１０７からの第２符号化ビット列３３０と、第３符号化部１０８からの第３符号化ビット列３４０とが多重化される。
【０２２２】
なお、本実施の形態の動作を複数の並列処理によって説明したが、この並列処理部分を連続的に処理するように、本実施の形態の構成を動作させても勿論よい。
【０２２３】
従って、本実施の形態７では、図１９に示すような構成とすることによって、図１に示す実施の形態１と、図１２に示す実施の形態４の構成によって得られるそれぞれの効果を同時に得ることができる。
【０２２４】
また、本実施の形態７では、第１符号化部１０２が入力された基準解像度の動画像に対して、所定の符号化および復号処理を行って基準解像度の第１符号化ビット列を生成し、第２符号化部１０７が第２の符号化処理を行って基準解像度の第２符号化ビット列を生成するとともに、第３符号化部１０８が第３符号化処理を行って高解像度の第３符号化ビット列を生成し、これら第１～第３の符号化ビット列を所定の多重化処理を行うことにより多重化ビット列を生成することにより、本来入力動画像に対する符号化結果と、超解像拡大処理および解像度変換処理によって得られた超解像拡大画像や超解像拡大・変換画像によって拡大された周波数成分情報との予測誤差に対する符号化結果とを単一の符号化ビットストリームによって効率よく蓄積もしくは伝送することができるとともに、復号側で選択的な復号を可能にする。
【０２２５】
また、本実施の形態７では、第２符号化部１０７が所定の予測処理を行う際に利用する参照ピクチャとして、基準解像度の復号画像から得られる第１参照ピクチャと、基準解像度の復号画像の超解像拡大・変換復号信号から得られる第２参照ピクチャとのどちらか一方を利用して予測ピクチャを生成し、基準解像度の入力画像の超解像拡大・変換信号から得られる符号化対象ピクチャから予測ピクチャを減算することで残差情報を生成し、この残差情報に対して所定の符号化処理を行って第２符号化ビット列を生成するとともに、第３符号化部１０８は、所定の予測処理を行う際に利用する参照ピクチャとして、高解像度の解像度変換拡大復号画像から得られる第１参照ピクチャと、超解像拡大復号画像から得られる第２参照ピクチャとのどちらか一方を利用して予測ピクチャを生成し、超解像拡大画像から得られる符号化対象ピクチャから予測ピクチャを減算することで残差情報を生成し、この残差情報に対して所定の符号化処理を行って第３符号化ビット列を生成するように構成することで、要求に応じて、基準解像度の入力画像の超解像拡大・変換信号と復号画像との間における空間解像度の相関性を利用した場合と、基準解像度の入力画像の超解像拡大・変換信号と超解像拡大・変換復号信号との間における空間解像度の相関性を利用した場合の階層符号化を行うことができるとともに、超解像拡大画像と解像度変換拡大復

号画像との間における空間解像度の相関性を利用した場合と、超解像拡大画像と超解像拡大復号画像との間における空間解像度の相関性を利用した場合の階層符号化を行うことができ、異なる多重化ビット列を生成し、復号側へ供給、蓄積、または伝送することができる。

【０２２６】

更に、第１および第２参照ピクチャのどちらを利用したかを特定するための参照ピクチャ選択情報、および参照ピクチャ選択情報を生成し、多重化部１０９に供給するように構成することで、本実施の形態７の符号化時に利用した参照ピクチャを容易に特定することができるようになる。

【０２２７】

また、本実施の形態７では、第１符号化部１０２から得られる基準解像度の第１符号化ビット列、第２符号化部１０７から得られる第１から第３の第２符号化ビット列、第３符号化部１０８から得られる第１から第３の第３符号化ビット列に対して多重化処理を行い、多重化後の第１から第６の符号化ビット列を要求に応じて生成することで多様な符号化ビット列の生成を可能にする。また、図示されない外部の蓄積装置に伝送した後に所定の記録媒体に記録したり、図示されない外部の通信装置によってネットワーク配信したりすることにより、本実施の形態の動画像符号化装置によって大量の情報量をもつ動画像を効率よく符号化し、蓄積、および伝送することを可能にするとともに、復号側で選択的な復号を可能にする。

【０２２８】

なお、図１９に示す実施の形態７の動画像符号化装置では、図１に示す実施の形態１の動画像符号化装置と、図１３に示す実施の形態４の動画像符号化装置とを統合した構成としているが、図７、図８、図９に示す実施の形態２の動画像符号化装置と、図１６、図１７に示す実施の形態５の動画像符号化装置とを統合したり、さらには図１に示す実施の形態１の動画像符号化装置と、図１６、図１７に示す実施の形態５の動画像符号化装置とを統合したり、図７、図８、図９に示す実施の形態２の動画像符号化装置と、図１３に示す実施の形態４の動画像符号化装置とを統合しても勿論よい。

【０２２９】

実施の形態８．

次に、本発明の実施の形態８の動画像符号化装置について説明する。

【０２３０】

図２２は、実施の形態８の動画像符号化装置の構成例を示すブロック図である。

【０２３１】

図２２に示す実施の形態８における構成要素は、図１３に示す実施の形態４と、図１８に示す実施の形態６とを統合したものである。従って、実施の形態８の動作も、実施の形態４との動作と、実施の形態６の動作とを組み合わせたものになるので、省略する。

【０２３２】

従って、本実施の形態８の動画像符号化装置によれば、図１９に示す実施の形態７の動画像符号化装置と同様の効果が得られると共に、図１０に示す実施の形態３や、図１８に示す実施の形態６と同様に、さらに、蓄積量制御部４１２と符号量制御部４２３等とを有し、各バッファにおける蓄積量制御や、第１符号化部１０２と第３符号化部１０８とにおける符号量制御を行うようにしたので、第１符号化部１０２と第３符号化部１０８とにおける符号量や、各バッファにおける蓄積量を考慮した符号化を実行することができる。

【０２３３】

なお、上記実施の形態１～８の説明では、動画像符号化装置をブロック図により図示してハードウエアにより構成したものとして説明したが、本発明では、これに限らず、ＣＰＵと、メモリやＨＤＤに格納された動画像符号化プログラムにより、上記実施の形態１～８の機能をソフトウェア処理により達成するようにしても勿論よい。また、本発明の動画像符号化装置、動画像符号化方法、および動画像符号化プログラムの適用される範囲は、動画像を符号化するような装置、方法、プログラム、システム等であれば、特に限定され

るものではない。本発明は、例えば、ＴＶに代表される放送装置、携帯電話、テレビ会議装置、監視装置、ＤＶＤ－Ｒ／ＲＷやＢＤ－Ｒ／ＲＷ、ＨＤＤ、ＳＤ（商標または登録商標）、ホログラフィックメモリなどの追記および書き換え可能な記録媒体を利用した録画再生装置、およびカムコーダといった撮像記録再生装置、オーサリングなどの記録編集装置、動画像の配信装置などに適用しても構わない。

【０２３４】

実施の形態９．

次に、実施の形態９以降により、上記実施の形態１～８の動画像符号化装置によって符号化された符号化ビット列を取得して、復号や、復号および再符号化する本発明の動画像復号装置、動画像再符号化装置の実施形態について説明する。

【０２３５】

図２３は、実施の形態９の動画像復号装置の構成例を示すブロック図である。

【０２３６】

図２３において、実施の形態９の動画像復号装置は、少なくとも多重化分離部１８０１、第１復号部１８０２、第１超解像拡大部１８０３、第１解像度変換部１８０４、第２復号部１８０５、第２解像度変換部１８０６、第３復号部１８０７を有している。

【０２３７】

多重化分離部１８０１は、入力として入力する多重化後の符号化ビット列を取得し、所定の構文構造に基づいて符号化で利用した各種パラメータ情報や符号化モード情報を特定するための識別情報を特定しながら多重化分離を行うことで、多重化後の符号化ビット列から、第１復号部１８０２で復号される第１符号化ビット列、第２復号部１８０５で復号される第２符号化ビット列、第３復号部１８０７で復号される第３符号化ビット列を取得する機能を有する。また、多重化分離部１８０１は、多重化後の符号化ビット列から取得が可能であれば、拡大率情報ビット列、解像度変換率情報ビット列、第２復号処理で利用するための参照ピクチャ選択モード情報、および参照ピクチャ選択情報の符号化ビット列、第３復号処理で利用するための参照ピクチャ選択モード情報、および参照ピクチャ選択情報の符号化ビット列、を更に取得し、供給することができる機能を有する構成であると良い。多重化分離部１８０１は、少なくとも、取得した第１符号化ビット列を第１復号部１８０２、第２符号化ビット列を第２復号部１８０５、第３符号化ビット列を第３復号部１８０７にそれぞれ供給する機能を有する。更に、多重化分離部１８０１は、多重化後の符号化ビット列から取得が可能であれば、動きベクトル情報の符号化ビット列を取得し、第１復号部１８０２に供給する機能を有する構成であると良い。

【０２３８】

第１復号部１８０２は、多重化分離部１８０１から基準解像度の第１符号化ビット列を取得し、所定の第１復号処理を行うことにより、基準解像度の復号画像列を生成する機能を有する。また、第１復号部１８０２は、取得が可能であれば、図示しないエントロピー復号部を介し、所定のエントロピー復号処理が行われることで得られる動きベクトル情報を取得し、所定の復号処理を行う機能を有すると良い。第１復号部１８０２は、生成された基準解像度の復号画像列を第１超解像拡大部１８０３、第２復号部１８０５、第２解像度変換部１８０６に供給する機能を有する。また、第１復号部１８０２は、復号画像列を一時的に格納するための機能を有することが望ましい。更に、第１復号部１８０２は、生成された基準解像度の復号画像列を要求に応じて外部の図示されていない表示装置に供給する機能を有することで、基準解像度の復号画像列を出力表示できるような構成であると良い。

【０２３９】

第１超解像拡大部１８０３は、第１復号部１８０２から基準解像度の復号画像列を取得し、所定の超解像拡大処理に必要となる、少なくとも２枚の基準解像度をもつ復号画像列を取得し、取得した基準解像度の復号画像列に対し、所定の超解像拡大処理を行い、基準解像度よりも高い解像度をもつ、超解像拡大復号画像列を生成し出力する機能を有する。ここで、所定の超解像拡大処理を行う際の拡大率は、所定の拡大率情報として設定される

か、多重化分離部１８０１で取得され、図示しないエントロピー復号部を介し、所定のエントロピー復号処理が行われることで得られる拡大率情報を取得する機能を有し、取得した拡大率情報に基づいて拡大率が特定されて所定の超解像拡大処理を行うように構成すると良い。また、第１超解像拡大部１８０３は、生成した超解像拡大復号画像列を第１解像度変換部１８０４に供給する機能を有する。更に、第１超解像拡大部１８０３は、生成された超解像拡大復号画像列を要求に応じて外部の図示されていない表示装置に供給する機能を有することで、基準解像度よりも高い解像度をもつ超解像拡大復号画像列を出力表示できるような構成であると良い。

【０２４０】

第１解像度変換部１８０４は、第１超解像拡大部１８０３から超解像拡大復号画像列を取得し、取得した超解像拡大復号画像列に対して所定の解像度変換処理を行うことにより、基準解像度よりも高い解像度をもつ超解像拡大復号画像列から、基準解像度をもつ超解像復号画像列を生成し、第２復号部１８０５に供給する機能を有する。ここで、所定の解像度変換処理を行う際の解像度変換率は、所定の解像度変換率情報として設定されるか、多重化分離部１８０１から図示しないエントロピー復号部を介し、所定のエントロピー復号処理が行われることで得られる解像度変換率情報を取得できる場合には、この取得した解像度変換率情報に基づいて解像度変換率が特定されて所定の解像度変換処理を行う機能を有するように構成すると良い。更に、第１解像度変換部１８０４は、生成された基準解像度の超解像復号画像列を要求に応じて外部の図示されていない表示装置に供給する機能を有することで、基準解像度の超解像復号画像列を出力表示できるような構成であると良い。

【０２４１】

第２復号部１８０５は、多重化分離部１８０１から基準解像度の第２符号化ビット列、第１復号部１８０２から基準解像度の復号画像列、第１解像度変換部１８０４から基準解像度の超解像復号画像列を取得し、取得した第２符号化ビット列に対して所定の基準解像度の拡張復号である第２復号処理を行うことにより、基準解像度の復号残差情報を生成する機能を有する。ここで、第２復号部１８０５は、取得した画像列を一時的に蓄積する機能を有することが望ましい。

【０２４２】

また、第２復号部１８０５は、復号画像列における各復号画像を第１の参照ピクチャとし、超解像復号画像列における各超解像復号画像を第２の参照ピクチャとして、所定の予測処理を行うことにより、基準解像度の予測ピクチャを生成する機能を有する。ここで、第２復号部１８０５は、多重化分離部１８０１から図示しないエントロピー復号部を介し、所定のエントロピー復号処理が行われることで得られる参照ピクチャ選択モード情報、および参照ピクチャ選択情報を取得できる場合には、この参照ピクチャ選択モード情報、および参照ピクチャ選択情報に基づいて所定の予測処理を行い、基準解像度の予測ピクチャを生成する機能を有すると更に良い構成となる。ここで、所定の予測処理は、取得した参照ピクチャ選択モード情報および参照ピクチャ選択情報に従って、復号対象となっている第２符号化ビット列が、どのような符号化モードの下で、どのような参照ピクチャを利用して予測ピクチャを作成したかを特定し、符号化時と同等の予測ピクチャを作成するように構成すると良い。例えば、第２復号部１８０５は、参照ピクチャ選択モード情報から、第１参照ピクチャと第２参照ピクチャのどちらか一方を利用して予測処理を行う符号化モードであることを特定すると、特定された参照ピクチャを利用して所定の予測処理を行い、予測ピクチャを生成する。また、例えば、第２復号部１８０５は、参照ピクチャ選択モード情報から、第１参照ピクチャと第２参照ピクチャのどちらも利用しないで予測処理を行う符号化モードであることを特定すると、どちらの参照ピクチャも利用せずに所定の予測処理を行い、予測ピクチャを生成する。また、例えば、第２復号部１８０５は、参照ピクチャ選択モード情報から、各ピクチャ、もしくは所定のピクチャ数ごとに参照ピクチャの選択を制御して予測処理を行う符号化モードであることを特定すると、参照ピクチャ選択情報を利用して順次、第１参照ピクチャと第２参照ピクチャのどちらを利用したかを

特定し、特定された参照ピクチャを利用して所定の予測処理を行い、予測ピクチャを生成する。また、例えば、第２復号部１８０５は、参照ピクチャ選択モード情報から、対象ピクチャをそれぞれ所定の大きさをもつ領域ごとに隙間なく分割し、第１参照ピクチャと第２参照ピクチャも同様に所定の大きさをもつ領域ごとに隙間なく分割し、対応する領域ごとに第１参照ピクチャと第２参照ピクチャのどちらを利用するかを制御して予測処理を行う符号化モードであることを特定すると、参照ピクチャ選択情報を利用して順次、対応する領域ごとに第１参照ピクチャと第２参照ピクチャのどちらを利用したかを特定し、特定された各領域の参照ピクチャを利用して所定の予測処理を行い、予測ピクチャを生成する。

【０２４３】

そして、第２復号部１８０５は、生成した基準解像度の復号残差情報と、基準解像度の予測ピクチャとを加算することで、復号後の基準解像度の超解像画像列を生成する機能を有する。更に、第２復号部１８０５は、生成された復号後の基準解像度の超解像画像列を要求に応じて外部の図示されていない表示装置に供給する機能を有することで、基準解像度の超解像画像列を出力表示できるような構成であると良い。

【０２４４】

第２解像度変換部１８０６は、第１復号部１８０２から基準解像度の復号画像列を取得し、取得した基準解像度の復号画像列に対して所定の解像度変換処理を行うことにより、第１超解像拡大部１８０３が生成する超解像拡大復号画像列の空間解像度と同じ解像度をもつ、高解像度の拡大復号画像列を生成し、第３符号化部１８０７に供給する機能を有する。ここで、所定の解像度変換処理を行う際の解像度変換率は、所定の解像度変換率情報として設定されるか、多重化分離部１８０１から図示しないエントロピー復号部を介し、所定のエントロピー復号処理が行われることで得られる解像度変換率情報を取得できる場合には、この取得した解像度変換率情報に基づいて解像度変換率が特定されて所定の解像度変換処理を行う機能を有するように構成すると良い。更に、第２解像度変換部１８０６は、生成された高解像度の拡大復号画像列を要求に応じて外部の図示されていない表示装置に供給する機能を有することで、高解像度の拡大復号画像列を出力表示できるような構成であると良い。

【０２４５】

第３復号部１８０７は、多重化分離部１８０１から高解像度の第３符号化ビット列、第２解像度変換部１８０６から高解像度の拡大復号画像列、第１超解像拡大部１８０３から高解像度の超解像拡大復号画像列を取得し、取得した第３符号化ビット列に対して所定の高解像度の拡張復号である第３復号処理を行うことにより、高解像度の復号残差情報を生成する機能を有する。ここで、第３復号部１８０７は、取得した画像列を一時的に蓄積する機能を有することが望ましい。

【０２４６】

また、第３復号部１８０７は、拡大復号画像列における各拡大復号画像を拡大復号画像列から得られる第１の参照ピクチャとし、超解像拡大復号画像列における各超解像拡大復号画像を第２の参照ピクチャとして、所定の予測処理を行うことにより、高解像度の予測ピクチャを生成する機能を有する。ここで、第３復号部１８０７は、多重化分離部１８０１から図示しないエントロピー復号部を介し、所定のエントロピー復号処理が行われることで得られる参照ピクチャ選択モード情報、および参照ピクチャ選択情報を取得できる場合には、この参照ピクチャ選択モード情報、および参照ピクチャ選択情報に基づいて所定の予測処理を行い、高解像度の予測ピクチャを生成する機能を有すると更に良い構成となる。ここで、所定の予測処理は、取得した参照ピクチャ選択モード情報および参照ピクチャ選択情報に従って、復号対象となっている第３符号化ビット列が、どのような符号化モードの下で、どのような参照ピクチャを利用して予測ピクチャを作成したかを特定し、符号化時と同等の予測ピクチャを作成するように構成すると良い。例えば、第３復号部１８０７は、参照ピクチャ選択モード情報から、第１参照ピクチャと第２参照ピクチャのどちらか一方を利用して予測処理を行う符号化モードであることを特定すると、特定された参

照ピクチャを利用して所定の予測処理を行い、予測ピクチャを生成する。また、例えば、第３復号部１８０７は、参照ピクチャ選択モード情報から、第１参照ピクチャと第２参照ピクチャのどちらも利用しないで予測処理を行う符号化モードであることを特定すると、どちらの参照ピクチャも利用せずに所定の予測処理を行い、予測ピクチャを生成する。また、例えば、第３復号部１８０７は、参照ピクチャ選択モード情報から、各ピクチャ、もしくは所定のピクチャ数ごとに参照ピクチャの選択を制御して予測処理を行う符号化モードであることを特定すると、参照ピクチャ選択情報を利用して順次、第１参照ピクチャと第２参照ピクチャのどちらを利用したかを特定し、特定された参照ピクチャを利用して所定の予測処理を行い、予測ピクチャを生成する。また、例えば、第３復号部１８０７は、参照ピクチャ選択モード情報から、対象ピクチャをそれぞれ所定の大きさをもつ領域ごとに隙間なく分割し、第１参照ピクチャと第２参照ピクチャも同様に所定の大きさをもつ領域ごとに隙間なく分割し、対応する領域ごとに第１参照ピクチャと第２参照ピクチャのどちらを利用するかを制御して予測処理を行う符号化モードであることを特定すると、参照ピクチャ選択情報を利用して順次、対応する領域ごとに第１参照ピクチャと第２参照ピクチャのどちらを利用したかを特定し、特定された各領域の参照ピクチャを利用して所定の予測処理を行い、予測ピクチャを生成する。

【０２４７】

そして、第３復号部１８０７は、生成した高解像度の復号残差情報と、高解像度の予測ピクチャとを加算することで、復号後の高解像度の超解像拡大画像列を生成する機能を有する。例えば、生成した復号後の高解像度の超解像拡大画像列を、要求に応じて外部の図示されていない表示装置に供給する機能を有することで、高解像度の超解像拡大画像列を出力表示できるような構成であると良い。

【０２４８】

以上のように動画像復号装置を構成することにより、上記実施の形態１～８の動画像符号化装置等によって生成された多重化後の符号化ビット列を入力し、符号化の手順とは逆に復号することで、基準解像度の復号画像列、拡大復号画像列、超解像拡大復号画像列、超解像復号画像列、復号後の超解像画像列、復号後の超解像拡大画像列といった、従来よりも高品質で多様な空間解像度や周波数成分を持った復号画像列を得ることができる。また、これらの多様な復号画像列を図示されていない表示装置に対して、要求に応じた選択的な出力に対応するように構成することが可能である。例えば、ユーザが携帯端末表示装置などのような、高い解像度を表示できない表示装置を利用している場合には、基準解像度の復号画像列、基準解像度の超解像復号画像列、復号後の基準解像度の超解像画像列を、出力として選択的に要求し、視聴することができる。また、例えば、ユーザが高精細テレビなどのような、高い解像度を表示できる表示装置を利用している場合には、高解像度の拡大復号画像列、高解像度の超解像拡大復号画像列、復号後の超解像拡大画像列を、出力として選択的に要求し、視聴することができる。

【０２４９】

次に、図２３に示す実施の形態９の動画像復号装置の動作を、図２４のフローチャートを参照して説明する。

【０２５０】

まず、多重化分離部１８０１は、入力される多重化後の符号化ビット列を取得し、所定の構文構造に基づいて符号化で利用した各種パラメータ情報や符号化モード情報を特定するための識別情報を特定しながら多重化分離を行う（ステップＳ６０１）ことで、基準解像度の第１符号化ビット列、基準解像度の第２符号化ビット列、高解像度の第３符号化ビット列を取得し、第１符号化ビット列を第１復号部１８０２、第２符号化ビット列を第２復号部１８０５、第３符号化ビット列を第３復号部１８０７に供給する。また、多重化分離部１８０１は、多重化後の符号化ビット列から取得が可能であれば、動きベクトル情報を取得し、第１復号部１８０２に供給する。

【０２５１】

その後、第１の並列処理（ステップＳ６０２、ステップＳ６０３）、第２の並列処理（

ステップＳ６０４）、および第３の並列処理（ステップＳ６０５）に分岐し、並行して動作を行う。

【０２５２】

つまり、第１の並列処理では、第１復号部１８０２は、多重化分離部１８０１から第１符号化ビット列と、取得が可能であれば、動きベクトル情報を取得し、基準解像度の第１復号処理を行う（ステップＳ６０２）ことで基準解像度の復号画像列を生成し、第２復号部１８０５に供給する。

【０２５３】

その後、第２復号部１８０５は、第１復号部１８０２によって生成された基準解像度の復号画像列を取得し、一時的に蓄積するための所定のバッファに格納する（ステップＳ６０３）。その後、他の並列処理が完了するまで待機する。

【０２５４】

第２の並列処理では、第２復号部１８０５は、多重化分離部１８０１から基準解像度の第２符号化ビット列を取得し、所定の第２復号処理を行う（ステップＳ６０４）ことで、基準解像度の復号残差情報を生成する。その後、他の並列処理が完了するまで待機する。

【０２５５】

第３の並列処理では、第３復号部１８０７は、多重化分離部１８０１から高解像度の第３符号化ビット列を取得し、所定の第３復号処理を行う（ステップＳ６０５）ことで、高解像度の復号残差情報を生成する。その後、他の並列処理が完了するまで待機する。

【０２５６】

第１～第３の並列処理が完了すると、第４の並列処理（ステップＳ６０６，Ｓ６０７，Ｓ６０８，Ｓ６０９）、第５の並列処理（ステップＳ６１０，Ｓ６１１）に分岐し、並列して動作を行う。

【０２５７】

第４の並列処理では、第１超解像拡大部１８０３は、第１復号部１８０２から基準解像度の復号画像列を取得し、所定の超解像拡大処理を行う（ステップＳ６０６）ことで、基準解像度よりも高い解像度をもつ高解像度の超解像拡大復号画像列を生成し、第１解像度変換部１８０４、および第３復号部１８０７に供給する。

【０２５８】

その後、第３復号部１８０７は、第１超解像拡大部１８０３によって生成された高解像度の超解像拡大復号画像列を取得し、一時的に蓄積するための所定のバッファに格納する（ステップＳ６０７）。

【０２５９】

その後、第１解像度変換部１８０４は、第１超解像拡大部１８０３から高解像度の超解像拡大復号画像列を取得し、所定の解像度変換処理を行う（ステップＳ６０８）ことで、基準解像度よりも高い解像度をもつ超解像拡大復号画像列から、基準解像度をもつ超解像復号画像列を生成し、第２復号部１８０５に供給する。

【０２６０】

その後、第２復号部１８０５は、第１解像度変換部１８０４によって生成された基準解像度の超解像復号画像列を取得し、一時的に蓄積するための所定のバッファに格納する（ステップＳ６０９）。その後、他の並列処理が完了するまで待機する。

【０２６１】

第５の並列処理では、第２解像度変換部１８０６は、第１復号部１８０２から基準解像度の復号画像列を取得し、所定の解像度変換処理を行う（ステップＳ６１０）ことで高解像度の拡大復号画像列を生成し、第３号化部１８０７に供給する。

【０２６２】

その後、第３復号部１８０７は、第２解像度変換部１８０６によって生成された高解像度の拡大復号画像列を取得し、一時的に蓄積するための所定のバッファに格納する（ステップＳ６１１）。その後、他の並列処理が完了するまで待機する。

【０２６３】

以上の並列処理が完了すると、第６の並列処理（ステップＳ６１２）、第７の並列処理（ステップＳ６１３）に分岐し、並列して動作を行う。

【０２６４】

第６の並列処理では、第２復号部１８０５は、所定の予測処理を行う（ステップＳ６１２）ことで、基準解像度の予測ピクチャを生成し、生成した基準解像度の復号残差情報と、基準解像度の予測ピクチャとを加算することで、復号後の基準解像度の超解像画像列を生成する。その後、他の並列処理が完了するまで待機する。

【０２６５】

第７の並列処理では、第３復号部１８０７は、所定の予測処理を行う（ステップＳ６１３）ことで、高解像度の予測ピクチャを生成し、生成した高解像度の復号残差情報と、高解像度の予測ピクチャとを加算することで、復号後の高解像度の超解像拡大画像列を生成する。その後、他の並列処理が完了するまで待機する。

【０２６６】

並列処理が完了すると、第１復号部１８０２、第１超解像拡大部１８０３、第１解像度変換部１８０４、第２復号部１８０５、第２解像度変換部１８０６、第３復号部１８０７は、生成された復号後の各解像度の画像列を要求に応じて外部の図示されていない表示装置等に供給することで、多様な復号結果を要求に応じて出力表示する（ステップＳ６１４）。以上のようなステップを経ることで、本実施形態の一連の動作が完了する。

【０２６７】

このようなステップを実行することで、実施の形態９の動画像復号装置を動作させることにより、所望の復号後の画像列を生成することができる。

【０２６８】

なお、本実施形態９の動作を複数の並列処理によって説明したが、この並列処理部分を連続的に処理するように、本実施形態の構成を動作させても良いことに注意する。

【０２６９】

図２５は、図２４のステップＳ６０２の基準解像度の復号処理の動作手順の一例を示すフローチャートである。

【０２７０】

図２５において、第１復号部１８０２は、所定のエントロピー復号部、逆量子化部、逆直交変換部、イントラ予測部、動き補償部に基づいて所定の復号処理を行う。

【０２７１】

まず、第１復号部１８０２は、現在の復号対象領域の復号を行うために、多重化分離部１８０２から基準解像度の第１符号化ビット列を取得すると、エントロピー復号部により所定のエントロピー復号処理を行って復号後の量子化後情報を生成し、量子化後情報に対して逆量子化部により所定の逆量子化処理を行って復号後の直交変換係数情報を生成し、直交変換係数情報に対して逆直交変換部により所定の逆直交変換処理を行って復号残差情報を生成することにより、第１の復号を行う（ステップＳ７０１）。

【０２７２】

次に、イントラ予測部は、現在の復号対象領域における予測情報を生成するために、現在の復号対象領域に隣接する復号済み領域の情報に基づいて、所定のイントラ予測処理を行う（ステップＳ７０２）ことで予測情報を生成し、生成された復号対象領域の復号残差情報と予測情報とを加算することで、復号対象領域の復号情報を生成する。

【０２７３】

その後、面内の各領域の復号情報が全て生成されて復号画像が得られたかを判別どうかをイントラ復号が完了しかたどうかを判定する（ステップＳ７０３）。

【０２７４】

イントラ復号が完了した場合（ステップＳ７０３　ＹＥＳ）、復号すべき符号化ビット列が存在する場合には処理を継続し、ステップＳ７０４に進む。復号すべき符号化ビット列が存在しない場合には、一連の復号処理を終了する。

【０２７５】

イントラ復号が完了していない場合（ステップＳ７０３　ＮＯ）、次の復号対象領域を特定し、ステップＳ７０１に戻ることで処理を継続する。

【０２７６】

イントラ復号が完了すると、次にインター復号を行うために、第１復号部１８０２は、イントラ復号と同様に、第１の復号を行う（ステップＳ７０４）ことで、復号残差情報を生成する。

【０２７７】

また、動き補償部は、生成された復号画像を参照ピクチャとし、多重化分離部１８０１から動きベクトル情報を取得し、動きベクトル情報に基づいて参照ピクチャを利用しながら所定の動き補償を行う（ステップＳ７０５）ことで予測ピクチャを生成し、生成した復号残差情報と予測ピクチャとを加算することで、復号画像を生成する。

【０２７８】

その後、インター復号が完了したかどうかを符号化モード情報などから判定する（ステップＳ７０６）。

【０２７９】

次の復号もインター復号である場合（ステップＳ７０６　ＮＯ）、インター復号を継続するためにステップＳ７０４に戻ることで処理を継続する。

【０２８０】

次の復号がインター復号ではない場合（ステップＳ７０６　ＹＥＳ）、インター復号処理を終了する。ここで、復号すべき符号化ビット列が存在し、次の復号がイントラ復号である場合には、ステップＳ７０１に戻ることで、一連の復号処理が繰り返される。また、復号すべき符号化ビット列が存在しない場合には、一連の復号処理を終了する。

【０２８１】

なお、本実施の形態９も、ブロック図によりハードウエア的に構成して説明したが、上記実施の形態１～８と同様に、図２３に示す動画像復号装置の機能を、ＣＰＵとプログラムとによりソフトウエア的に実行するようにしても勿論よい。

【０２８２】

実施の形態１０.

次に、実施の形態１０の動画像復号装置の実施形態について説明する。

【０２８３】

図２６は、実施の形態１０の動画像復号装置の構成例を示すブロック図である。

【０２８４】

図２６に示す実施の形態１０の動画像復号装置は、図２３に示す本発明の動画像復号装置から第２解像度変換部１８０６、第３復号部１８０７を省略ないしは機能させないように構成したもので、図２６の各構成要素の機能は、図２３に示すものと同等であり、重複を避けるため説明を省略する。

【０２８５】

このような動画像復号装置を構成することにより、本発明と対になる動画像符号化装置、動画像符号化方法、動画像符号化プログラム、動画像再符号化装置、動画像再符号化方法、動画像再符号化プログラムによって生成された多重化後の符号化ビット列を取得し、本発明の動画像復号装置によって正しく復号することで、基準解像度の復号画像列、超解像拡大復号画像列、超解像復号画像列、復号後の超解像画像列といった、従来よりも高品質で多様な空間解像度や周波数成分を持った復号画像列を得ることができる。また、これらの多様な復号画像列を図示されていない表示装置に対して、要求に応じた選択的な出力に対応するように構成することが可能である

【０２８６】

なお、本実施の形態１０も、ブロック図によりハードウエア的に構成して説明したが、上記実施の形態１～９と同様に、図２６に示す動画像復号装置の機能を、ＣＰＵとプログラムとによりソフトウエア的に実行するようにしても勿論よい。

【０２８７】

実施の形態１１．

次に、本発明の実施の形態１１である、再符号化装置について説明する。

【０２８８】

図２７は、実施の形態である、再符号化装置の構成例を示すブロック図である。

【０２８９】

図２７に示す実施の形態１１の再符号化装置は、図２６に示す実施の形態１０の動画像復号装置に対し、新たに再符号化部１８０８および多重化部１８０９を追加することで、ある特定の符号化形式から別の異なる符号化形式に変換する再符号化処理（トランスコーディング）を行うような構成としている。

【０２９０】

図２７に示す実施の形態１１における再符号化処理を、例えば、ＡＶＣリライティング（またはＡＶＣトランスコーディング）、つまりＡＶＣの符号化形式に再符号化するような処理に基づく構成とすることもできる。なお、図２３に示す実施の形態９の動画像復号装置に対し、新たに再符号化部１８０８および多重化部１８０９を追加するように構成しても勿論よい。

【０２９１】

ここで、本実施の形態１１では、多重化分離部１８０１によって得られる基準解像度の第２符号化ビット列は、例えば、ＭＰＥＧ-４ ＳＶＣにおけるＣＧＳ(Coarse Grain Scalability)レイヤの構成であると良い。これは、さらに、基本階層となる基準解像度の画像列と、基本階層を参照する拡張階層となる基準解像度の超解像画像列との間の空間解像度が同一であるように符号化されている場合には、ＭＰＥＧ及びＩＴＵ-Ｔとの共同グループであるＪＶＴ(Joint Video Team)におけるＡＶＣリライティングに関する奇書（ＡＶＣ Rewritingに関する文献ファイルJVT-U043、http://ftp3.itu.ch/av-arch/jvt-site/2006 10 Hangzhou/ JVT- U043.zip、およびJVT-V035、http://ftp3.itu.ch/av-arch/jvt-site/2007 01 Marrakech/ JVT-V035.zip）中に示す、ＳＶＣからＡＶＣに容易に変換できるようにするための抑制条件を満たすような所定の構文構造に基づいて符号化を行って符号化ビット列が生成されていると良い。本実施の形態１１では、このように生成された符号化ビット列を取得し、本発明のＣＧＳレイヤで構成された拡張階層を扱う符号化形式から単層の符号化であるＡＶＣの符号化形式に、完全な復号と符号化を行うような再符号化を行うことなく、変換することができるような符号化ビット列を生成できるような構成であると良い。

【０２９２】

また、このようなＡＶＣリライティングに適した符号化が行われていない符号化ビット列に対しては、基準解像度の符号化ビット列、および基準解像度の第２符号化ビット列を復号することによって得られる超解像画像列と、基準解像度の符号化ビット列を復号した際に得られる各種の符号化モード情報や動きベクトル情報などを利用しながら、単一階層のＡＶＣの符号化形式に基づいて再符号化を行うことで、符号化ビット列を生成できるような構成であると良い。

【０２９３】

したがって、図２７に示す本実施の形態１１の再符号化装置を構成する各要素は、更に以下に示すような機能を備えると良い。

【０２９４】

つまり、第１復号部１８０２は、更に、所定のエントロピー復号処理および逆量子化処理を行うことにより、取得した基準解像度の符号化ビット列に対して、完全に復号せずに、基準解像度の基本層における直交変換係数情報の状態まで復号するための機能を有する。また、第１復号部１８０２は、ＡＶＣリライティングが可能であると判断された場合には復号途中である直交変換係数情報を、再符号化が必要であると判断された場合には基準解像度の復号画像列を再符号化部１８０８に供給する機能を有する。また、第１復号部１８０２は、復号時に得られる各種パラメータ情報および符号化モード情報を再符号化部１８０８に供給する機能を有すると良い。

【０２９５】
第１解像度変換部１８０４は、更に、再符号化が必要であると判断された場合には、基準解像度の超解像復号画像列を再符号化部１８０８に供給する機能を有する。
【０２９６】
第２復号部１８０５は、更に、所定のエントロピー復号処理および逆量子化処理を行うことにより、取得した基準解像度拡張符号化ビット列に対して、完全に復号せずに、基準解像度の拡張層における直交変換係数情報の状態まで復号するための機能を有し、ＡＶＣリライティングが可能であると判断した場合には、復号途中である基準解像度の拡張層における直交変換係数情報を、再符号化が必要であると判断された場合には復号後における基準解像度の超解像画像列を再符号化部１８０８に供給する機能を有する。
【０２９７】
再符号化部１８０８は、ＡＶＣリライティングが可能であると判断された場合には第１復号部１８０２から復号途中である直交変換係数情報、および第２復号部１８０５から復号途中である基準解像度の拡張層における直交変換係数情報を取得し、それぞれの直交変換係数情報を合成した後に所定のエントロピー符号化処理を行うことにより再符号化後の符号化ビット列を生成し、多重化部１８０９に供給する機能を有する。また、再符号化部１８０８は、再符号化が必要であると判断された場合には第１復号部１８０２から基準解像度の復号画像列、第１解像度変換部１８０４から基準解像度の超解像復号画像列、および第２復号部１８０５から基準解像度の超解像画像列を必要に応じて取得し、所定の符号化処理を行うことにより再符号化後の符号化ビット列を生成し、多重化部１８０９に供給する機能を有する。
【０２９８】
多重化部１８０９は、取得した再符号化後の符号化ビット列を取得し、所定の構文構造に基づいて、符号化で利用した各種パラメータ情報や符号化モード情報を特定するための識別情報を挿入しながら多重化処理を行い、出力である多重化後の符号化ビット列を生成する機能を有する。
【０２９９】
このように動画像再符号化装置を構成することにより、上記実施の形態１～８の動画像符号化装置等によって生成された多重化後の符号化ビット列を取得し、本発明の動画像再符号化装置によって、第１復号部１８０２から復号途中である直交変換係数情報、および第２復号部１８０５から復号途中である基準解像度の拡張層における直交変換係数情報を取得し、それぞれの直交変換係数情報を合成し、再度エントロピー符号化処理および多重化処理を行うことにより、再符号化後の符号化ビット列を生成できることから、従来よりも高品質で多様な空間解像度や周波数成分を持った復号成分を、完全に復号して復号画像列を生成することなく、多くの演算量を費やすことなく容易に再符号化することができる。
【０３００】
また、再符号化後の符号化ビット列を生成することで異なる符号化形式に変換し、対象となる符号化形式に適合した符号化ビット列を生成することができるように構成することが可能である。
【０３０１】
基準解像度の復号画像列、超解像復号画像列、復号後の超解像画像列といった、従来よりも高品質で多様な空間解像度や周波数成分を持った復号画像列を得ることができる。また、これらの多様な復号画像列に対して再符号化を行うことで、単一階層の符号化ビット列を生成することができる。
【０３０２】
したがって、例えば、携帯端末表示装置などのように、搭載されている動画像復号装置が、演算量や消費電力などの制約により、より低い演算量や消費電力、低い符号化伝送レートで復号できるような符号化形式にのみ対応しているような場合には、本発明の動画像再符号化装置によって再符号化を行うことで、対象となる符号化形式に適合した符号化ビ

ット列を生成することができるように構成することが可能である。

【０３０３】

また、このように動画像再符号化装置を構成することにより、上記実施の形態１～８の動画像符号化装置等によって生成された多重化後の符号化ビット列を取得し、本発明の動画像再符号化装置によって正しく復号することで、基準解像度の復号画像列、超解像復号画像列、復号後の超解像画像列といった、従来よりも高品質で多様な空間解像度や周波数成分を持った復号画像列を得ることができる。

【０３０４】

また、これらの多様な復号画像列に対して再符号化を行うことで、単一階層の符号化ビット列を生成することができる。したがって、例えば、携帯端末表示装置などのように、搭載されている動画像復号装置が、演算量や消費電力などの制約により、より低い演算量や消費電力、低い符号化伝送レートで復号できるような符号化形式にのみ対応しているような場合には、本発明の動画像再符号化装置によって再符号化を行うことで、異なる符号化形式に変換し、対象となる符号化形式に適合した符号化ビット列を生成することができるように構成することが可能である。

【０３０５】

次に、図２８のフローチャートを参照して、図２７に示す再符号化装置の動作について説明する。

【０３０６】

まず、多重化分離部１８０１は、入力として入力する多重化後の符号化ビット列を取得し、所定の構文構造に基づいて符号化で利用した各種パラメータ情報や符号化モード情報を特定するための識別情報を特定しながら多重化分離を行う（ステップＳ７０１）ことで、多重化後の符号化ビット列から、基準解像度の第１符号化ビット列、基準解像度の第２符号化ビット列を取得する一方、多重化後の符号化ビット列から取得が可能であれば、拡大率情報ビット列、解像度変換率情報ビット列、基準解像度拡張予測情報の符号化ビット列を更に取得する。その後、多重化分離部１８０１は、取得した第１符号化ビット列を第１復号部１８０２、第２符号化ビット列を第２復号部１８０５にそれぞれ供給し、更に、多重化後の符号化ビット列から取得が可能であれば、動きベクトル情報を取得し、第１復号部１８０２に供給する。

【０３０７】

その後、多重化分離部１８０１は、ＡＶＣリライティングが可能であるか、可能でないかを判定する（ステップＳ７０２）。この判定は、多重化後の符号化ビット列内に含まれる、ＡＶＣリライティングが可能であるか、可能でないかを判定するための判定情報に基づいて行うと良い。

【０３０８】

ＡＶＣリライティングが可能である場合（ステップＳ７０２　ＹＥＳ）、本装置では、第１の並列処理（ステップＳ７０３）、第２の並列処理（ステップＳ７０４）に分岐して、並行してその後の動作を行う。

【０３０９】

これに対し、ＡＶＣリライティングが可能でない場合（ステップＳ７０２　ＮＯ）、本装置では、再符号化が必要であるとして、第３の並列処理（ステップＳ７０７、ステップＳ７０８）、第４の並列処理（ステップＳ７０９）に分岐し、並行してその後の動作を行う。

【０３１０】

ＡＶＣリライティングが可能である場合は、以下の処理を行う。

【０３１１】

つまり、第１の並列処理では、第１復号部１８０２は、第１符号化ビット列を取得し、所定のエントロピー復号処理（ステップＳ７０３）および逆量子化処理を行うことにより、復号途中である基本層の直交変換係数情報を生成し、再符号化部１８０８に供給する。その後、第２の並列処理が完了するまで待機する。

【０３１２】
第２の並列処理では、第２復号部１８０５は、第２符号化ビット列を取得し、所定のエントロピー復号処理（ステップＳ７０４）および逆量子化処理を行うことにより、復号途中である拡張層の直交変換係数情報を生成し、再符号化部１８０８に供給する。その後、第１の並列処理が完了するまで待機する。
【０３１３】
第１および第２の並列処理が完了すると、再符号化部１８０８は、第１復号部１８０２から復号途中である基本層の直交変換係数情報、第２復号部１８０５から復号途中である拡張層の直交変換係数情報を取得した上で、所定の合成処理に基づいて合成し（ステップＳ７０５）、合成結果に対して所定のエントロピー符号化を行う（ステップＳ７０６）ことで、再符号化後の符号化ビット列を生成し、多重化部１８０９に供給する。ここまでの処理が、ＡＶＣリライティングが可能である場合の処理となる。
【０３１４】
次に、ＡＶＣリライティングが可能でない場合、つまり再符号化が必要である場合には、以下の処理を行う。
【０３１５】
第３の並列処理では、第１復号部１８０２は、多重化分離部１８０１から基準解像度の符号化ビット列と、取得が可能であれば、動きベクトル情報を取得し、基準解像度の復号処理を行う（ステップＳ７０７）ことで基準解像度の復号画像列を生成し、第２復号部１８０５、および必要に応じて再符号化部１８０８に供給する。
【０３１６】
その後、第２復号部１８０５は、第１復号部１８０２によって生成された基準解像度の復号画像列を取得し、一時的に蓄積するための所定のバッファに格納する（ステップＳ７０８）。その後、第４の並列処理が完了するまで待機する。
【０３１７】
第４の並列処理において、第２復号部１８０５は、多重化分離部１８０１から第２符号化ビット列を取得し、所定の復号処理を行う（ステップＳ７０９）ことで、基準解像度の復号残差情報を生成する。その後、第３の並列処理が完了するまで待機する。
【０３１８】
第３および第４の並列処理が完了すると、第１超解像拡大部１８０３は、第１復号部１８０２から基準解像度の復号画像列を取得し、所定の超解像拡大処理を行う（ステップＳ７１０）ことで、基準解像度よりも高い解像度をもつ高解像度の超解像拡大復号画像列を生成し、第１解像度変換部１８０４に供給する。
【０３１９】
その後、第１解像度変換部１８０４は、第１超解像拡大部１８０３から高解像度の超解像拡大復号画像列を取得し、所定の解像度変換処理を行う（ステップＳ７１１）ことで、基準解像度よりも高い解像度をもつ超解像拡大復号画像列から、基準解像度をもつ超解像復号画像列を生成し、第２復号部１８０５、および必要に応じて再符号化部１８０８に供給する。
【０３２０】
その後、第２復号部１８０５は、第１解像度変換部１８０４によって生成された基準解像度の超解像復号画像列を取得し、一時的に蓄積するための所定のバッファに格納する（ステップＳ７１２）。
【０３２１】
第２復号部１８０５は、所定の予測処理を行う（ステップＳ７１３）ことで、基準解像度の予測ピクチャを生成し、生成した基準解像度の復号残差情報と、基準解像度の予測ピクチャとを加算することで、復号後の基準解像度の超解像画像列を生成し、必要に応じて再符号化部１８０８に供給する。
【０３２２】
再符号化部１８０８は、第１復号部１８０２から基準解像度の復号画像列、第１解像度

変換部１８０４から基準解像度の超解像復号画像列、および第２復号部１８０５から基準解像度の超解像画像列を必要に応じて取得し、所定の符号化処理によって再符号化を行う（ステップＳ７１４）ことで符号化ビット列を生成し、多重化部１８０９に供給する。

【０３２３】

多重化部１８０９は、取得した再符号化後の符号化ビット列を取得し、所定の構文構造に基づいて、符号化で利用した各種パラメータ情報や符号化モード情報を特定するための識別情報を挿入しながら多重化処理を行い、出力である多重化後の符号化ビット列を生成し、出力する（ステップＳ７１５）。以上のようなステップを経ることで、本実施形態の一連の動作が完了する。

【０３２４】

このようなステップを実行することで、本実施の形態の動画像再符号化装置を動作させることにより、再符号化後の符号化ビット列を生成することができる。なお、本実施の形態の動作を複数の並列処理によって説明したが、この並列処理部分を連続的に処理するように、本実施の形態の構成を動作させても良いことに注意する。

【０３２５】

なお、本実施の形態１１も、ブロック図によりハードウエア的に構成して説明したが、上記実施の形態１～１０と同様に、図２７に示す再符号化装置の機能を、ＣＰＵとプログラムとによりソフトウエア的に実行するようにしても勿論よい。

【０３２６】

なお、本発明の動画像復号装置、動画像復号方法、および動画像復号プログラム、そして、本発明の動画像再符号化装置、動画像再符号化方法、および動画像再符号化プログラムの適用される範囲は、動画像を符号化し、復号するような装置、方法、プログラム、システム等であれば、特に限定されるものではない。例えば、本発明を、ＴＶに代表される受像装置、携帯電話、テレビ会議装置、監視装置、ＣＤ、ＤＶＤ、Ｂｌｕ－ｒａｙ　Ｄｉｓｃ（登録商標）などの記録媒体を利用した再生装置、ＤＶＤ－Ｒ／ＲＷやＢＤ－Ｒ／ＲＷ、ＨＤＤ、ＳＤなどの追記および書き換え可能な記録媒体を利用した録画再生装置、およびカムコーダといった撮像記録再生装置、オーサリングなどの記録編集装置、動画像の配信装置などに適用しても良い。

【符号の説明】

【０３２７】

１０１　第１蓄積バッファ
１０２　第１符号化部
１０３　第１超解像拡大部
１０４　第１解像度変換部
１０５　第２超解像拡大部
１０６　第２解像度変換部
１０７　第２符号化部
１０８　第３符号化部
１０９　多重化部
１１０　第３解像度変換部
１８０１　多重化分離部
１８０２　第１復号部
１８０３　第１超解像拡大部
１８０４　第１解像度変換部
１８０５　第２復号部
１８０６　第２解像度変換部
１８０７　第３復号部
１８０８　再符号化部
１８０９　多重化部

【書類名】特許請求の範囲
【請求項１】
基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、
基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、
前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像度をもつ超解像拡大・変換画像を生成する第１解像度変換部と、
前記第１解像度変換部からの前記超解像拡大・変換画像を符号化対象画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する第２符号化部と、
を有する動画像符号化装置。
【請求項２】
請求項１記載の動画像符号化装置において、
前記第２符号化部は、さらに、
前記第１符号化部からの前記復号画像を参照画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する、動画像符号化装置。
【請求項３】
請求項１または請求項２記載の動画像符号化装置において、さらに、
前記第１符号化部から基準解像度の前記復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、
前記超解像拡大復号画像に対し第２の解像度変換処理を行って基準解像度をもつ超解像拡大・変換復号画像を生成する第２解像度変換部と、を有し、
前記第２符号化部は、さらに、
前記第２解像度変換部からの前記超解像拡大・変換復号画像を参照画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する、動画像符号化装置。
【請求項４】
請求項１～請求項３の記載の動画像符号化装置において、
前記第１の超解像拡大部は、
超解像拡大処理を行う際の基準となる基準画像と、少なくとも１枚の観測画像とに基づいて、所望の高解像度の画素位置への位置合わせを行い、不等間隔にサンプリングされた不均一高解像度画像を生成する位置合わせ器と、
前記位置合わせ器にて生成された不均一高解像度画像に対し所定の不均一補間処理を行って、所望の高解像度を持つ補間画像を生成する補間器と、
前記補間器にて生成された前記補間画像を取得して、所定の復元処理を行い、所望の解像度を持つ推定画像を生成する推定画像生成器と、
前記位置合わせ器から前記不均一高解像度画像を取得するとともに、前記推定画像生成器から前記不均一推定画像を取得して、取得したそれぞれの画像を利用して、所定の判定方法に従って超解像拡大処理の繰り返しが必要か否かを判定し、その判定の結果、繰り返しが必要な場合は、前記補間器に対して処理を継続するための制御情報を供給する一方、繰り返しが必要ない場合には、前記推定画像生成器に対して超解像度拡大結果である高解像度の推定画像を出力するための制御情報を出力する繰り返し判定器と、
を有する動画像符号化装置。
【請求項５】
請求項１～請求項４のいずれか一の請求項に記載された動画像符号化装置において、
さらに、
前記第１符号化部からの前記第１符号化ビット列と、前記第２符号化部からの前記第２符号化ビット列と、前記第１符号化部における符号化および前記第２符号化部における符号化の際に使用した各種符号化パラメータ情報とを、所定の構文構造に基づいて多重化する多重化部、

を有する動画像符号化装置。
【請求項６】
請求項２～請求項５のいずれか一の請求項に記載された動画像符号化装置において、
さらに、
前記第１符号化部および前記第１超解像拡大部の前段に設けられ、基準解像度の前記動画像列を蓄積する第１蓄積バッファと、
前記第１符号化部と前記第２符号化部の間に設けられ、前記第１符号化部からの前記復号画像を蓄積する第２蓄積バッファと、
前記第１蓄積バッファと、前記第２蓄積バッファと、前記第１符号化部と、前記第２符号化部とにおける各バッファ蓄積量を検出し、各バッファ蓄積量を制御する蓄積制御部と、
前記蓄積制御部における前記各バッファ蓄積量に基づいて、前記第１符号化部と前記第２符号化部とにおける符号量制御を行う符号量制御部と、
を有する動画像符号化装置。
【請求項７】
基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、
基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、
前記第１符号化部から前記復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、
前記第１符号化部から前記復号画像を取得し、第３の解像度変換処理を行って基準解像度よりも高い解像度をもつ解像度変換拡大復号画像を生成する第３解像度変換部と、
前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第２超解像拡大部からの前記超解像拡大復号画像と、前記第３超解像拡大部からの前記解像度変換拡大復号画像とを参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、
を有する動画像符号化装置。
【請求項８】
基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、
基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、
前記第１符号化部から前記復号画像を取得し、第３の解像度変換処理を行って基準解像度よりも高い解像度をもつ解像度変換拡大復号画像を生成する第３解像度変換部と、
前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第３解像度変換部からの前記解像度変換拡大復号画像を参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、
を有する動画像符号化装置。
【請求項９】
基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、
基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、
前記第１符号化部から前記復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、
前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第２超解像拡大部からの前記超解像拡大復号画像を参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、
を有する動画像符号化装置。

出証特２００９－３０１７００７

【請求項１０】
基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成する第１符号化部と、
基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成する第１超解像拡大部と、
前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像度をもつ超解像拡大・変換画像を生成する第１解像度変換部と、
前記第１符号化部から前記復号画像を取得し、第２超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大復号画像を生成する第２超解像拡大部と、
前記第２超解像拡大部からの前記超解像拡大復号画像に対し第２の解像度変換処理を行って基準解像度をもつ超解像拡大・変換復号画像を生成する第２解像度変換部と、
前記第１解像度変換部からの前記超解像拡大・変換画像を符号化対象画像として、前記第１符号化部からの前記復号画像と、前記第２解像度変換部からの基準解像度をもつ超解像拡大・変換復号画像とを参照画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成する第２符号化部と、
前記第１符号化部から前記復号画像を取得し、第３の解像度変換処理を行って基準解像度よりも高い解像度をもつ解像度変換拡大復号画像を生成する第３解像度変換部と、
前記第１超解像拡大部からの前記超解像拡大画像を符号化対象画像とし、前記第２超解像拡大部からの前記超解像拡大復号画像と、前記第３解像度変換部からの前記解像度変換拡大復号画像をと参照画像として使用して、第３の予測処理および符号化処理を行い、第３符号化ビット列を生成する第３符号化部と、
を有する動画像符号化装置。
【請求項１１】
基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成するステップと、
基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成するステップと、
前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像度をもつ超解像拡大・変換画像を生成するステップと、
前記超解像拡大・変換画像を符号化対象画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成するステップと、
を有する動画像符号化方法。
【請求項１２】
基準解像度の動画像列に対し第１の符号化および復号処理を行って基準解像度の第１符号化ビット列および復号画像を生成するステップと、
基準解像度の前記動画像列に対し第１超解像拡大処理を行って基準解像度よりも高い解像度をもつ超解像拡大画像を生成するステップと、
前記超解像拡大画像に対し第１の解像度変換処理を行って基準解像度をもつ超解像拡大・変換画像を生成するステップと、
前記超解像拡大・変換画像を符号化対象画像として、第２の予測処理および符号化処理を行い、第２符号化ビット列を生成するステップと、
をコンピュータに実行させる動画像符号化プログラム。
【請求項１３】
入力される符号化ビット列に対して所定の多重化分離処理を行って少なくとも第１および第２の符号化ビット列を出力する多重化分離部と、
前記多重化分離部によって得られる基準解像度の第１符号化ビット列を取得して所定の第１復号処理を行うことにより基準解像度の復号画像列を生成する第１復号部と、
前記第１復号部によって生成された基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成する第１超解像拡大部と、
前記第１超解像拡大部によって生成された超解像拡大復号画像列を取得して所定の解像

度変換処理を行うことにより、基準解像度の超解像復号画像列を生成する第１解像度変換部と、

前記多重化分離部によって得られる基準解像度の第２符号化ビット列と、前記第１復号部によって生成された基準解像度の復号画像列と、前記第１解像度変換部によって生成された基準解像度の超解像復号画像列とを取得し、所定の予測処理および所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成する第２復号部と、

を有する動画像復号装置。

【請求項１４】

請求項１３に記載の動画像復号装置において、さらに、

前記多重化分離部は、入力される符号化ビット列に対して所定の多重化分離処理を行って、さらに第３の符号化ビット列を出力し、

前記第１復号部から基準解像度の復号画像列を取得し、所定の解像度変換処理を行うことにより基準解像度よりも高い解像度をもつ高解像度の拡大復号画像列を生成する第２解像度変換部と、

前記多重化分離部によって得られる高解像度の第３符号化ビット列と、前記第１超解像拡大部によって生成された超解像拡大復号画像列と、前記第２解像度変換部から高解像度の拡大復号画像列とを取得し、所定の予測処理および所定の高解像度の拡張復号である第３復号処理を行うことにより、復号後の超解像拡大画像列を生成する第３復号部と、

を有する動画像復号装置。

【請求項１５】

入力される符号化ビット列に対して所定の多重化分離処理を行って少なくとも第１および第２の符号化ビット列を出力する多重化分離部と、

前記多重化分離部によって得られる基準解像度の第１符号化ビット列を取得して所定の第１復号処理を行うことにより基準解像度の復号画像列を生成する第１復号部と、

前記第１復号部によって生成された基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成する第１超解像拡大部と、

前記第１超解像拡大部によって生成された超解像拡大復号画像列を取得して所定の解像度変換処理を行うことにより、基準解像度の超解像復号画像列を生成する第１解像度変換部と、

前記多重化分離部によって得られる基準解像度の第２符号化ビット列と、前記第１復号部によって生成された基準解像度の復号画像列と、前記第１解像度変換部によって生成された基準解像度の超解像復号画像列とを取得して所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成する第２復号部と、

前記第１復号部から復号途中である直交変換係数情報と、前記第２復号部から復号途中である基準解像度の拡張層における直交変換係数情報とを取得し、それぞれの直交変換係数情報を合成した後に所定のエントロピー符号化処理を行うことにより再符号化後の符号化ビット列を生成する再符号化部と、

前記再符号化部によって再符号化された符号化ビット列を取得し、所定の構文構造に基づいて、符号化で利用した各種パラメータ情報や符号化モード情報を特定するための識別情報を挿入しながら多重化処理を行い、多重化後の符号化ビット列を生成する多重化部と、

を有する動画像再符号化装置。

【請求項１６】

請求項１５に記載の動画像再符号化装置において、

前記再符号化部は、更に、前記第１復号部から基準解像度の復号画像列と、第１解像度変換部からの基準解像度の超解像復号画像列と、前記第２復号部から基準解像度の超解像画像列とを取得し、所定の符号化処理を行うことにより再符号化後の符号化ビット列を生成する、動画像再符号化装置。

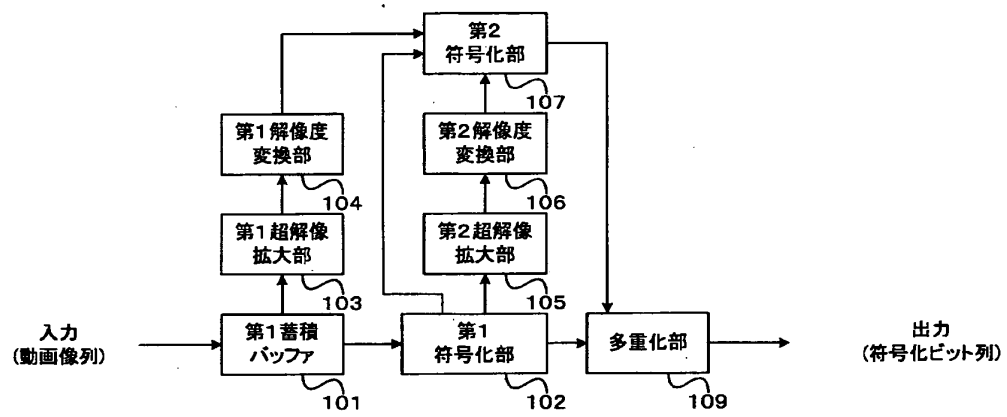
出証特２００９－３０１７００７

【請求項１７】
入力される符号化ビット列に対して所定の多重化分離処理を行って少なくとも第１および第２の符号化ビット列を出力するステップと、
所定の多重化分離処理によって得られた前記基準解像度の第１符号化ビット列を取得して所定の第１復号処理を行うことにより基準解像度の復号画像列を生成するステップと、
所定の第１復号処理によって生成された前記基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成するステップと、
所定の超解像拡大処理によって生成された前記超解像拡大復号画像列を取得して所定の解像度変換処理を行うことにより、基準解像度の超解像復号画像列を生成するステップと、
所定の多重化分離処理によって得られた前記基準解像度の第２符号化ビット列と、所定の第１復号処理によって生成された前記基準解像度の復号画像列と、所定の解像度変換処理によって生成された基準解像度の超解像復号画像列とを取得し、所定の予測処理および所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成するステップと、
を有する動画像復号方法。
【請求項１８】
請求項１７に記載の動画像復号方法において、さらに、
入力される符号化ビット列に対して所定の多重化分離処理を行って第３の符号化ビット列を出力するステップと、
所定の第１復号処理によって生成された前記基準解像度の復号画像列を取得し、所定の解像度変換処理を行うことにより基準解像度よりも高い解像度をもつ高解像度の拡大復号画像列を生成するステップと、
所定の多重化分離処理によって得られる高解像度の第３符号化ビット列と、所定の超解像拡大処理によって生成された前記超解像拡大復号画像列と、所定の解像度変換処理によって生成された前記高解像度の拡大復号画像列とを取得し、所定の予測処理および所定の高解像度の拡張復号である第３復号処理を行うことにより、復号後の超解像拡大画像列を生成するステップと、
を有する動画像復号方法。
【請求項１９】
入力される符号化ビット列に対して所定の多重化分離処理を行うステップと、
所定の多重化分離処理によって得られた前記基準解像度の第１符号化ビット列を取得して所定の第１復号処理を行うことにより基準解像度の復号画像列を生成するステップと、
所定の第１復号処理によって生成された前記基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成するステップと、
所定の超解像拡大処理によって生成された前記超解像拡大復号画像列を取得して所定の解像度変換処理を行うことにより、基準解像度の超解像復号画像列を生成するステップと、
所定の多重化分離処理によって得られた基準解像度の第２符号化ビット列と、所定の第１復号処理によって生成された前記基準解像度の復号画像列と、所定の第１解像度変換処理によって生成された前記基準解像度の超解像復号画像列とを取得して所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成するステップと、
所定の第１復号処理の復号途中である直交変換係数情報と、所定の基準解像度の拡張復号である第２復号処理の復号途中である基準解像度の拡張層における直交変換係数情報とを取得し、それぞれの直交変換係数情報を合成した後に所定のエントロピー符号化処理を行うことにより再符号化後の符号化ビット列を生成するステップと、
再符号化後の前記符号化ビット列を取得し、所定の構文構造に基づいて、符号化で利用した各種パラメータ情報や符号化モード情報を特定するための識別情報を挿入しながら多重化処理を行い、多重化後の符号化ビット列を生成するステップと、

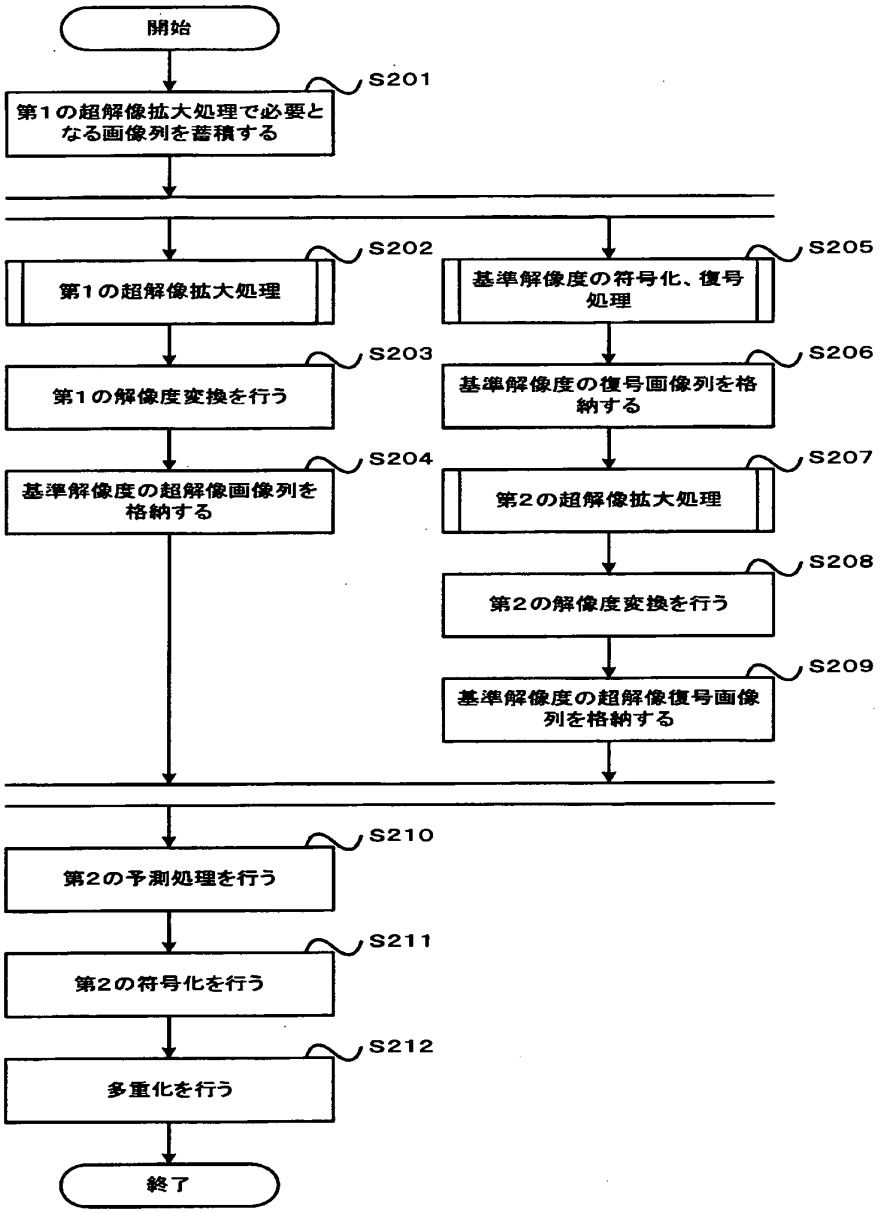
を有する動画像再符号化方法。
【請求項２０】
入力される符号化ビット列に対して所定の多重化分離処理を行って少なくとも第１および第２の符号化ビット列を出力するステップと、
所定の多重化分離処理によって得られた前記基準解像度の第１符号化ビット列を取得して所定の第１復号処理を行うことにより基準解像度の復号画像列を生成するステップと、
所定の第１復号処理によって生成された前記基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成するステップと、
所定の超解像拡大処理によって生成された前記超解像拡大復号画像列を取得して所定の解像度変換処理を行うことにより、基準解像度の超解像復号画像列を生成するステップと、
所定の多重化分離処理によって得られた前記基準解像度の第２符号化ビット列と、所定の第１復号処理によって生成された前記基準解像度の復号画像列と、所定の解像度変換処理によって生成された基準解像度の超解像復号画像列とを取得し、所定の予測処理および所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成するステップと、
をコンピュータに実行させる動画像復号プログラム。
【請求項２１】
入力される符号化ビット列に対して所定の多重化分離処理を行うステップと、
所定の多重化分離処理によって得られた前記基準解像度の第１符号化ビット列を取得して所定の第１復号処理を行うことにより基準解像度の復号画像列を生成するステップと、
所定の第１復号処理によって生成された前記基準解像度の復号画像列を取得して所定の超解像拡大処理を行うことにより、超解像拡大復号画像列を生成するステップと、
所定の超解像拡大処理によって生成された前記超解像拡大復号画像列を取得して所定の解像度変換処理を行うことにより、基準解像度の超解像復号画像列を生成するステップと、
所定の多重化分離処理によって得られた基準解像度の第２符号化ビット列と、所定の第１復号処理によって生成された前記基準解像度の復号画像列と、所定の第１解像度変換処理によって生成された前記基準解像度の超解像復号画像列とを取得して所定の基準解像度の拡張復号である第２復号処理を行うことにより、復号後の基準解像度の超解像画像列を生成するステップと、
所定の第１復号処理の復号途中である直交変換係数情報と、所定の基準解像度の拡張復号である第２復号処理の復号途中である基準解像度の拡張層における直交変換係数情報とを取得し、それぞれの直交変換係数情報を合成した後に所定のエントロピー符号化処理を行うことにより再符号化後の符号化ビット列を生成するステップと、
再符号化後の前記符号化ビット列を取得し、所定の構文構造に基づいて、符号化で利用した各種パラメータ情報や符号化モード情報を特定するための識別情報を挿入しながら多重化処理を行い、多重化後の符号化ビット列を生成するステップと、
をコンピュータに実行させる動画像再符号化プログラム。

【書類名】要約書
【要約】
【課題】入力動画像の解像度で表現される空間周波数成分情報より多くのの空間周波数成分情報を符号化し、伝送すること。
【解決手段】第１超解像拡大部１０３は、基準解像度の入力動画像に対し超解像拡大処理を行うことにより、入力動画像中に潜在的に含まれるが基準解像度では十分表現できていなかった空間方向および時間方向の周波数成分情報を含め、第１解像度変換部１０４がその超解像拡大後信号を基準解像度に戻し、第２符号化部１０７はその基準解像度に戻された超解像拡大後信号を符号化する。第１符号化部１０２は基準解像度の入力動画像を符号化し、多重化部１０９は第１符号化部１０２からの符号化ビット列と第２符号化部１０７からの符号化ビット列等とを多重化する。なお、第２符号化部１０７は第１符号化部１０２における局所復号信号またはそれを加工した信号を参照信号として使用しても良い。
【選択図】図１

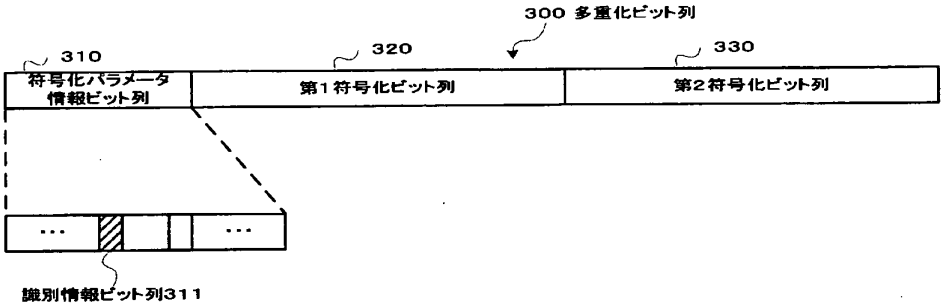
【書類名】図面
【図１】


第2
符号化部
107
第1解像度
変換部
104
第2解像度
変換部
106
第1超解像
拡大部
103
第2超解像
拡大部
105
入力
(動画像列)
第1蓄積
バッファ
101
第1
符号化部
102
多重化部
109
出力
(符号化ビット列)

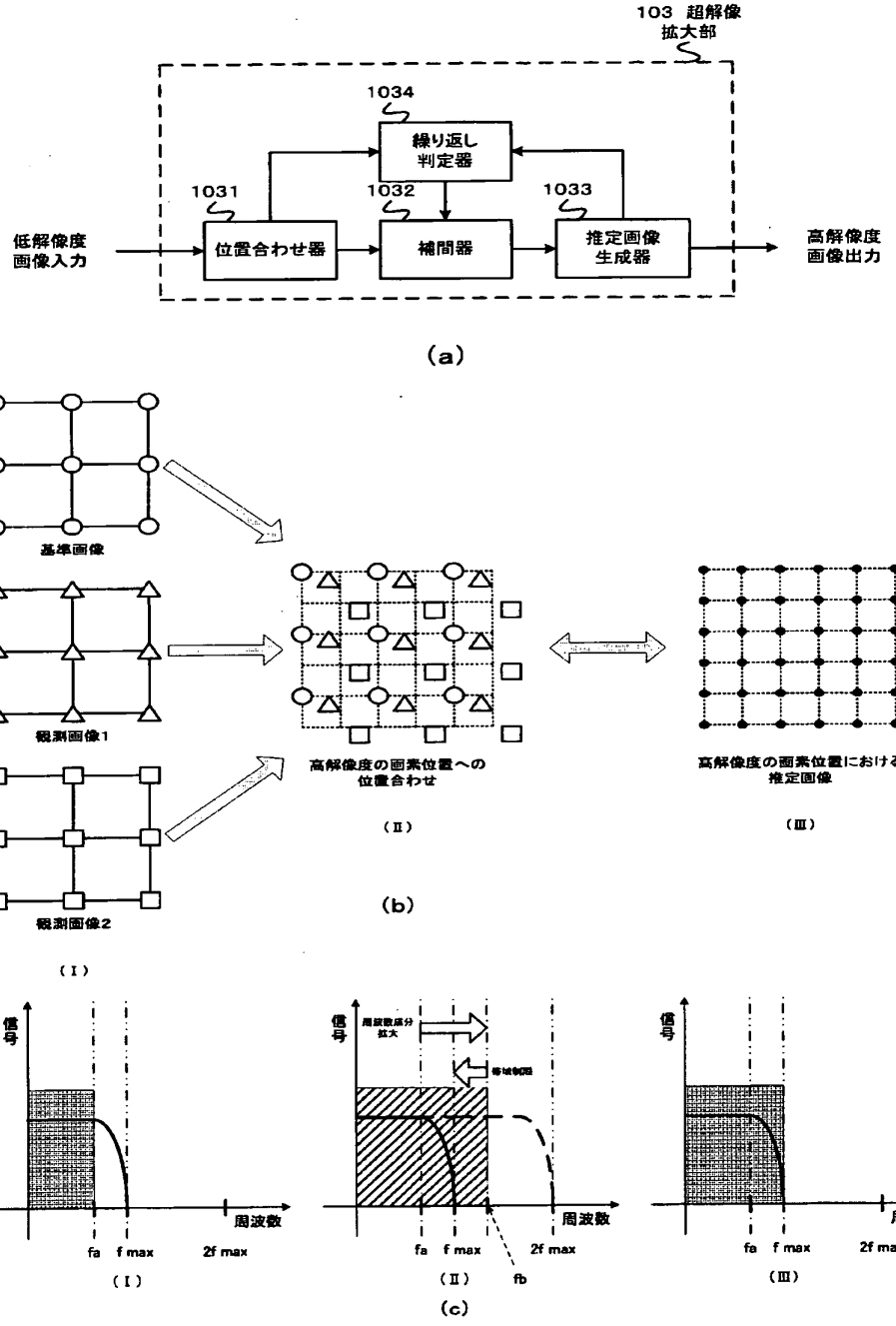
【図２】


開始
S201
第１の超解像拡大処理で必要となる画像列を蓄積する
S202
第１の超解像拡大処理
S203
第１の解像度変換を行う
S204
基準解像度の超解像画像列を格納する
S205
基準解像度の符号化、復号処理
S206
基準解像度の復号画像列を格納する
S207
第２の超解像拡大処理
S208
第２の解像度変換を行う
S209
基準解像度の超解像復号画像列を格納する
S210
第２の予測処理を行う
S211
第２の符号化を行う
S212
多重化を行う
終了

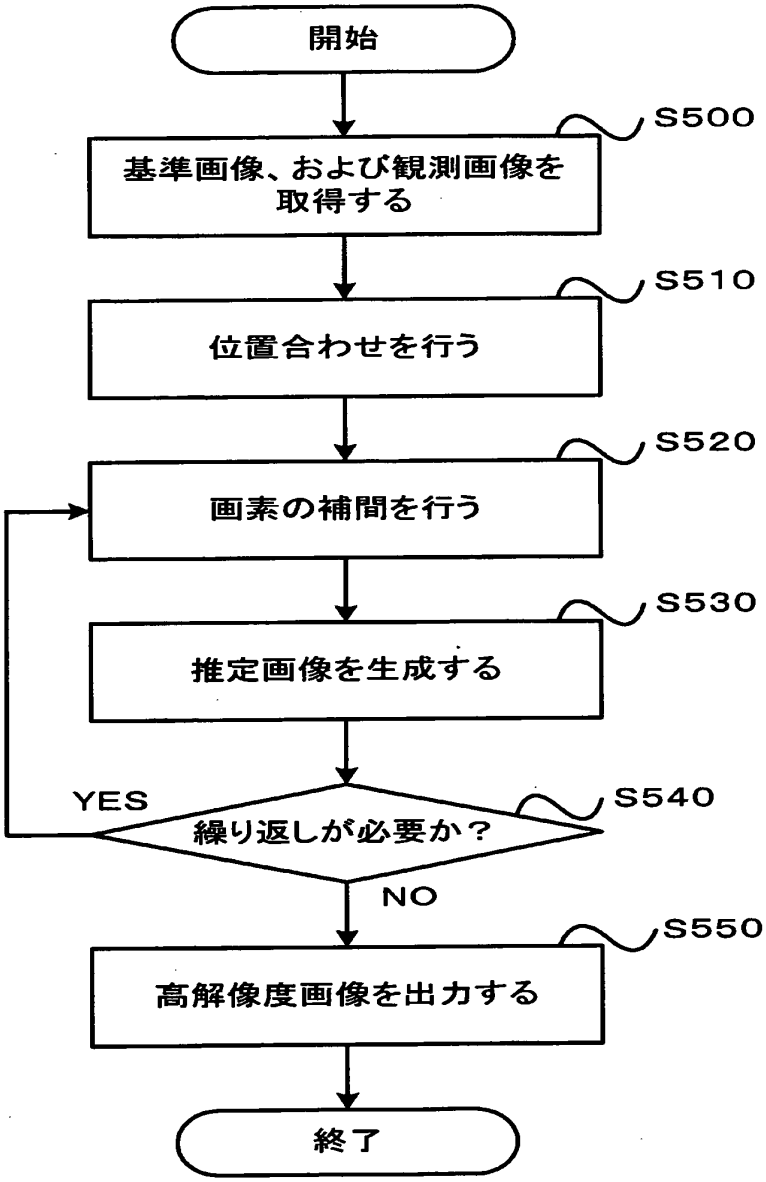
【図３】


300 多重化ビット列
310
320
330
符号化パラメータ情報ビット列
第1符号化ビット列
第2符号化ビット列
識別情報ビット列311

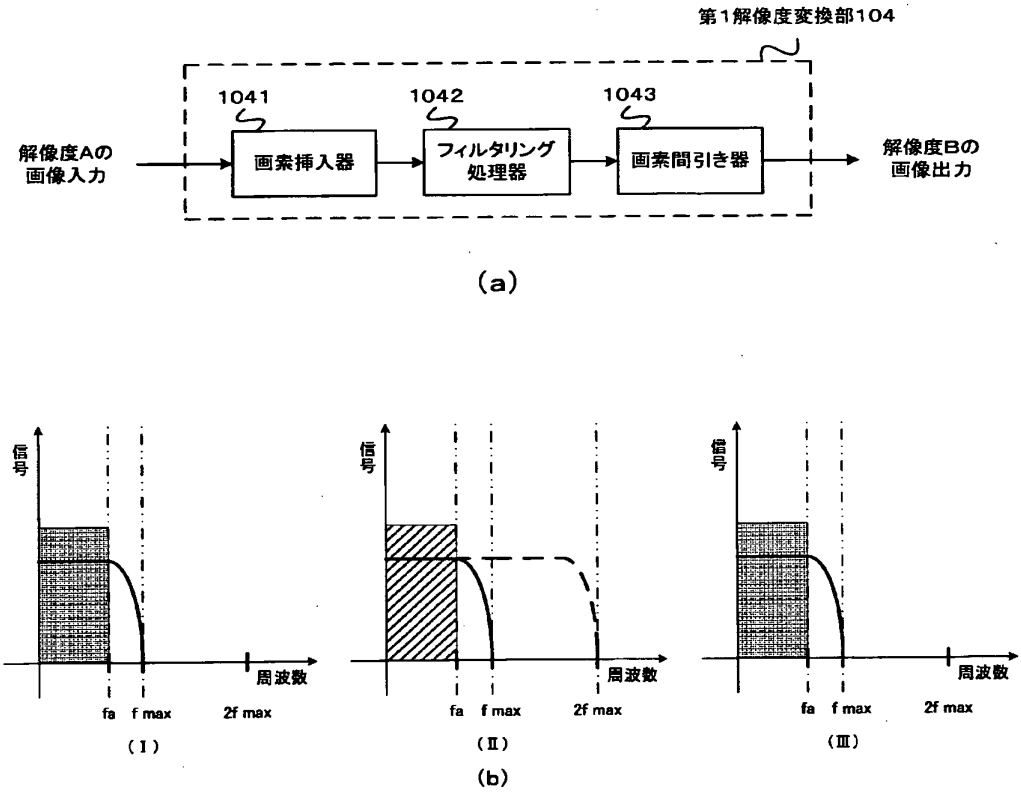
【図４】


103 超解像
拡大部
1034
繰り返し
判定器
1031
1032
1033
低解像度
画像入力
位置合わせ器
補間器
推定画像
生成器
高解像度
画像出力
(a)
基準画像
観測画像1
観測画像2
(I)
高解像度の画素位置への
位置合わせ
(II)
高解像度の画素位置における
推定画像
(III)
(b)
信号
周波数
fa
f max
2f max
(I)
周波数成分
拡大
帯域制限
fb
(II)
(III)
(c)

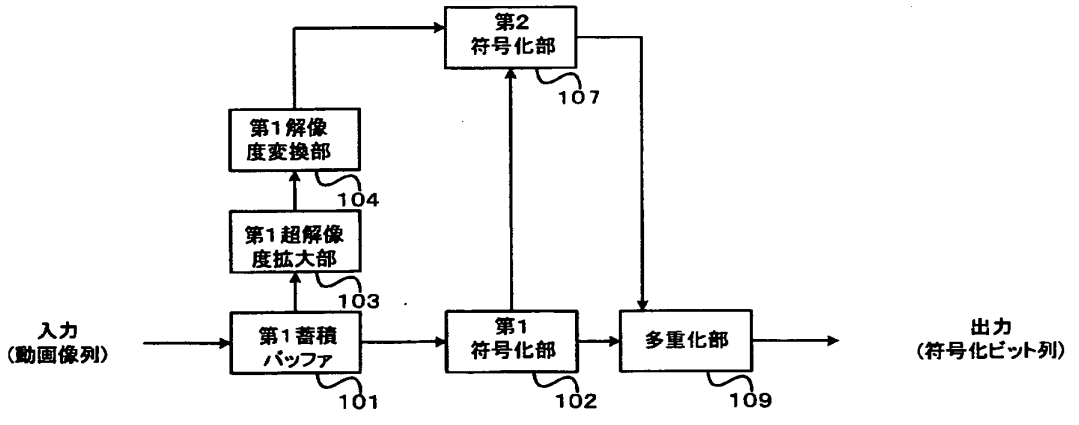
【図５】


開始
S500
基準画像、および観測画像を取得する
S510
位置合わせを行う
S520
画素の補間を行う
S530
推定画像を生成する
S540
YES
繰り返しが必要か？
NO
S550
高解像度画像を出力する
終了

【図６】

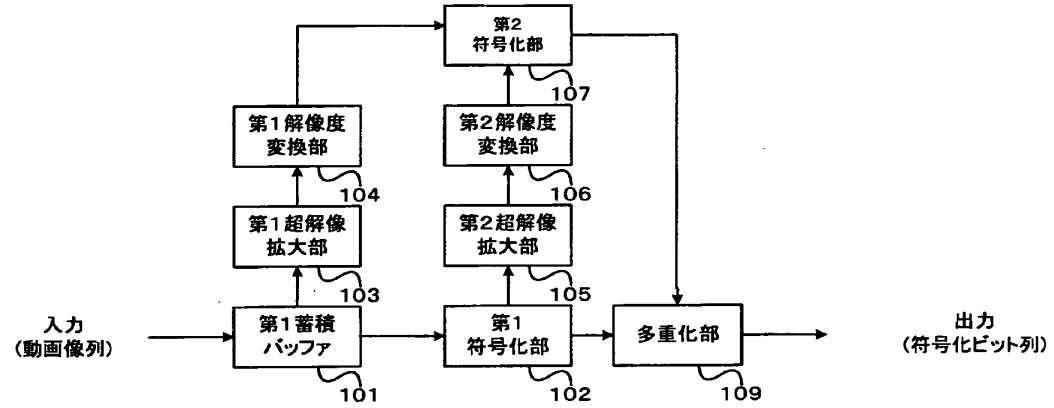


【図７】

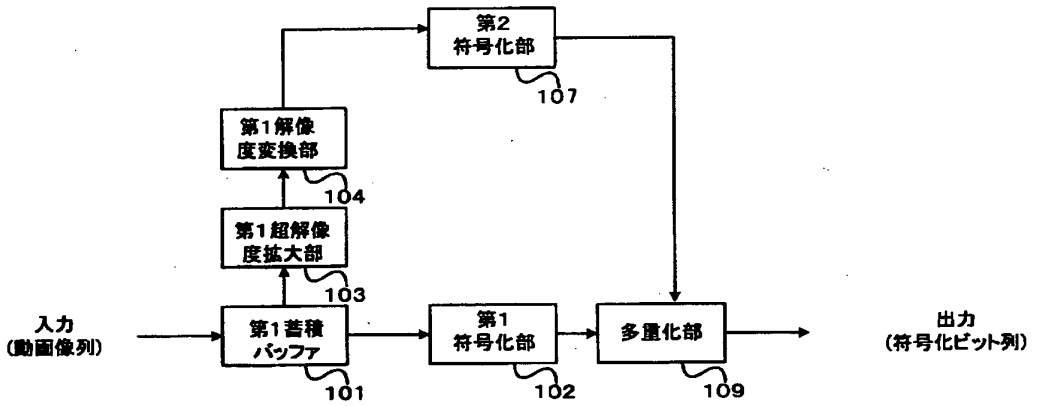


出証特２００９－３０１７００７

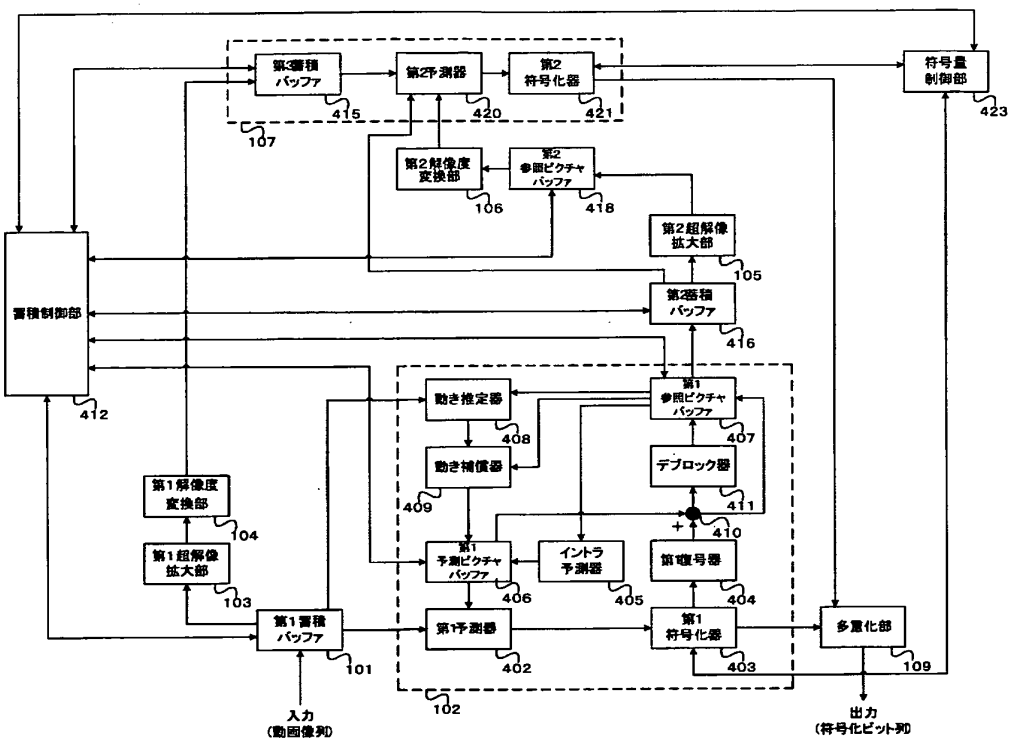
【図８】


第2
符号化部
107
第1解像度
変換部
104
第2解像度
変換部
106
第1超解像
拡大部
103
第2超解像
拡大部
105
入力
(動画像列)
第1蓄積
バッファ
101
第1
符号化部
102
多重化部
109
出力
(符号化ビット列)

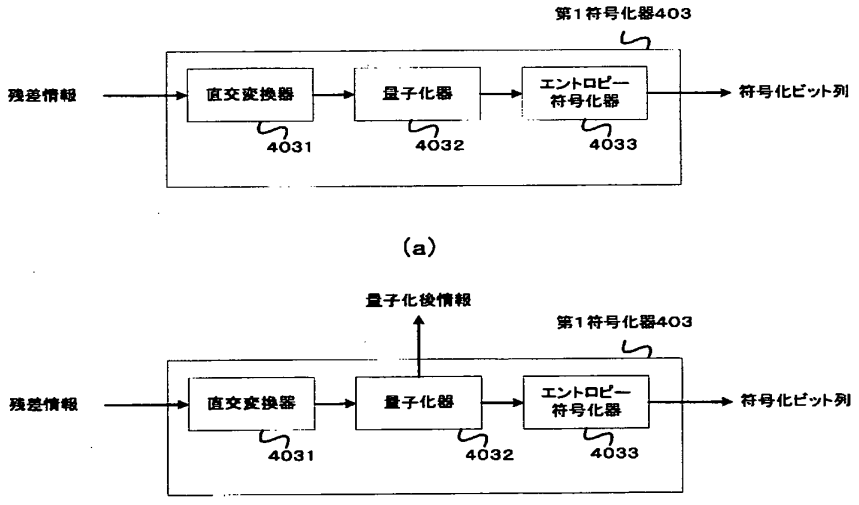
【図９】


第2
符号化部
107
第1解像
度変換部
104
第1超解像
度拡大部
103
入力
(動画像列)
第1蓄積
バッファ
101
第1
符号化部
102
多重化部
109
出力
(符号化ビット列)

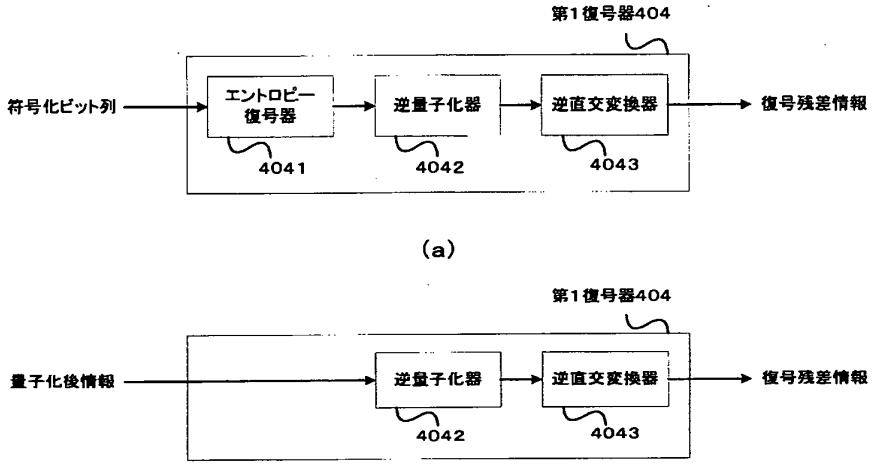
【図１０】


第2蓄積バッファ
415
第2予測器
420
第2符号化器
421
107
符号量制御部
423
第2解像度変換部
106
第2参照ピクチャバッファ
418
第2超解像拡大部
105
蓄積制御部
412
第2蓄積バッファ
416
動き推定器
408
第1参照ピクチャバッファ
407
動き補償器
409
デブロック器
411
410
第1解像度変換部
104
第1超解像拡大部
103
第1予測ピクチャバッファ
406
イントラ予測器
405
第1復号器
404
第1蓄積バッファ
101
第1予測器
402
第1符号化器
403
多重化部
109
102
入力
(動画像列)
出力
(符号化ビット列)

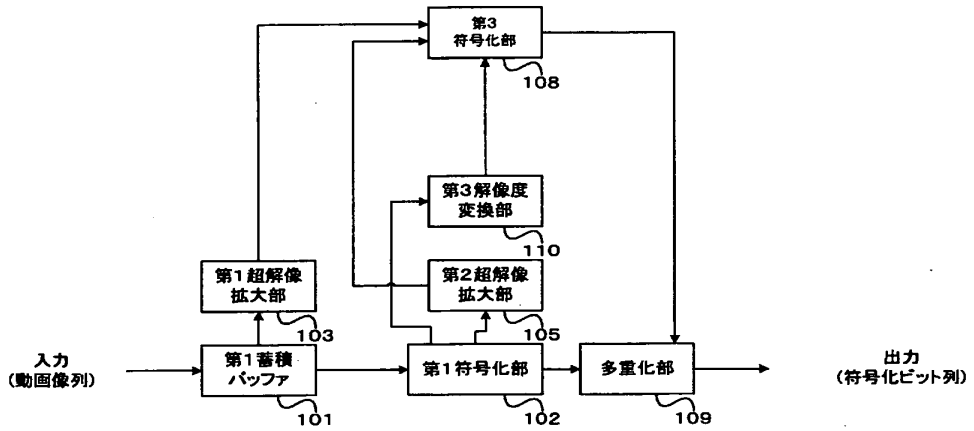
【図１１】


第1符号化器403
残差情報
直交変換器
4031
量子化器
4032
エントロピー符号化器
4033
符号化ビット列
(a)
量子化後情報
第1符号化器403
残差情報
直交変換器
4031
量子化器
4032
エントロピー符号化器
4033
符号化ビット列
(b)

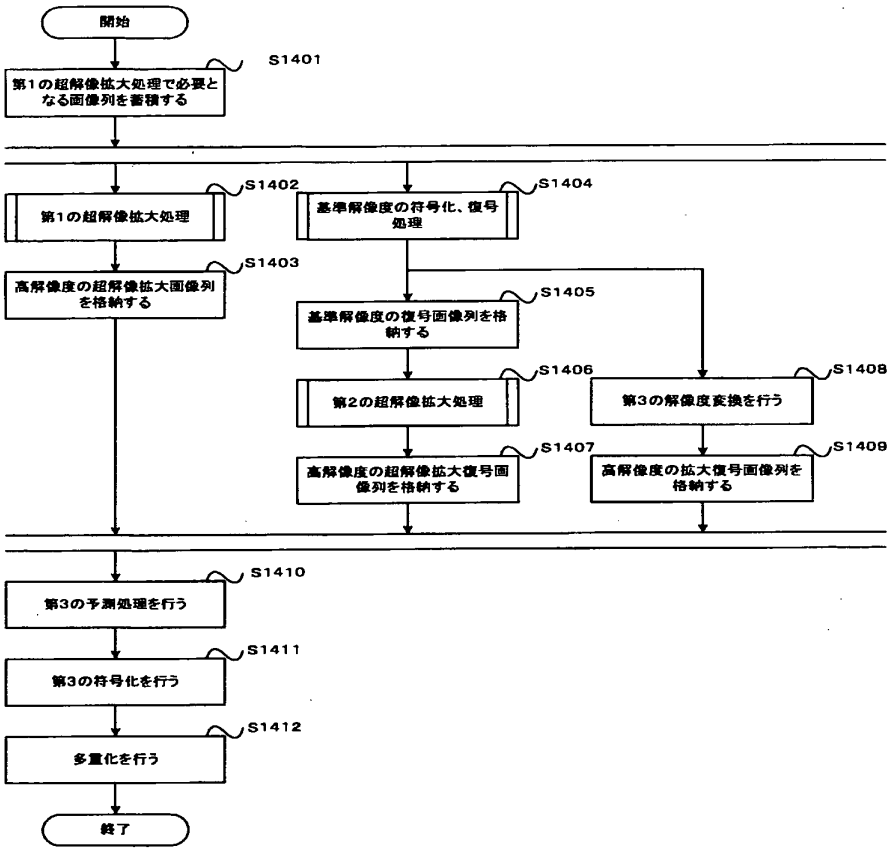
【図１２】


第1復号器404
符号化ビット列
エントロピー復号器
逆量子化器
逆直交変換器
復号残差情報
4041
4042
4043
(a)
第1復号器404
量子化後情報
逆量子化器
逆直交変換器
復号残差情報
4042
4043
(b)

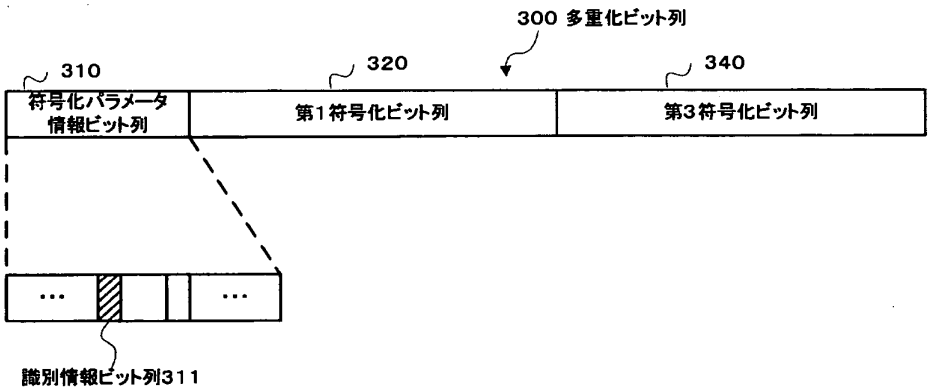
【図１３】


第3符号化部
108
第3解像度変換部
110
第1超解像拡大部
103
第2超解像拡大部
105
入力（動画像列）
第1蓄積バッファ
101
第1符号化部
102
多重化部
109
出力（符号化ビット列）

【図１４】

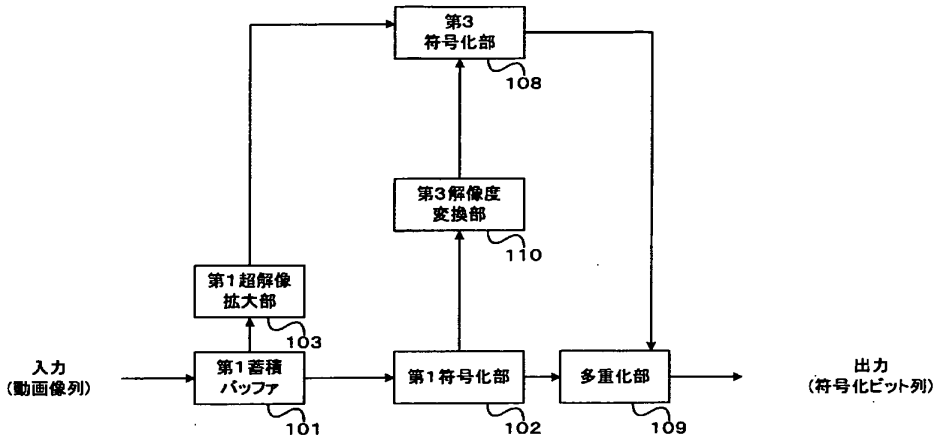


【図１５】

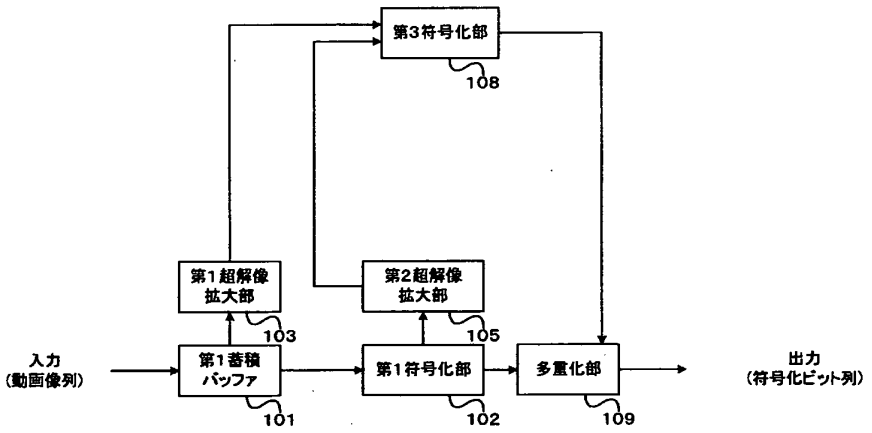


出証特２００９－３０１７００７

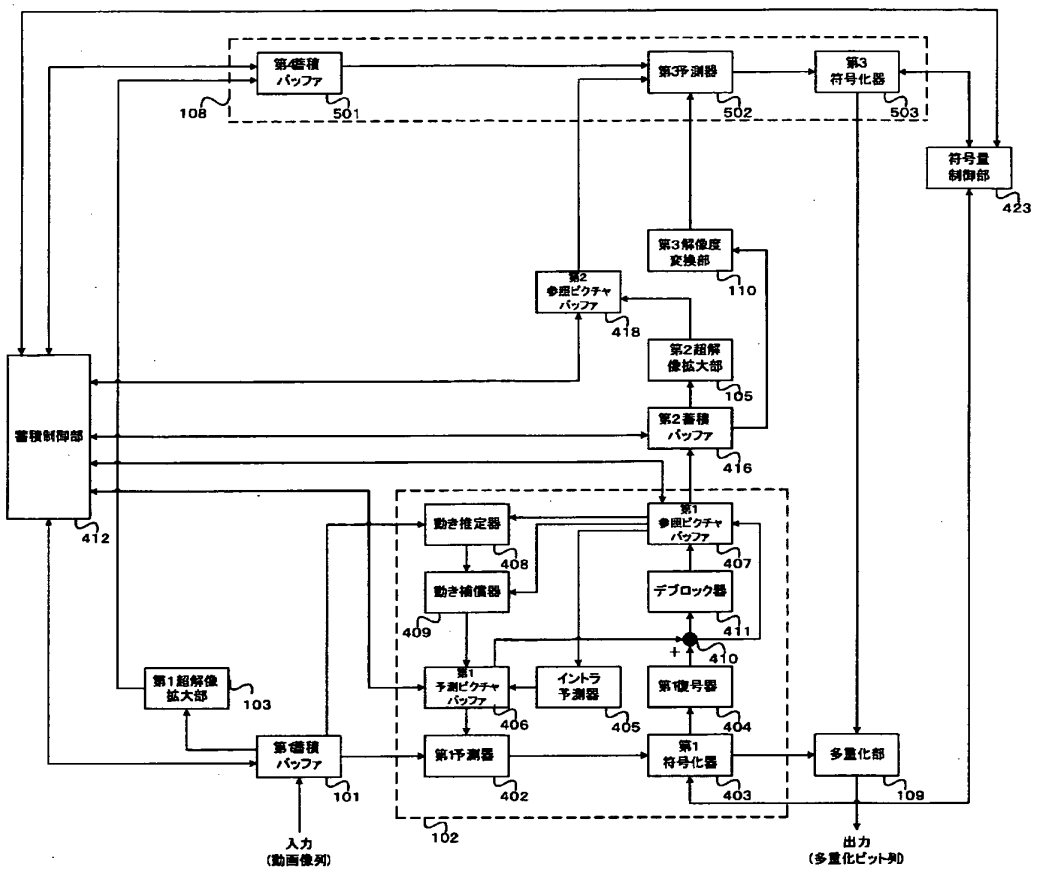
【図１６】


第3
符号化部
108
第3解像度
変換部
110
第1超解像
拡大部
103
入力
(動画像列)
第1蓄積
バッファ
101
第1符号化部
102
多重化部
109
出力
(符号化ビット列)

【図１７】

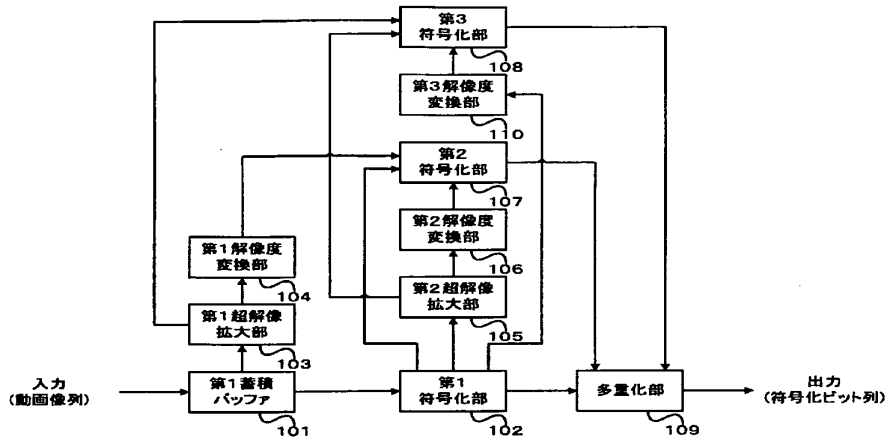

第3符号化部
108
第1超解像
拡大部
103
第2超解像
拡大部
105
入力
(動画像列)
第1蓄積
バッファ
101
第1符号化部
102
多重化部
109
出力
(符号化ビット列)

【図１８】

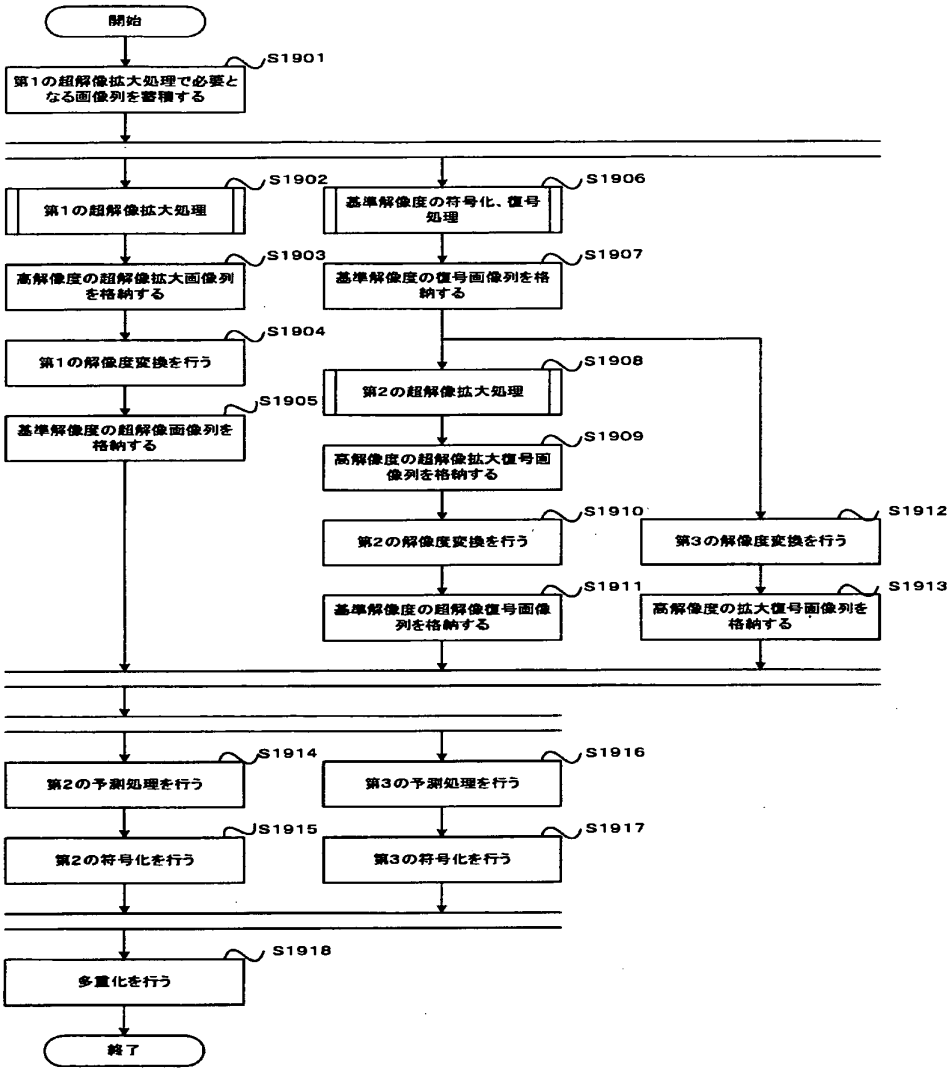


出証特２００９－３０１７００７

【図１９】

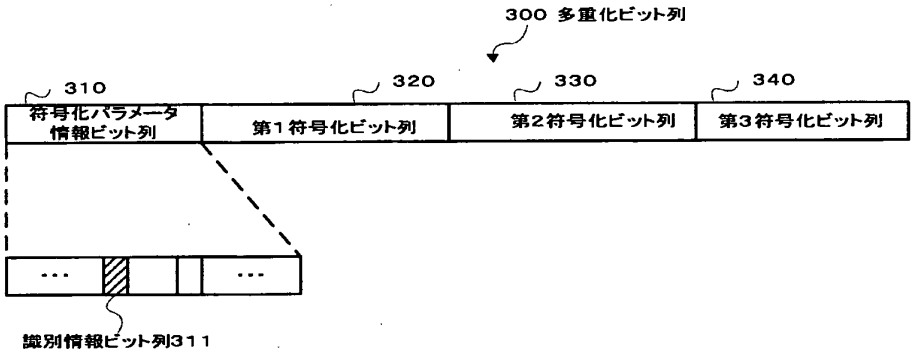

第3
符号化部
108
第3解像度
変換部
110
第2
符号化部
107
第2解像度
変換部
106
第2超解像
拡大部
105
第1解像度
変換部
104
第1超解像
拡大部
103
入力
(動画像列)
第1蓄積
バッファ
101
第1
符号化部
102
多重化部
109
出力
(符号化ビット列)

【図２０】

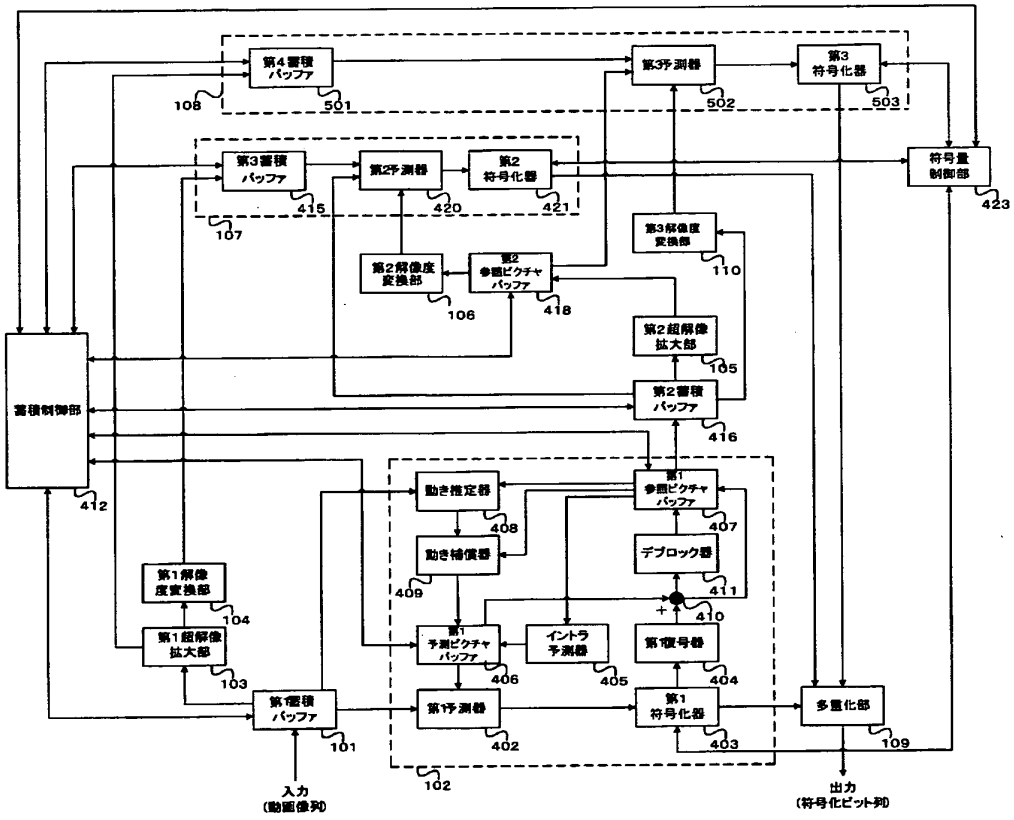


出証特２００９－３０１７００７

【図２１】

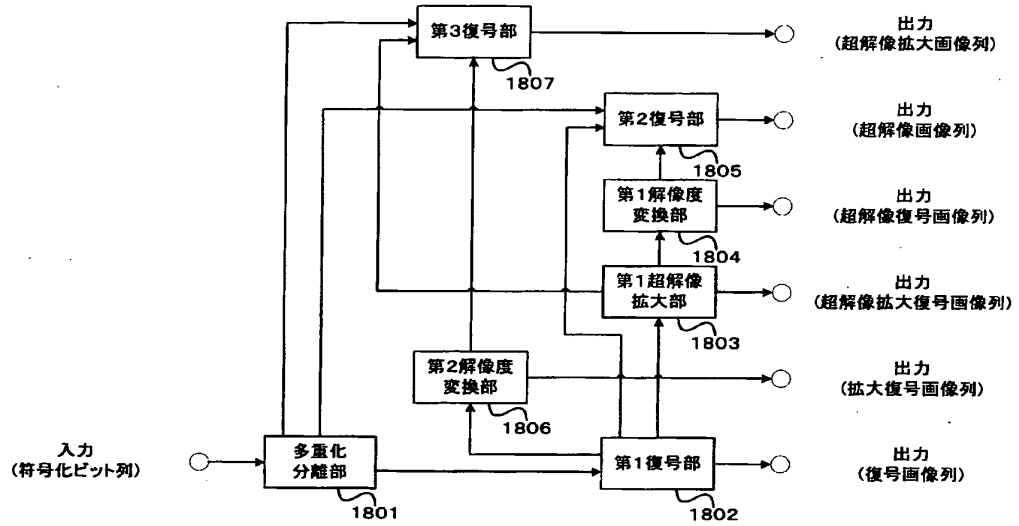


【図２２】

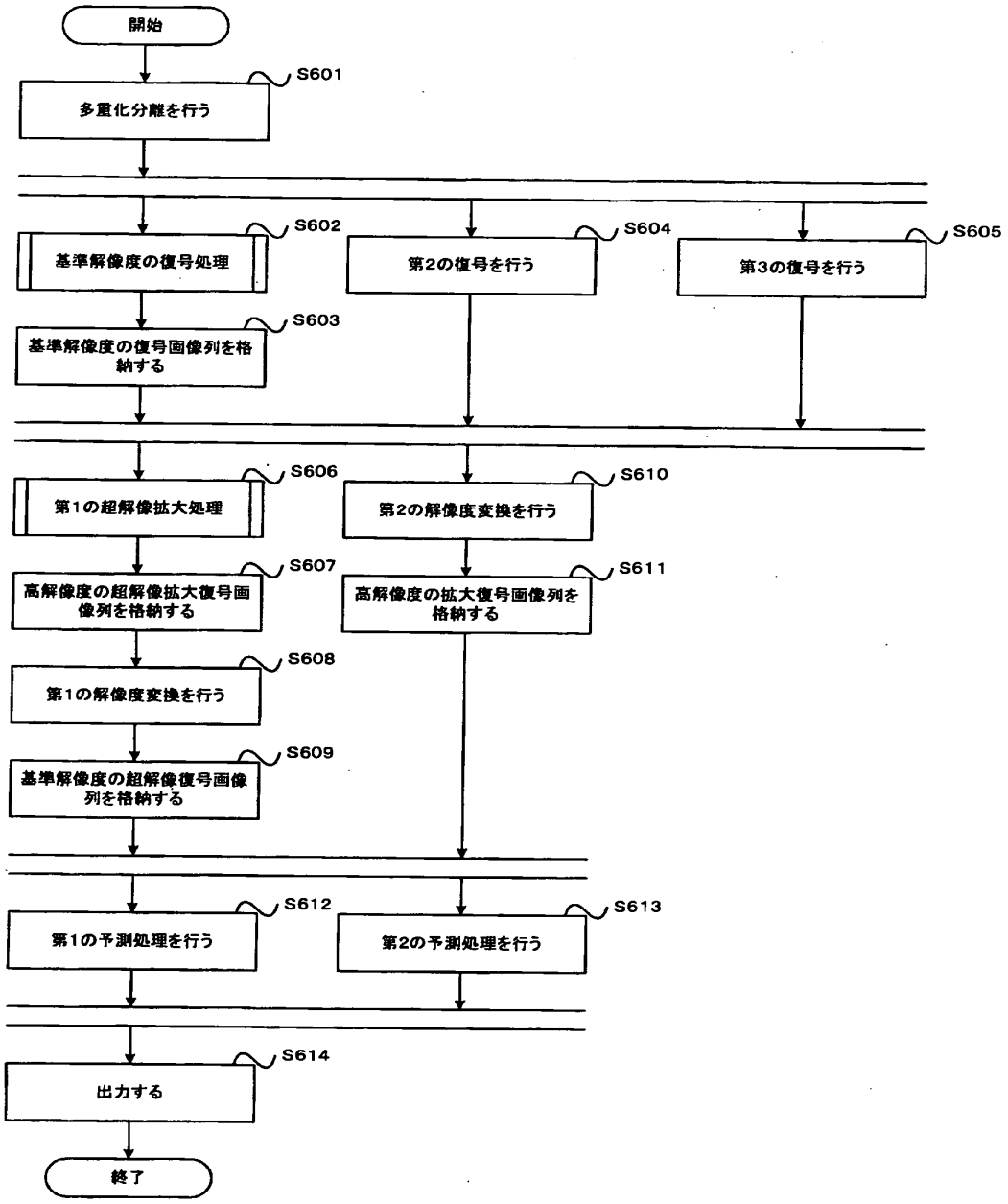


出証特２００９－３０１７００７

【図２３】

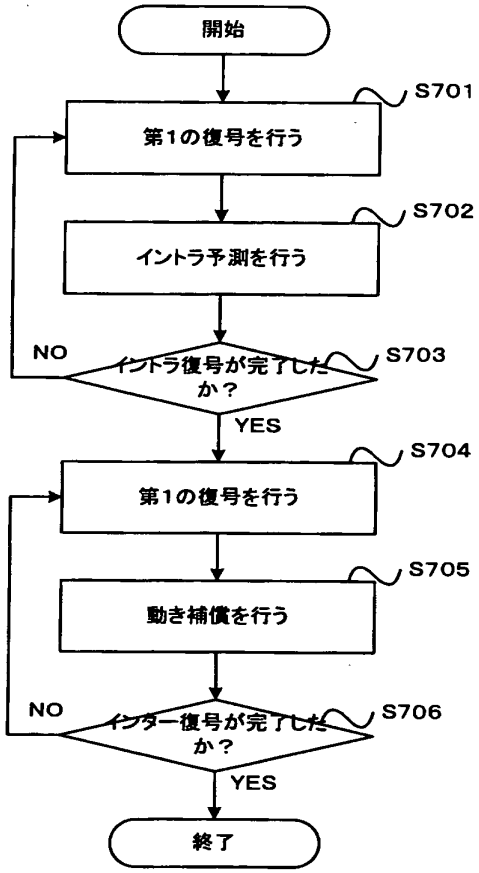

第3復号部
1807
出力
(超解像拡大画像列)
第2復号部
1805
出力
(超解像画像列)
第1解像度
変換部
1804
出力
(超解像復号画像列)
第1超解像
拡大部
1803
出力
(超解像拡大復号画像列)
第2解像度
変換部
1806
出力
(拡大復号画像列)
入力
(符号化ビット列)
多重化
分離部
1801
第1復号部
1802
出力
(復号画像列)

【図２４】

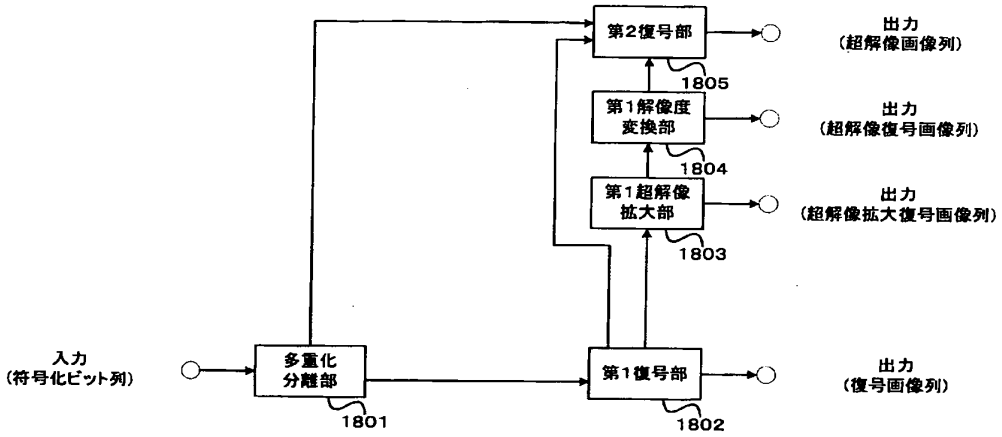


出証特２００９－３０１７００７

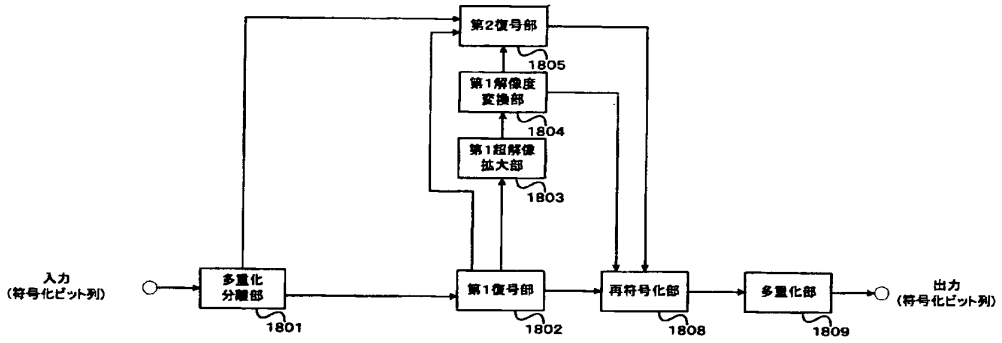
【図２５】


開始
S701
第1の復号を行う
S702
イントラ予測を行う
NO
イントラ復号が完了したか？
S703
YES
S704
第1の復号を行う
S705
動き補償を行う
NO
インター復号が完了したか？
S706
YES
終了

【図２６】

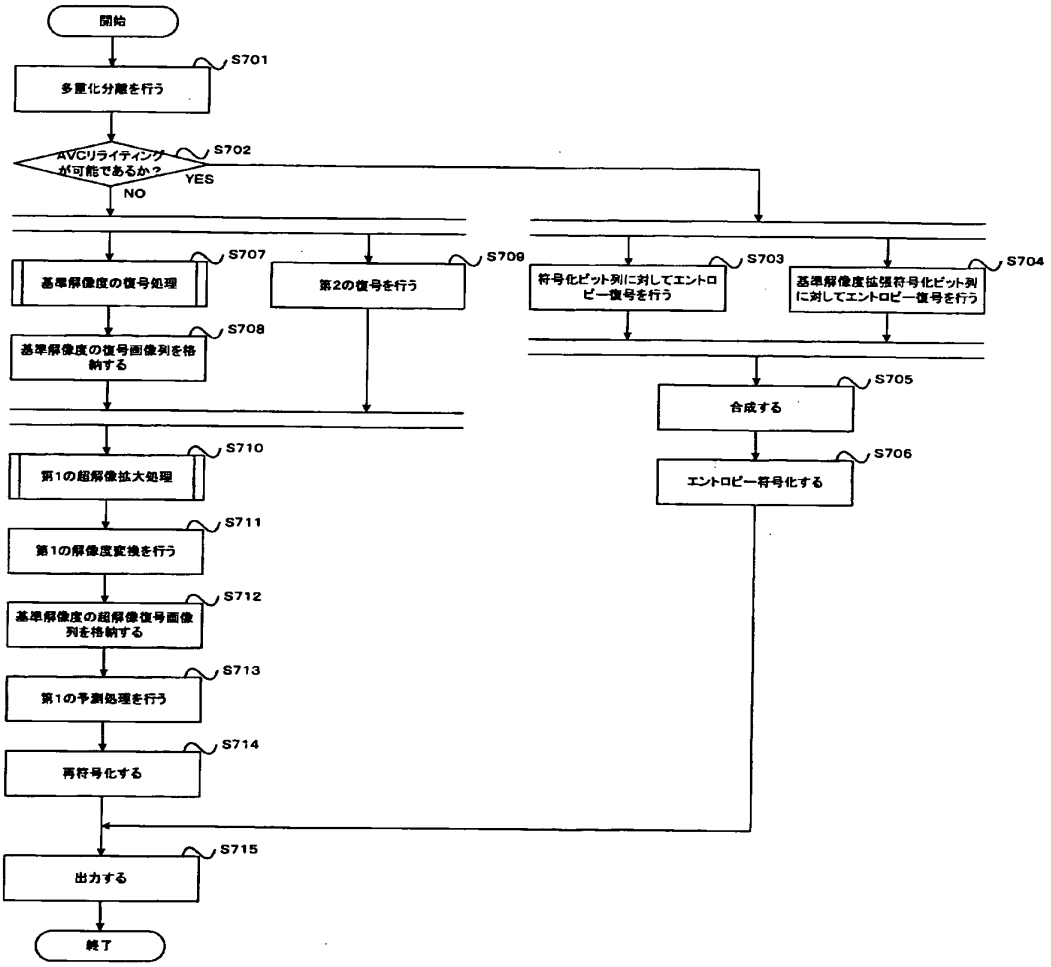


【図２７】



出証特２００９－３０１７００７

【図２８】


開始
S701
多重化分離を行う
S702
AVCリライティングが可能であるか？
YES
NO
S707
基準解像度の復号処理
S708
基準解像度の復号画像列を格納する
S709
第2の復号を行う
S703
符号化ビット列に対してエントロピー復号を行う
S704
基準解像度拡張符号化ビット列に対してエントロピー復号を行う
S705
合成する
S706
エントロピー符号化する
S710
第1の超解像拡大処理
S711
第1の解像度変換を行う
S712
基準解像度の超解像復号画像列を格納する
S713
第1の予測処理を行う
S714
再符号化する
S715
出力する
終了

特願２００９－１２３９６０

出　願　人　履　歴　情　報

識別番号　［０００００４３２９］

１．変更年月日　１９９０年　８月　８日
［変更理由］　新規登録
住　所　神奈川県横浜市神奈川区守屋町３丁目１２番地
氏　名　日本ビクター株式会社

出証番号　出証特２００９－３０１７００７

PTO/SB/06 (07-06)
Approved for use through 1/31/2007. OMB 0651-0032
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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number	Filing Date	☐ To be Mailed
12/995,039	11/29/2010	

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)	SMALL ENTITY ☐		OR	OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT		(Column 1)		(Column 2)	(Column 3)	SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
	11/29/2010	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 25	Minus	** 25	= 0	X $ =		OR	X $52=	0
	Independent (37 CFR 1.16(h))	* 16	Minus	***16	= 0	X $ =		OR	X $220=	0
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	0

AMENDMENT		(Column 1)		(Column 2)	(Column 3)	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA					
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/ROLITA WIMBUSH/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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