PTO-1390 (01-18)
Approved for use through 8/31/2019. OMB 0651-0021
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 displays a valid OMB control number.

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A SUBMISSION UNDER 35 U.S.C. 371

Attorney Docket No.	
CRB313	
U.S. Application No. (if known, see 37 CFR 1.5)	

International Application No.	International Filing Date	Priority Date Claimed
PCT/CA2017/050496	21 April 2017	21 April 2016

Title of Invention
Echocardiographic Image Analysis

First Named Inventor
Purang ABOLMAESUMI et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information.

1. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). NOTE: The express request under 35 U.S.C. 371(f) will not be effective unless the requirements under 35 U.S.C. 371(c)(1), (2), and (4) for payment of the basic national fee, copy of the International Application and English translation thereof (if required), and the oath or declaration of the inventor(s) have been received.
2. ☐ A copy of the International Application (35 U.S.C. 371(c)(2)) is attached hereto (not required if the International Application was previously communicated by the International Bureau or was filed in the United States Receiving Office (RO/US)).
3. An English language translation of the International Application (35 U.S.C. 371(c)(2))
   a. ☐ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
4. An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4))
   a. ☐ is attached.
   b. ☐ was previously filed in the international phase under PCT Rule 4.17(iv).

Items 5 to 8 below concern amendments made in the international phase.

PCT Article 19 and 34 amendments

5. ☐ Amendments to the claims under PCT Article 19 are attached (not required if communicated by the International Bureau) (35 U.S.C. 371(c)(3)).
6. ☐ English translation of the PCT Article 19 amendment is attached (35 U.S.C. 371(c)(3)).
7. ☐ English translation of annexes (Article 19 and/or 34 amendments only) of the International Preliminary Examination Report is attached (35 U.S.C. 371(c)(5)).

Cancellation of amendments made in the international phase

8a. ☐ Do not enter the amendment made in the international phase under PCT Article 19.

8b. ☐ Do not enter the amendment made in the international phase under PCT Article 34.

NOTE: A proper amendment made in English under Article 19 or 34 will be entered in the U.S. national phase application absent a clear instruction from applicant not to enter the amendment(s).

The following items 9 to 17 concern a document(s) or information included.

9. ■ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
10. ☐ A preliminary amendment.
11. ■ An Application Data Sheet under 37 CFR 1.76.
12. ☐ A substitute specification. NOTE: A substitute specification cannot include claims. See 37 CFR 1.125(b).
13. ☐ A power of attorney and/or change of address letter.
14. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13*ter*.3 and 37 CFR 1.821-1.825 (not required if sequence listing in text format was indicated on the PCT Request as part of the International Application and the sequence listing was published as part of the international application).
15. ☐ Assignment papers *(cover sheet and document(s))*. Name of Assignee: _____
16. ☐ 37 CFR 3.73(c) Statement *(when there is an Assignee)*.

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

U.S. APPLN. No. (if known – see 37 CFR 1.5)	INTERNATIONAL APPLICATION No.	ATTORNEY DOCKET No.
	PCT/CA2017/050496	CRB313

17. ☐ Other items or information:

The following fees have been submitted.	CALCULATIONS
18. ■ Basic national fee (37 CFR 1.492(a)) **$300**	$ 300.00
19. ☐ 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 **$760**	$
20. ☐ Search fee (37 CFR 1.492(b)) • 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** • Search fee (37 CFR 1.445(a)(2)) has been paid on the international application to the USPTO as an International Searching Authority ..... **$140** • 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..... **$520** • All other situations **$660**	$
TOTAL OF 18, 19, and 20 =	$

☐ 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)).

Fee for each additional 50 sheets of paper or fraction thereof **$400**

Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof (round **up** to a whole number)	RATE	
- 100 =	/ 50 =		x **$400**	$

Surcharge 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)).....**$140**	$

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	- 20 =		x **$100**	$
Independent claims	- 3 =		x **$460**	$
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			**+ $820**	$
Fee for submission of Sequence Listing text file of 300 MB to 800 MB (37 CFR 1.21(o)(1))..... **$1,000**				$
Fee for submission of Sequence Listing text file of more than 800 MB (37 CFR 1.21(o)(2))..... **$10,000**				$
Processing fee for furnishing the English translation later than 30 months from the earliest claimed priority date (37 CFR 1.492(i))..... **$140 +**				$
TOTAL OF ABOVE CALCULATIONS =				$
■ **Applicant asserts small entity status.** See 37 CFR 1.27. Fees above are reduced by ½.				
☐ **Applicant certifies micro entity status.** See 37 CFR 1.29. Fees above are reduced by ¾. Applicant must attach form PTO/SB/15A or B or equivalent.				
TOTAL NATIONAL FEE =				$
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)..... **$50.00** per property **+**				$
TOTAL FEES ENCLOSED =				$ 150.00

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 Director is hereby authorized to charge additional fees which may be required, or credit any overpayment, to Deposit Account No. _____ as follows:

i. ☐ any required fee.

ii. ☐ any required fee except for excess claims fees required under 37 CFR 1.492(d) and (e) and multiple dependent claim fee required under 37 CFR 1.492(f).

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 to pay 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.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013, and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.

NOTE 1: By providing this statement under 37 CFR 1.55 or 1.78, **this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA**.

NOTE 2: A U.S. national stage application may not claim priority to the international application of which it is the national phase. The filing date of a U.S. national stage application is the international filing date. See 35 U.S.C. 363.

Correspondence Address

■ The address associated with Customer Number: 157691 **OR** ☐ Correspondence address below

Name					
Address					
City		State		Zip Code	
Country		Telephone			
Email					

Signature	/David Bourgeau/	Date	22 October 2018
Name (Print/Type)	David BOURGEAU	Registration No. (Attorney/Agent)	72711

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.

ABSTRACT

A computer-implemented system for facilitating echocardiographic image analysis is disclosed. The system includes at least one processor configured to receive signals representing a first at least one echocardiographic image, associate the image with a first view category of a plurality of predetermined view categories, determine, based on the first at least one echocardiographic image and the first view category, a first quality assessment value representing a view category specific quality assessment of the first at least one echocardiographic image, and produce signals representing the first quality assessment value for causing the first quality assessment value to be associated with the first at least one echocardiographic image. The at least one processor may also be configured to do the above steps for a second at least one echocardiographic and a second view category that is different from the first view category image. Other systems, methods, and computer-readable media are also disclosed.

CLAIMS:

1. A computer-implemented system for facilitating echocardiographic image analysis, the system comprising at least one processor configured to:

receive signals representing a first at least one echocardiographic image;

associate the first at least one echocardiographic image with a first view category of a plurality of predetermined echocardiographic image view categories;

determine, based on the first at least one echocardiographic image and the first view category, a first quality assessment value representing a view category specific quality assessment of the first at least one echocardiographic image;

produce signals representing the first quality assessment value for causing the first quality assessment value to be associated with the first at least one echocardiographic image;

receive signals representing a second at least one echocardiographic image;

associate the second at least one echocardiographic image with a second view category of the plurality of predetermined echocardiographic image view categories, said second view category being different from the first view category;

determine, based on the second at least one echocardiographic image and the second view category, a second quality assessment value representing a view category specific quality assessment of the second at least one echocardiographic image; and

produce signals representing the second quality assessment value for causing the second quality assessment value to be associated with the second at least one echocardiographic image.

2. The system of claim **1** wherein the first quality assessment value represents an assessment of suitability of the first at least one echocardiographic image for quantified clinical measurement of anatomical features and wherein the second quality assessment value represents an assessment of suitability of the second at least one echocardiographic image for quantified measurement of anatomical features.

3. The system of claim **1** or **2** wherein the at least one processor is configured to:

produce signals for causing a representation of the first quality assessment value to be transmitted to at least one display for causing the at least one display to display the first quality assessment value in association with the first at least one echocardiographic image, to assist one or more operators of an echocardiographic device in capturing at least one subsequent echocardiographic image; and

produce signals for causing a representation of the second quality assessment value to be transmitted to the at least one display for causing the at least one display to display the second quality assessment value in association with the second at least one echocardiographic image, to assist the one or more operators in capturing at least one subsequent echocardiographic image.

4. The system of any one of claims **1** to **3** wherein the at least one processor is configured to:

apply one or more view categorization functions to the first at least one echocardiographic image to determine that the first at least one echocardiographic image falls within the first view category; and

apply one or more view categorization functions to the second at least one echocardiographic image to determine that the second at least one echocardiographic image falls within the second view category.

5. The system of any one of claims **1** to **4** wherein the first at least one echocardiographic image comprises a plurality of echocardiographic images and wherein the at least one processor is configured to determine the first quality assessment value by determining a single quality assessment value representing a view category specific assessment of the plurality of echocardiographic images.

6. The system of any one of claims **1** to **5** wherein each of the plurality of predetermined echocardiographic image view categories is associated with a respective set of assessment parameters and wherein the at least one processor is configured to:

determine that a first set of assessment parameters of the sets of assessment parameters is associated with the first view category;

in response to determining that the first set of assessment parameters is associated with the first view category, apply a first function based on the first set of assessment parameters to the first at least one echocardiographic image;

determine that a second set of assessment parameters of the sets of assessment parameters is associated with the second view category; and

in response to determining that the second set of assessment parameters is associated with the second view category, apply a second function based on the second set of assessment parameters to the second at least one echocardiographic image.

7. The system of claim **6** wherein each of the sets of assessment parameters includes:

a set of common assessment parameters, which are common to each of the sets of assessment parameters; and

a set of view category specific assessment parameters, which are unique to the set of assessment parameters.

8. The system of claim **6** or **7** wherein each of the sets of assessment parameters is a set of neural network parameters that defines a neural network having a plurality of layers including an input layer configured to receive one or more echocardiographic images and an output layer configured to output one or more quality assessment values and wherein the at least one processor is configured to:

apply the first function based on the first set of assessment parameters to the first at least one echocardiographic image by inputting the first at least one echocardiographic image into the neural network defined by the first set of assessment parameters; and

apply the second function based on the second set of assessment parameters to the second at least one echocardiographic image by inputting the second at least one echocardiographic image into the neural network defined by the second set of assessment parameters.

9. The system of claim **8** wherein the at least one processor is configured to train the neural networks by:

receiving signals representing a plurality of echocardiographic training images, each of the plurality of echocardiographic training images associated with one of the plurality of predetermined echocardiographic image view categories;

receiving signals representing respective expert quality assessment values representing view category specific quality assessments of the plurality of echocardiographic training images, each of the expert quality assessment values provided by an expert echocardiographer and associated with one of the plurality of echocardiographic training images; and

training the neural networks using the plurality of echocardiographic training images as inputs and the associated expert quality assessment values as desired outputs to determine the sets of neural network parameters defining the neural networks.

10. The system of claim **9** wherein each of the expert quality assessment values represents an assessment of suitability of the associated echocardiographic image for quantified clinical measurement of anatomical features.

11. The system of claim **9** or **10** wherein the at least one processor is configured to derive each of the expert quality assessment values at least in part from a clinical plane assessment value representing an expert opinion whether the associated echocardiographic training image was taken in an anatomical plane suitable for quantified clinical measurement of anatomical features.

12. The system of any one of claims **9** to **11** wherein each of the sets of neural network parameters includes:

a set of common neural network parameters, which are common to each of the sets of neural network parameters; and

a set of view category specific neural network parameters, which are unique to the set of neural network parameters; and

wherein the at least one processor is configured to, for each echocardiographic training image:

select one of the sets of view category specific neural network parameters based on the predetermined echocardiographic image view category associated with the echocardiographic training image; and

using the echocardiographic training image as an input and the associated expert quality assessment values as a desired output, train a neural network defined by the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters to update the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters.

13. A computer-implemented system for training neural networks to facilitate echocardiographic image analysis, the system comprising at least one processor configured to:

receive signals representing a plurality of echocardiographic training images, each of the plurality of echocardiographic training images associated with one of a plurality of predetermined echocardiographic image view categories;

receive signals representing expert quality assessment values representing view category specific quality assessments of the plurality of echocardiographic training images, each of the expert quality assessment values provided by an expert echocardiographer and associated with one of the plurality of echocardiographic training images; and

train the neural networks using the plurality of echocardiographic training images and the associated expert quality assessment values to determine sets of neural network parameters defining the neural networks, at least a portion of each of said neural networks associated with one of the plurality of predetermined echocardiographic image view categories.

14. The system of claim **13** wherein each of the expert quality assessment values represents an assessment of suitability of the associated echocardiographic image for quantified clinical measurement of anatomical features.

15. The system of claim **13** or **14** wherein the at least one processor is configured to derive each of the expert quality assessment values at least in part from a clinical plane assessment value representing an expert opinion whether the associated echocardiographic training image was taken in an anatomical plane suitable for a quantified clinical measurement of anatomical features.

16. The system of any one of claims **13** to **15** wherein each of the sets of neural network parameters includes:

a set of common neural network parameters, which are common to each of the sets of neural network parameters; and

a set of view category specific neural network parameters, which are unique to the set of neural network parameters; and

wherein the at least one processor is configured to, for each echocardiographic training image:

select one of the sets of view category specific neural network parameters based on the predetermined echocardiographic image view category associated with the echocardiographic training image; and

using the echocardiographic training image as an input and the associated expert quality assessment value as a desired output, train a neural network defined by the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters to update the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters.

17. A computer-implemented method of facilitating echocardiographic image analysis, the method comprising:

receiving signals representing a first at least one echocardiographic image;

associating the first at least one echocardiographic image with a first view category of a plurality of predetermined echocardiographic image view categories;

determining, based on the first at least one echocardiographic image and the first view category, a first quality assessment value representing a view category specific quality assessment of the first at least one echocardiographic image;

producing signals representing the first quality assessment value for causing the first quality assessment value to be associated with the first at least one echocardiographic image;

receiving signals representing a second at least one echocardiographic image;

associating the second at least one echocardiographic image with a second view category of the plurality of predetermined echocardiographic image view categories, said second view category being different from the first view category;

determining, based on the second at least one echocardiographic image and the second view category, a second quality assessment value representing a view category specific quality assessment of the second at least one echocardiographic image; and

producing signals representing the second quality assessment value for causing the second quality assessment value to be associated with the second at least one echocardiographic image.

18. The method of claim **17** wherein the first quality assessment value represents an assessment of suitability of the first at least one echocardiographic image for quantified clinical measurement of anatomical features and wherein the second quality assessment value represents an assessment of suitability of the second at least one echocardiographic image for quantified measurement of anatomical features.

19. The method of claim **17** or **18** wherein:

producing the signals representing the first quality assessment value comprises producing signals for causing a representation of the first quality assessment value to be transmitted to at least one display for causing the at least one display to display the first quality assessment value in association with the first at least one echocardiographic image, to assist one or more operators of an echocardiographic device in capturing at least one subsequent echocardiographic image; and

producing the signals representing the second quality assessment value comprises producing signals for causing a representation of the second quality assessment value to be transmitted to the at least one display for causing the at least one display to display the second quality assessment value in association with the second at least one echocardiographic image, to assist the one or more operators in capturing at least one subsequent echocardiographic image.

20. The method of any one of claims **17** to **19** wherein:

associating the first at least one echocardiographic image with the first view category comprises applying one or more view categorization functions to the first at least one echocardiographic image to determine that the first at least one echocardiographic image falls within the first view category; and

associating the second at least one echocardiographic image with the second view category comprises applying one or more view categorization functions to the second at least one echocardiographic image to determine that the second at least one echocardiographic image falls within the second view category.

21. The method of any one of claims **17** to **20** wherein the first at least one echocardiographic image comprises a plurality of echocardiographic images and wherein determining the first quality assessment value comprises determining a single quality assessment value representing a view category specific assessment of the plurality of echocardiographic images.

22. The method of any one of claims **17** to **21** wherein each of the plurality of predetermined echocardiographic image view categories is associated with a respective set of assessment parameters and wherein:

determining the first quality assessment value comprises:

determining that a first set of assessment parameters of the sets of assessment parameters is associated with the first view category; and

in response to determining that the first set of assessment parameters is associated with the first view category, applying a first function based on the first set of assessment parameters to the first at least one echocardiographic image; and

determining the second quality assessment value comprises:

determining that a second set of assessment parameters of the sets of assessment parameters is associated with the second view category; and

in response to determining that the second set of assessment parameters is associated with the second view category, applying a second function based on the second set of assessment parameters to the second at least one echocardiographic image.

23. The method of claim **22** wherein each of the sets of assessment parameters includes:

a set of common assessment parameters, which are common to each of the sets of assessment parameters; and

a set of view category specific assessment parameters, which are unique to the set of assessment parameters.

24. The method of claim **22** or **23** wherein each of the sets of assessment parameters is a set of neural network parameters that defines a neural network having a plurality of layers including an input layer configured to receive one or more echocardiographic images and an output layer configured to output one or more quality assessment values and wherein:

applying the first function based on the first set of assessment parameters to the first at least one echocardiographic image comprises inputting the first at least one echocardiographic image into the neural network defined by the first set of assessment parameters; and

applying the second function based on the second set of assessment parameters to the second at least one echocardiographic image comprises inputting the second at least one echocardiographic image into the neural network defined by the second set of assessment parameters.

25. The method of claim **24** further comprising training the neural networks, said training comprising:

receiving signals representing a plurality of echocardiographic training images, each of the plurality of echocardiographic training images associated with one of the plurality of predetermined echocardiographic image view categories;

receiving signals representing respective expert quality assessment values representing view category specific quality assessments of the plurality of echocardiographic training images, each of the expert quality assessment values provided by an expert echocardiographer and associated with one of the plurality of echocardiographic training images; and

training the neural networks using the plurality of echocardiographic training images as inputs and the associated expert quality assessment values as desired outputs to determine the sets of neural network parameters defining the neural networks.

26. The method of claim **25** wherein each of the expert quality assessment values represents an assessment of suitability of the associated echocardiographic image for quantified clinical measurement of anatomical features.

27. The method of claim **25** or **26** further comprising deriving each of the expert quality assessment values at least in part from a clinical plane assessment value representing an expert opinion whether the associated echocardiographic training image was taken in an anatomical plane suitable for quantified clinical measurement of anatomical features.

28. The method of any one of claims **25** to **27** wherein each of the sets of neural network parameters includes:

a set of common neural network parameters, which are common to each of the sets of neural network parameters; and

a set of view category specific neural network parameters, which are unique to the set of neural network parameters; and

wherein training the neural networks using the plurality of echocardiographic training images and the associated expert quality assessment values comprises, for each echocardiographic training image:

selecting one of the sets of view category specific neural network parameters based on the predetermined echocardiographic image view category associated with the echocardiographic training image; and

using the echocardiographic training image as an input and the associated expert quality assessment values as a desired output, training a neural network defined by the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters to update the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters.

29. A computer-implemented method of training neural networks to facilitate echocardiographic image analysis, the method comprising:

receiving signals representing a plurality of echocardiographic training images, each of the plurality of echocardiographic training images associated with one of a plurality of predetermined echocardiographic image view categories;

receiving signals representing expert quality assessment values representing view category specific quality assessments of the plurality of echocardiographic training images, each of the expert quality assessment values provided by an expert echocardiographer and associated with one of the plurality of echocardiographic training images; and

training the neural networks using the plurality of echocardiographic training images and the associated expert quality assessment values to determine sets of neural network parameters defining the neural networks, at least a portion of each of said neural networks associated with one of the plurality of predetermined echocardiographic image view categories.

30. The method of claim **29** wherein each of the expert quality assessment values represents an assessment of suitability of the associated echocardiographic image for quantified clinical measurement of anatomical features.

31. The method of claim **29** or **30** further comprising deriving each of the expert quality assessment values at least in part from a clinical plane assessment value representing an expert opinion whether the associated echocardiographic training image was taken in an anatomical plane suitable for a quantified clinical measurement of anatomical features.

32. The method of any one of claims **29** to **31** wherein each of the sets of neural network parameters includes:

a set of common neural network parameters, which are common to each of the sets of neural network parameters; and

a set of view category specific neural network parameters, which are unique to the set of neural network parameters; and

wherein training the neural networks using the plurality of echocardiographic training images and the associated expert quality assessment values comprises, for each echocardiographic training image:

selecting one of the sets of view category specific neural network parameters based on the predetermined echocardiographic image view category associated with the echocardiographic training image; and

using the echocardiographic training image as an input and the associated expert quality assessment value as a desired output, training a neural network defined by the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters to update the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters.

33. A computer readable medium having stored thereon codes which when executed by at least one processor cause the at least one processor to perform the method of any one of claims **17** to **32**.

34. A system for facilitating echocardiographic image analysis, the system comprising:

means for receiving signals representing a first at least one echocardiographic image;

means for associating the first at least one echocardiographic image with a first view category of a plurality of predetermined echocardiographic image view categories;

means for determining, based on the first at least one echocardiographic image and the first view category, a first quality assessment value representing a view category specific quality assessment of the first at least one echocardiographic image;

means for producing signals representing the first quality assessment value for causing the first quality assessment value to be associated with the first at least one echocardiographic image;

means for receiving signals representing a second at least one echocardiographic image;

means for associating the second at least one echocardiographic image with a second view category of the plurality of predetermined echocardiographic image view categories, said second view category being different from the first view category;

means for determining, based on the second at least one echocardiographic image and the second view category, a second quality assessment value representing a view category specific quality assessment of the second at least one echocardiographic image; and

means for producing signals representing the second quality assessment value for causing the second quality assessment value to be associated with the second at least one echocardiographic image.

35. A system for training neural networks to facilitate echocardiographic image analysis, the system comprising:

means for receiving signals representing a plurality of echocardiographic training images, each of the plurality of echocardiographic training images associated with one of a plurality of predetermined echocardiographic image view categories;

means for receiving signals representing expert quality assessment values representing view category specific quality assessments of the plurality of echocardiographic training images, each of the expert quality assessment values provided by an expert echocardiographer and associated with one of the plurality of echocardiographic training images; and

means for training the neural networks using the plurality of echocardiographic training images and the associated expert quality assessment values to determine sets of neural network parameters defining the neural networks, at least a portion of each of said neural networks associated with one of the plurality of predetermined echocardiographic image view categories.

ECHOCARDIOGRAPHIC IMAGE ANALYSIS

RELATED APPLICATION

This application claims the benefit of U.S. Provisional Application No. **62/325,779** entitled "PROCESS FOR IMAGING QUALITY ASSURANCE", filed on April **21, 2016**, which is hereby incorporated by reference herein in its entirety.

BACKGROUND

1. Field

Embodiments of this invention relate to echocardiographic image analysis and more particularly to echocardiographic image analysis for image quality assessment.

2. Description of Related Art

Despite advances in medicine and technology, cardiovascular disease remains the leading cause of mortality worldwide. Cardiac ultrasound, better known as echocardiography (echo), is the standard method for screening, detection, and monitoring of cardiovascular disease. This noninvasive imaging modality is widely available, cost-effective, and may be used for clinical measurement of anatomical features which may then be used for evaluation of cardiac structure and/or function. Some existing echocardiographic systems may be configured to provide feedback regarding general properties of captured images. However, this feedback may not assist echocardiographers in capturing high quality echocardiographic images for use in subsequent quantified clinical measurement of anatomical features.

SUMMARY

In accordance with one embodiment, there is provided a computer-implemented system for facilitating echocardiographic image analysis. The system includes at least one processor configured to, receive signals representing a first at least one echocardiographic image, associate the first at least one echocardiographic

image with a first view category of a plurality of predetermined echocardiographic image view categories, determine, based on the first at least one echocardiographic image and the first view category, a first quality assessment value representing a view category specific quality assessment of the first at least one echocardiographic image, produce signals representing the first quality assessment value for causing the first quality assessment value to be associated with the first at least one echocardiographic image, receive signals representing a second at least one echocardiographic image, associate the second at least one echocardiographic image with a second view category of the plurality of predetermined echocardiographic image view categories, said second view category being different from the first view category, determine, based on the second at least one echocardiographic image and the second view category, a second quality assessment value representing a view category specific quality assessment of the second at least one echocardiographic image, and produce signals representing the second quality assessment value for causing the second quality assessment value to be associated with the second at least one echocardiographic image.

In accordance with another embodiment, there is provided a computer-implemented system for training neural networks to facilitate echocardiographic image analysis. The system includes at least one processor configured to: receive signals representing a plurality of echocardiographic training images, each of the plurality of echocardiographic training images associated with one of a plurality of predetermined echocardiographic image view categories, receive signals representing expert quality assessment values representing view category specific quality assessments of the plurality of echocardiographic training images, each of the expert quality assessment values provided by an expert echocardiographer and associated with one of the plurality of echocardiographic training images, and train the neural networks using the plurality of echocardiographic training images and the associated expert quality assessment values to determine sets of neural network parameters defining the

neural networks, at least a portion of each of said neural networks associated with one of the plurality of predetermined echocardiographic image view categories.

In accordance with another embodiment, there is provided a computer-implemented method of facilitating echocardiographic image analysis. The method includes receiving signals representing a first at least one echocardiographic image, associating the first at least one echocardiographic image with a first view category of a plurality of predetermined echocardiographic image view categories, determining, based on the first at least one echocardiographic image and the first view category, a first quality assessment value representing a view category specific quality assessment of the first at least one echocardiographic image, producing signals representing the first quality assessment value for causing the first quality assessment value to be associated with the first at least one echocardiographic image, receiving signals representing a second at least one echocardiographic image, associating the second at least one echocardiographic image with a second view category of the plurality of predetermined echocardiographic image view categories, said second view category being different from the first view category, determining, based on the second at least one echocardiographic image and the second view category, a second quality assessment value representing a view category specific quality assessment of the second at least one echocardiographic image, and producing signals representing the second quality assessment value for causing the second quality assessment value to be associated with the second at least one echocardiographic image.

In accordance with another embodiment, there is provided a computer-implemented method of training neural networks to facilitate echocardiographic image analysis. The method includes receiving signals representing a plurality of echocardiographic training images, each of the plurality of echocardiographic training images associated with one of a plurality of predetermined

echocardiographic image view categories, receiving signals representing expert quality assessment values representing view category specific quality assessments of the plurality of echocardiographic training images, each of the expert quality assessment values provided by an expert echocardiographer and associated with one of the plurality of echocardiographic training images, and training the neural networks using the plurality of echocardiographic training images and the associated expert quality assessment values to determine sets of neural network parameters defining the neural networks, at least a portion of each of said neural networks associated with one of the plurality of predetermined echocardiographic image view categories.

In accordance with another embodiment, there is provided a computer readable medium having stored thereon codes which when executed by at least one processor cause the at least one processor to perform any of the above methods.

In accordance with another embodiment, there is provided a system for facilitating echocardiographic image analysis. The system includes means for receiving signals representing a first at least one echocardiographic image, means for associating the first at least one echocardiographic image with a first view category of a plurality of predetermined echocardiographic image view categories, means for determining, based on the first at least one echocardiographic image and the first view category, a first quality assessment value representing a view category specific quality assessment of the first at least one echocardiographic image, means for producing signals representing the first quality assessment value for causing the first quality assessment value to be associated with the first at least one echocardiographic image, means for receiving signals representing a second at least one echocardiographic image, means for associating the second at least one echocardiographic image with a second view category of the plurality of predetermined echocardiographic image view categories, said second view category being different from the first view

category, means for determining, based on the second at least one echocardiographic image and the second view category, a second quality assessment value representing a view category specific quality assessment of the second at least one echocardiographic image, and means for producing signals representing the second quality assessment value for causing the second quality assessment value to be associated with the second at least one echocardiographic image.

In accordance with another embodiment, there is provided a system for training neural networks to facilitate echocardiographic image analysis. The system includes means for receiving signals representing a plurality of echocardiographic training images, each of the plurality of echocardiographic training images associated with one of a plurality of predetermined echocardiographic image view categories, means for receiving signals representing expert quality assessment values representing view category specific quality assessments of the plurality of echocardiographic training images, each of the expert quality assessment values provided by an expert echocardiographer and associated with one of the plurality of echocardiographic training images, and means for training the neural networks using the plurality of echocardiographic training images and the associated expert quality assessment values to determine sets of neural network parameters defining the neural networks, at least a portion of each of said neural networks associated with one of the plurality of predetermined echocardiographic image view categories.

Other aspects and features of embodiments of the invention will become apparent to those ordinarily skilled in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

BRIEF DESCRIPTION OF THE DRAWINGS

In drawings which illustrate embodiments of the invention,

Figure **1** is a schematic view of a system for facilitating echocardiographic image analysis in accordance with various embodiments of the invention;

Figure **2** is a schematic view of an echocardiographic image analyzer of the system of Figure **1** including a processor circuit in accordance with various embodiments of the invention;

Figure **3** is a flowchart depicting blocks of code for directing the analyzer of the system of Figure **1** to perform image analysis functions in accordance with various embodiments of the invention;

Figure **4** is a representation of an exemplary image file that may be used in the system shown in Figure **1**;

Figure **5** is a flowchart depicting blocks of code that may be included in the flowchart of Figure **3** in accordance with various embodiments of the invention;

Figure **6** is a representation of an exemplary view category determining neural network that may be used in the system shown in Figure **1**;

Figure **7** is a representation of an exemplary view category record that may be used in the system shown in Figure **1**;

Figure **8** is a representation of an exemplary image quality assessment neural network that may be used in the system shown in Figure **1**;

Figure **9** is a representation of an exemplary common neural network record that may be used in the system shown in Figure **1**;

Figure **10** is a representation of an exemplary view category specific neural network record that may be used in the system shown in Figure **1**;

Figure **11** is a flowchart depicting blocks of code that may be included in the flowchart of Figure **3** in accordance with various embodiments of the invention;

Figure **12** is a representation of an exemplary quality assessment record that may be used in the system shown in Figure **1**;

Figure **13** is a representation of a display that may be presented by a display of a user interface system included in the system shown in Figure **1** in accordance with embodiments of the invention;

Figure **14** is a schematic view of a system for training neural networks to facilitate echocardiographic image analysis in accordance with various embodiments of the invention;

Figure **15** is a schematic view of a neural network trainer of the system of Figure **1** including a processor circuit in accordance with various embodiments of the invention;

Figure **16** is a flowchart depicting blocks of code for directing the trainer of the system of Figure **14** to perform image assessment neural network training functions in accordance with various embodiments of the invention;

Figure **17** is a representation of an exemplary training image file that may be used in the system shown in Figure **1**;

Figure **18** is a representation of an exemplary expert quality assessment record that may be used in the system shown in Figure **1**;

Figure **19** is a schematic view of a system for facilitating echocardiographic image analysis in accordance with various embodiments of the invention;

Figure **20** is a representation of an exemplary view category determining neural network that may be used in the system shown in Figure **1**; and

Figure **21** is a representation of an exemplary image quality assessment neural network that may be used in the system shown in Figure **1**.

DETAILED DESCRIPTION

Referring to Figure **1**, according to one embodiment of the invention, there is provided a system **10** for facilitating echocardiographic image analysis. The system **10** includes a computer-implemented echocardiographic image analyzer **12** in communication with a user interface system **14** and a transducer **16**. In the embodiment shown, the analyzer **12** is also in communication with a network **126** and the user interface system **14** includes a display **15**. In various embodiments, the system **10** may be incorporated within an ultrasound machine or scanner. For example, in various embodiments, the system **10** may be included in an ultrasound machine generally similar to a Philips™ IE**33** Ultrasound machine or a mobile ultrasound machine made by Clarius™.

In operation, an operator of the system **10**, who may be for example, an echocardiographer, technician, or sonographer, may manipulate the transducer

16 on or around a patient, and the analyzer **12** may communicate with the transducer **16** and receive signals representing echocardiographic images of the patient. The analyzer **12** may store representations of the echocardiographic images in memory and/or output representations of the images on the display **15**. The analyzer **12** may determine a quality assessment value representing a quality assessment of at least one echocardiographic image and produce signals for causing the quality assessment value to be associated with the at least one echocardiographic image. For example, the analyzer **12** may be configured to produce signals for causing the display **15** to display a sequence of echocardiographic images captured by the analyzer **12** in near real-time, in association with the determined quality assessment value for the images. In some embodiments, the quality assessment value may be determined for a single image. In some embodiments, the quality assessment value may be determined for a sequence of images or video, which may be referred to herein as an echo cine.

In various embodiments, this near real-time feedback to the operator may help the operator improve their skills and/or improve image quality for subsequently captured images. For example, in some embodiments, the operator may, in response to viewing a low quality assessment value on the display **15**, adjust positioning of the transducer and/or adjust image capture parameters, such as, for example, depth, focus, gain, frequency, and/or another parameter which may affect image quality in the system **10**. The operator may make such adjustments until a high quality assessment value is provided on the display **15**, for example, at which point the operator may be confident that the echocardiographic images captured are suitable for subsequent quantified clinical measurement of anatomical features and/or to assist in diagnosing a medical condition or a characteristic of the heart.

In various embodiments, the operator may wish to capture echocardiographic images for various views or anatomical planes since multiple views may be

required in order to perform certain quantified clinical measurement of anatomical features and/or to assist in diagnosing a medical condition or a characteristic of the heart. In some embodiments, the views required for certain measurements or diagnoses may be chosen from standard **2**D echocardiographic views. For example, the operator may wish to capture echocardiographic images of multiple standard **2**D echocardiographic views to facilitate image analysis to determine ejection fraction for the patient's heart. For example, in some embodiments, a **2**D Method of Simpson may be used to determine ejection fraction, which requires images from AP**2** (apical **2**-chamber view) and AP**4** (apical **4**-chamber view).

In various embodiments, some of the desirable characteristics for each of the different views may differ and so it may be desirable to determine quality assessment values for the echocardiographic images in different ways, depending on what view the echocardiographic images are meant to represent. Accordingly, the analyzer **12** may be configured to associate each set of echocardiographic images with a view category of a plurality of predetermined echocardiographic image view categories and to select and apply a function to the set of images to determine the quality assessment value wherein the function selected depends on the view category associated with the set of images. In some embodiments, the analyzer **12** may be configured to automatically determine the view category to associate with the set of images by analyzing the set of images. In some embodiments, the analyzer **12** may be configured to receive operator input (via the user interface system **14**, for example), which sets the view category with which to associate the image.

Applying the function to a set of images may involve inputting the set of images into a view category specific image assessment neural network which is configured to output a view category specific quality assessment value. The quality assessment value may represent an assessment of suitability of the associated set of echocardiographic images for quantified clinical measurement of anatomical features.

Image Analyzer - Processor Circuit

Referring now to Figure **2**, a schematic view of the analyzer **12** of the system **10** shown in Figure **1** according to an embodiment is shown. As discussed above, in various embodiments, the analyzer **12** may be included in an ultrasound machine, for example.

Referring to Figure **2**, the analyzer **12** includes a processor circuit including an analyzer processor **100** and a program memory **102**, a storage memory **104**, and an input/output (I/O) interface **112**, all of which are in communication with the analyzer processor **100**. In various embodiments, the analyzer processor **100** may include one or more processing units, such as for example, a central processing unit (CPU), a graphical processing unit (GPU), and/or a field programmable gate arrays (FPGA). In some embodiments, any or all of the functionality of the analyzer **12** described herein may be implemented using one or more FPGAs.

The I/O interface **112** includes an interface **120** for communicating with the transducer **16** and an interface **122** for communicating with the user interface system **14** shown in Figure **1**. In some embodiments, the I/O interface **112** may also include an interface **124** for facilitating networked communication through the network **126**. In some embodiments, any or all of the interfaces **120**, **122**, or **124** may facilitate a wireless or wired communication.

In some embodiments, the I/O interface **112** may include a network interface device or card with an input/output for connecting to the network **126**, through which communications may be conducted with devices connected to the network **126**, such as the neural network trainer (as shown at **502** in Figure **14**), for example.

In some embodiments, each of the interfaces shown in Figure **2** may include one or more interfaces and/or some or all of the interfaces included in the I/O interface **112** may be implemented as combined interfaces or a single interface.

In some embodiments, where a device is described herein as receiving or sending information, it may be understood that the device receives signals representing the information via an interface of the device or produces signals representing the information and transmits the signals to the other device via an interface of the device.

Processor-executable program codes for directing the analyzer processor **100** to carry out various functions are stored in the program memory **102**. Referring to Figure **2**, the program memory **102** includes a block of codes **160** for directing the analyzer **12** to perform image capture functions and analysis functions and a block of codes **162** for directing the analyzer processor **100** to perform image reconstruction functions. In this specification, it may be stated that certain encoded entities such as applications or modules perform certain functions. Herein, when an application, module or encoded entity is described as taking an action, as part of, for example, a function or a method, it will be understood that at least one processor (e.g. the analyzer processor **100**) is directed to take the action by way of programmable codes or processor-executable codes or instructions defining or forming part of the application.

The storage memory **104** includes a plurality of storage locations including location **140** for storing image data, location **142** for storing view category data, location **144** for storing view category neural network parameter data, location **146** for storing image assessment neural network parameter data, and location **148** for storing determined quality assessment value data. In various embodiments, the plurality of storage locations may be stored in a database in the storage memory **104**.

In various embodiments, the blocks of codes **160** and **162** may be integrated into a single block of codes and/or each of the blocks of code **160** and **162** may include one or more blocks of code stored in one or more separate locations in program memory **102**. In various embodiments, any or all of the locations **140**,

142, **144**, and **146** may be integrated and/or each may include one or more separate locations in the storage memory **104**.

Each of the program memory **102** and storage memory **104** may be implemented as one or more storage devices including random access memory (RAM), a hard disk drive (HDD), a solid-state drive (SSD), a network drive, flash memory, a memory stick or card, any other form of non-transitory computer-readable memory or storage medium, and/or a combination thereof. In some embodiments, the program memory **102**, the storage memory **104**, and/or any portion thereof may be included in a device separate from the analyzer **12** and in communication with the analyzer **12** via the I/O interface **112**, for example.

In various embodiments, other device components described herein, such as memory, program memory, blocks of code, storage memory, locations in memory, and/or I/O interfaces, may be implemented generally similarly to as described above for the analyzer **12**.

Image analysis

Referring now to Figure **3**, a flowchart depicting blocks of code for directing the analyzer processor **100** shown in Figure **2** to perform image analysis functions in accordance with one embodiment is shown generally at **200**. The blocks of code included in the flowchart **200** may be encoded in the block of codes **160** of the program memory **102** shown in Figure **2** for example.

Referring to Figure **3**, the flowchart **200** begins with block **202** which directs the analyzer processor **100** shown in Figure **2** to receive signals representing at least one echocardiographic image. In various embodiments, block **202** may direct the analyzer processor **100** to obtain image data via the transducer **16**. For example, block **202** may direct the analyzer processor **100** to execute blocks included in the block of codes **162** of the program memory **102**, to cause the analyzer processor **100** to receive signals representing at least one

echocardiographic image from the transducer **16** shown in Figure **1** via the interface **120** of the I/O interface. The blocks in the block of codes **162** of the program memory **102** may direct the analyzer processor **100** to interpret raw ultrasound echo waveforms received from the transducer **16** into fully formed images. The block of codes **162** may direct the analyzer processor **100** to use an image reconstruction algorithm to filter the waveforms, amplify the waveforms, time delay and sum the waveforms, demodulate the summed waveforms, and/or compress amplitudes of the summed waveforms. The block of codes **162** may direct the analyzer processor **100** to finally perform a scan-conversion of the waveforms to derive an image in Cartesian coordinates with pixels of known size in millimeters.

Block **202** may direct the analyzer processor **100** to store a representation of the received at least one echocardiographic image in the location **140** of the storage memory **104**.

In some embodiments, the analyzer **12** may be configured to receive and analyze respective sequences of echocardiographic images (echo cines). Accordingly, block **202** may direct the analyzer processor **100** to receive a sequence of images. Block **202** may direct the analyzer processor **100** to store a set of image files representing the sequence of images in the location **140** of the storage memory **104**. An exemplary image file which may be included in the set of image files received at block **202** is shown at **240** in Figure **4**.

Referring to Figure **4**, the image file **240** includes an image identifier field **242** for storing a unique identifier for identifying the image data stored in the image file **240**, an image group identifier field **243** for storing an identifier common to a set of image files which are to be analyzed together (e.g. frames of an echo cine), and an image data field **244** for storing information representing an image. In some embodiments, for example, the image file **240** may store a PNG file type representation of the echocardiographic image.

In some embodiments, block **202** may direct the analyzer processor **100** to receive and store a plurality of image files generally similar to the image file **240** shown in Figure **4** in the location **140** of storage memory **104** for analysis together during execution of block **206** of the flowchart **200** shown in Figure **3**. For example, in some embodiments, the analyzer **12** may be configured to analyze a sequence of **20** images during execution of block **206** of the flowchart **200** and so block **202** may direct the analyzer processor **100** to store the received images as groups of **20** image files, each generally similar in format to the image file **240** shown in Figure **4** and sharing a common value in their image group identifier fields.

Referring back to Figure **4**, block **204** then directs the analyzer processor **100** to associate the at least one echocardiographic image received at block **202** with a view category of a plurality of predetermined echocardiographic image view categories. In some embodiments, block **204** may direct the analyzer processor **100** to associate the at least one echocardiographic image with the view category by storing in the location **142** of the storage memory **104** a view category record that associates the view category with the received at least one echocardiographic image.

In various embodiments, associating the at least one echocardiographic image with a particular view category may assist with subsequent quality assessment of the echocardiographic images which may be performed at block **206** of the flowchart **200** shown in Figure **3**. In some embodiments, the view category that is associated with the at least one echocardiographic image may be associated with a function which can be applied to the at least one echocardiographic image to assess the quality of the at least one echocardiographic image. For example, in some embodiments, different analyses may be applied to a set of echocardiographic images, depending on which view category set of echocardiographic images falls within.

In some embodiments, the view categories with which the echocardiographic images may be associated may be chosen from a plurality of standard view categories. For example, the standard view categories may include the following **2**D echocardiographic imaging plane views: AP**2** (apical **2**-chamber view), AP**3** (apical **3**-chamber view), AP**4** (apical **4**-chamber view), $PSAX_A$ (parasternal short axis at aortic valve level view) and $PSAX_{PM}$ (parasternal short axis at papillary muscle level view). In various embodiments, the standard view categories may include further or alternative view categories, such as, for example, any or all of the following **2**D echocardiographic imaging plane view categories: parasternal long axis (PLAX), apical **5** chamber (AP**5**), subcostal view, aortic arch, or right parasternal. In various embodiments, with any of these views, an operator may switch the system **10** to Doppler and obtain **2**D Color Doppler or Power Doppler, Continuous Wave Doppler and Duplex Doppler. In various embodiments, each view category may be associated with a different function for assessing quality of images.

In some embodiments, the block **204** may direct the analyzer processor **100** to determine which of the plurality of predetermined view categories the at least one echocardiographic image falls within before associating the image with the view category.

For example, in some embodiments, this determination may be made automatically, such as by applying a function to the received at least one echocardiographic image. Referring to Figure **5**, there is shown at **260** a flowchart representing blocks of codes which may be included in the block **204** of the flowchart **200** shown in Figure **3**, in accordance with various embodiments. The blocks of codes included in the flowchart **260** may direct the analyzer processor **100** to apply one or more view categorization functions to the at least one echocardiographic image received at block **202** to determine which of a plurality of predetermined view categories the at least one echocardiographic image falls within.

Referring to Figure **5**, the flowchart **260** begins with block **262** which directs the analyzer processor **100** to receive signals representing parameters defining an image view category determining neural network. The image view category determining neural network may be configured to take the at least one echocardiographic images received at block **202** as an input and to output an indication of what image view category should be associated with the input at least one echocardiographic image.

Block **262** may direct the analyzer processor **100** to receive parameters defining the image view category determining neural network from the location **144** of the storage memory shown in Figure **2**, for example. The parameters defining the view category determining neural network may have been previously determined during training of the neural network and stored in the location **144** of the storage memory **104**.

In some embodiments, a neural network trainer (for example, as shown at **502** in Figure **14**) may have previously determined architecture and weight and bias values for the view category determining neural network. Blocks of code included in the block of codes **160** of the program memory **102** may have previously directed the analyzer processor **100** to receive signals representing the architecture and weight and bias values via the interface **124** of the I/O interface **112** and to store a view category neural network record representing the architecture and the weight and the bias values in the location **144** of the storage memory **104**.

In some embodiments, the view category neural network record stored in the location **144** of the storage memory may represent a neural network having convolutional layers, max-pooling layers, one or more fully connected layers, one or more Long Short Term Memory (LSTM) layers, and a softmax layer acting as an output layer and having outputs which represent a likelihood that an input set of echocardiographic images falls within a particular view category. In some

embodiments, the softmax outputs may indicate whether a set of echocardiographic images falls within one of the following standard **2**D echocardiographic views, for example: AP**2**, AP**3**, AP**4**, $PSAX_A$, or $PSAX_{PM}$. An exemplary view category determining neural network that may be represented by the view category neural network record stored in the location **144** of the storage memory, in accordance with some embodiments, is shown at **900** in Figure **6**. The view category determining neural network takes as input, a sequence of **20** echocardiographic images, and outputs respective indicators that represent respective likelihoods that an input sequence of **20** echocardiographic images fall within a particular view category.

Referring back to Figure **5**, block **264** of the flowchart **260** then directs the analyzer processor **100** to apply the view category determining neural network defined by the parameters received at block **262** to the at least one echocardiographic image received at block **202** of the flowchart **200** shown in Figure **3**. Block **264** may direct the analyzer processor **100** to use the image data fields **244** of the **20** image files stored in the location **140** of the storage memory **104** at block **202** as input data for the view category determining neural network defined by the view category neural network record taken from the location **144** of the storage memory **104**.

In some embodiments, the output of the neural network may be a softmax output which provides respective indicator values representing whether the set of images received at block **202** are AP**2**, AP**3**, AP**4**, PSAXA, and PSAXPM. In one embodiment, these indicator values may be **0**.**11**, **0**.**05**, **0**.**7**, **0**.**11**, **0**.**03**, respectively, for example. In various embodiments, although the indicator values sum to **1**.**00**, these values may not represent true probabilities that the at least one image received is of a particular view, as there may be a possibility that the at least one image is none of the views.

In some embodiments, block **264** of the flowchart **260** shown in Figure **5** may direct the analyzer processor **100** to use a GPU included in the analyzer processor **100** to perform the neural network calculations. In some embodiments, use of the GPU instead of a general CPU may reduce the execution time for block **264**.

Referring to Figure **5**, block **266** of the flowchart **260** then directs the analyzer processor **100** to associate the at least one echocardiographic image received at block **202** of the flowchart **200** shown in Figure **3** with a view category based on the output of the neural network. In some embodiments, block **266** may direct the analyzer processor **100** to associate the at least one echocardiographic image with a view category that corresponds to the highest softmax output determined at block **264** of the flowchart **260** shown in Figure **5**. For example, with a softmax output which provides respective indicators for AP**2**, AP**3**, AP**4**, $PSAX_A$, and $PSAX_{PM}$ of **0**.**11**, **0**.**05**, **0**.**7**, **0**.**11**, **0**.**03**, block **266** may direct the analyzer processor **100** to determine which output is the largest (i.e., the AP**4** view category output) and to associate the images with that output.

Block **266** may direct the analyzer processor **100** to associate the at least one echocardiographic image received at block **202** of the flowchart **200** shown in Figure **3** with the AP**4** view category by generating a view category record **300** as shown in Figure **7** and storing the view category record **300** in the location **142** of the storage memory **104**. Referring to Figure **7**, the view category record **300** includes a view category identifier field **302** for storing an identifier for identifying the view category to be associated with the echocardiographic images and an image group identifier field **304** for storing an identifier for identifying the images with which the view category is to be associated.

In some embodiments, block **204** of the flowchart **200** shown in Figure **3** may not include the blocks depicted in the flowchart **260**, but rather an operator of the system **10** shown in Figure **1** may input a view category by which the operator

wishes to have the received echocardiographic images assessed. For example, in some embodiments, the operator may input a desired view category using an input device such as a keyboard and/or pointer or mouse of the user interface system **14**. In such embodiments, block **204** may direct the analyzer processor **100** to receive operator input representing the view category via the interface **122** of the I/O interface **112** shown in Figure **2**. Block **204** may direct the analyzer processor **100** to, in response to receiving the input, generate and store a view category record in the location **142** of the storage memory **104** associating the received at least one echocardiographic image with the view category that the operator provided as input.

Referring back to Figure **3**, after block **204** has been executed, the at least one echocardiographic image received at block **202** may now be associated with a view category.

The flowchart **200** continues at block **206**, which directs the analyzer processor **100** to determine, based on the at least one echocardiographic image received at block **202** and the view category associated with the echocardiographic image, a quality assessment value representing a view category specific quality assessment of the at least one echocardiographic image.

In some embodiments, each of the view categories may be associated with a function which can be applied by the analyzer to the received at least one echocardiographic image to generate the quality assessment value. In some embodiments, block **206** may direct the analyzer processor **100** to select a function to apply to the at least one echocardiographic image based on the view category associated with the received at least one echocardiographic image.

In various embodiments, applying the function may involve applying a neural network to the at least one echocardiographic image. A neural network is a non-linear model and so, in some embodiments, by using a neural network to analyze

the echocardiographic images, the analyzer **12** may facilitate better functioning, for example, when there is variability in the echocardiographic image data than may be possible when analysis of the echocardiographic image relies on an average template or atlas with average shape.

Referring to Figure **2**, in various embodiments, a plurality of sets of parameters, each set defining a neural network, may be stored in the location **146** of the storage memory **104** shown in Figure **2** and each of the sets of parameters may be associated with a view category to indicate that the set of parameters defines a neural network that is to be applied to echocardiographic images which are associated with that view category.

In some embodiments, the parameters may define neural network architectures and may include weight and bias values for the neural networks. A neural network trainer (for example, as shown at **502** in Figure **14**) may have previously determined the neural network architecture and/or the weight and bias values for each of the neural networks and provided these values to the analyzer **12**. Blocks of code included in the block of codes **160** of the program memory **102** may have previously directed the analyzer processor **100** to receive signals representing the neural network architecture and the weight and bias values via the interface **124** of the I/O interface **112**, for example, and to store this information in image assessment neural network records in the location **146** of the storage memory **104**.

For example, in some embodiments, the image assessment neural network records stored in the location **146** of the storage memory **104** may represent the neural network shown at **360** in Figure **8**. Referring to Figure **8**, the neural network **360** includes **5** image quality assessment neural networks, each including the same shared layers **362** but including a different set of view category specific layers **370**, **372**, **374**, **376**, and **378**. In various embodiments, the shared layers **362** and the view category specific layers **370**, **372**, **374**, **376**,

and **378** may each be considered neural networks and it will be understood that a neural network may include more than one neural network within. Each of the **5** image quality assessment neural networks takes as an input a sequence of **20** echocardiographic images **380** and outputs a view category specific quality assessment value.

The neural network **360** shown in Figure **8** is a deep neural network and a regression model, consisting of convolutional (conv), pooling (pool), and Long Short Term Memory (LSTM) layers, and in various embodiments, may be simultaneously trained to estimate the quality of a sequence of **20** echocardiographic images for any of five standard **2**D echocardiographic views, AP**2**, AP**3**, AP**4**, $PSAX_A$, and $PSAX_{PM}$ by generating respective view category specific quality assessment values.

The neural network architecture, depicted in Figure **8**, represents a multi-stream network, i.e., five regression models that share weights across the first few common shared layers **362**. Each stream of the network has its own view-specific layer **370**, **372**, **374**, **376**, and **378** and has been trained based on the mean absolute error loss function, via a stochastic gradient-based optimization algorithm, to minimize the absolute difference between normalized quality assessment values assigned by a trained echocardiographer to training images, as discussed further below, and the generated quality assessment values.

In the embodiment shown, all conv layers have kernels with the size of **3X3**, which may, for example, follow the VGG architecture discussed in Simonyan, K., Zisserman, A.: Very Deep Convolutional Networks for Large-Scale Image Recognition. International Conference on Learning Representations (ICRL) pp. **1-14** (**2015**), with the number of kernels doubling for deeper conv layers, i.e., from **8** to **32** kernels. In some embodiments, the conv layers may extract hierarchical features in the image, with the first three shared layers **362** modeling high level spatial correlations, and the next two conv layers of the view category specific

layers **364** focusing on view-specific quality features. In some embodiments, activation functions of the conv layers may be Rectified Linear Units (ReLUs).

Referring still to Figure **8**, in various embodiments, the pool layers of the neural network **360** may be **2X2** max-pooling with a stride of **2** to facilitate selection of superior invariant features and divide the input feature-map size in half in both dimensions to reduce feature variance and train more generalized models. The conv and pool layers are applied to each image of an input echo cine, independently.

The output feature map of the last pool layer is flattened and sent to an LSTM unit, a type of Recurrent Neural Networks (RNN) that uses a gated technique to selectively add or remove information from the cell state. Each set of view category specific layers **370**, **372**, **374**, **376**, and **378** in the neural network **360** shown in Figure **8** uses a single LSTM cell to analyze **20** feature-sets corresponding to the **20** consecutive input images. The LSTM layer uses hard sigmoid functions for inner and output activations.

In some embodiments, the image assessment neural network records stored in the location **146** of the storage memory **104** which represent the neural network **360** may include a common neural network record representing the shared layers **362** and a plurality of different view category specific neural network records representing the sets of view category specific layers **370**, **372**, **374**, **376**, and **378**.

A representation of a portion of an exemplary common neural network record for storing a set of parameters defining the shared layers **362** of the neural network **360** shown in Figure **8**, is shown at **320** in Figure **9**. Referring to Figure **9**, the common neural network record **320** includes first, second, third, fourth, fifth and sixth sets of fields **324**, **326**, **328**, **330**, **332**, and **334** defining the parameters for the six layers of the shared layers **362** of the neural network **360** shown in Figure

8. For ease of reference, not all kernel fields of the common neural network record **320** are shown in Figure **9** and the content of the kernels is shown as [...], though it will be understood that there are **8** kernels in layer **1**, **16** kernels in layer **3** and **32** kernels in layer **5** and that each kernel field stores a **3X3** matrix of values.

A representation of a portion of an exemplary view category specific neural network record for storing a set of parameters defining the set of view category specific layers **374** of the neural network **360** shown in Figure **8**, is shown at **340** in Figure **10**. Referring to Figure **10**, the view category specific neural network record **340** includes a view category identifier field **342** for storing a view category identifier identifying which view category the record is associated with and seventh, eighth, ninth, and tenth sets of fields **344**, **346**, **348**, and **350** for storing parameters defining the set of view category specific layers **374** of the neural network **360** shown in Figure **8**. For ease of reference, not all kernel fields are shown in Figure **10** and the content of the kernels and LSTM parameters are shown as [...], though it will be understood that there are **32** kernels in layer **7** and **32** kernels in layer **9** and that each kernel field stores a **3X3** matrix of values and the LSTM parameter fields store values defining the parameters of the LSTM.

Additional neural network records representing the sets of shared layers **370**, **372**, **376** and **378** having generally the same format as the view category specific neural network record **340** shown in Figure **10** may also be stored in the location **146** of the storage memory **104**. Thus, each of the image view categories AP**2**, AP**3**, AP**4**, $PSAX_A$, and $PSAX_{PM}$ may be associated with a view category specific neural network record stored in the location **146** of the storage memory **104**.

In various embodiments, splitting the neural network **360** into a common portion and view category specific portions may facilitate more efficient training of the neural networks. In some embodiments, splitting the neural network 360 into a

common portion and view category specific portions may result in requiring fewer learning parameters than would be required if using fully separate neural networks, which may help facilitate easier transferring of a neural network to a new machine, and/or may reduce memory usage.

Referring now to Figure **11**, there is shown at **400** a flowchart representing blocks of codes which may be included in the block **206** of the flowchart **200** shown in Figure **3**, in accordance with various embodiments. The blocks included in the flowchart **400** may direct the analyzer processor **100** to determine which of the sets of quality assessment parameters is associated with the same view category as the at least one echocardiographic image received at block **202** and to apply a function based on that set of quality assessment parameters.

The flowchart **400** begins with block **402** which directs the analyzer processor **100** to determine that a set of assessment parameters of the sets of assessment parameters stored in the location **146** is associated with the same view category that is associated with the at least one echocardiographic image received at block **202**.

For example, in some embodiments, block **402** may direct the analyzer processor **100** to read "AP**4**" from the view category identifier field **302** of the view category record **300** associated with the echocardiographic image files received at block **202**. Block **402** may direct the analyzer processor **100** to read the view category specific neural network records from the location **146** of the storage memory to find a view category specific neural network record that includes the same view category identifier of "AP**4**" and is therefore associated with the same view category. Accordingly, block **402** may direct the analyzer processor **100** to determine that the view category specific neural network record **340** includes the view category identifier of "AP**4**" and is therefore associated with the same view category that is associated with the at least one echocardiographic image received at block **202**.

Block **404** then directs the analyzer processor **100** to, in response to determining that the set of assessment parameters is associated with the same view category, apply a function based on the set of assessment parameters to the at least one echocardiographic image received at block **202**. In some embodiments, block **404** may direct the analyzer processor **100** to apply the neural network defined by the parameters included in the common neural network record **320** and the view category specific neural network record **340** to the image data in the image files received at block **202**.

Block **404** may direct the analyzer processor **100** to read the image files received at block **202** from the location **140** of the storage memory **104** and to read the common neural network record **320** and the view category specific neural network record **340** from the location **146** of the storage memory, and to input the image data from the image files into a neural network that includes the shared layers **362** and the view category specific layers **374** shown in Figure **8**, which are defined by the common neural network record **320** and the view category specific neural network record **340**, to generate or determine a view category specific quality assessment value as an output of the neural network.

In some embodiments, the quality assessment value may represent a suitability for a quantified clinical measurement. In some embodiments, the quality assessment value may represent an estimate of an expected score which would be provided by an expert to the input at least one echocardiographic image. The estimate may be based on the training of the neural network wherein an expert provided quality assessment values for various echocardiographic images.

In some embodiments, the quality assessment value may be a score with criteria and/or a range that varies depending on the view category with which the neural network is associated. In some embodiments, the expert which provided the quality assessment values with which the neural network was trained may have determined the quality assessment values as an aggregation of scores derived

using semi-quantitative evaluation of component structures and parameter optimization features such as centering, depth, gain, axis, focus, frequency or another parameter optimization feature or image capture parameter. Accordingly, in various embodiments, the quality assessment value may represent an estimate of an expected aggregation of scores derived using semi-quantitative evaluation of component structures and parameter optimization features such as centering, depth, gain, axis, focus, frequency or another parameter optimization feature or image capture parameter.

For example, in some embodiments, an expert may have, for each at least one echocardiographic image that they assessed, determined for each component in the at least one echocardiographic image, a component quality score of up to **2** points based on the following observations: **0** points) the structure was not imaged or was inadequate for assessment; **1** point) the structure was adequately viewed; **2** points) the view was optimized for the structure. In some embodiments, the component score may act as a clinical plane assessment value representing an expert opinion whether the associated echocardiographic training image was taken in an anatomical plane suitable for a quantified clinical measurement of anatomical features. The expert may have, for each at least one echocardiographic image that they assessed, determined parameter optimization scores as follows: appropriate centering (**1** point), correct depth setting (**0.5** points), proper gain (**0.5** points), correct axis (**1** point), and correct depth of focus (**0.5** points). In various embodiments, the quality assessment value may represent a sum of the above-noted scores.

As discussed above, in some embodiments, images for the different view categories may include a different set of components and quality assessment values may be determined using different criteria. For example, for the AP**2** view category, the left ventricle (LV), left atrium (LA), and mitral valve (MV) may each be assigned a component quality score, which may be summed with scores for centering, depth, and gain to determine the quality assessment value. For the

AP**3** view category, the aortic valve (AV), MV, LA, LV, and septum may each be assigned a component quality score, which may be summed with scores for centering, depth, and gain to determine the quality assessment value. For the AP**4** view category, the LV, right ventricle (RV), LA, right atrium (RA), MV, and TV may each be assigned a component quality score, which may be summed with scores for centering, depth, and gain to determine the quality assessment value. For the $PSAX_A$ view category, the AV and leaflets may each be assigned a component quality score, which may be summed with scores for centering, depth, and gain to determine the quality assessment value. For the $PLAX_{PM}$ the papillary muscles may be assigned a component quality score, which may be summed with scores for centering, depth, gain, and axis to determine the quality assessment value.

In some embodiments, the quality assessment values for all views may be normalized to the same scale, which may be, for example, between **0** and **1** or between **0** and **5**.

Referring back to Figure **11**, in some embodiments, block **404** of the flowchart **400** may direct the analyzer processor **100** to apply the neural network such that the quality assessment value and associated at least one echocardiographic image may be viewed in real-time or near-real time for the operator. For example, in some embodiments, block **404** may direct the analyzer processor **100** to apply the neural network and determine a quality assessment value in less than about **3** seconds. In some embodiments, block **404** may direct the analyzer processor **100** to apply the neural network and determine a quality assessment value in less than about **1** second. In some embodiments, block **404** may direct the analyzer processor **100** to apply the neural network and determine a quality assessment value in less than about **0**.**33** ms. In some embodiments, for an input echo cine of **20** images of **200**x**200** pixels, a quality assessment value may be determined in about **10** ms, which may be suitable for real-time or near real-time deployment. In some embodiments, block **404** may direct the

analyzer processor **100** to use a GPU included in the analyzer processor **100** to apply the neural network. In some embodiments, use of the GPU instead of just a general CPU may reduce the time it takes to execute the block **404** and may thus facilitate real-time or near-real time image analysis.

Referring back to Figure **3**, the flowchart **200** continues at block **208** which directs the analyzer processor **100** to produce signals representing the quality assessment value determined at block **206**, for causing the quality assessment value to be associated with the at least one echocardiographic image received at block **202**.

In some embodiments, block **208** may direct the analyzer processor **100** to produce signals for causing the quality assessment value to be stored in the location **148** of the storage memory **104**. For example, in some embodiments, block **208** may direct the analyzer processor **100** to store a quality assessment record **420** as shown in Figure **12** in the location **148** of the storage memory **104**, wherein the quality assessment record **420** includes an image group identifier field **422** for storing the group identifier which identifies the group of images for which the quality assessment was made and a quality assessment value field **424** for storing the quality assessment that was generated at block **404** of the flowchart **400**.

In some embodiments, block **208** may direct the analyzer processor **100** to produce signals for causing a representation of the quality assessment value to be transmitted to the display **15** of the user interface system **14** for causing the display to display the quality assessment value in association with the received at least one echocardiographic image. In some embodiments, this may assist one or more operators of the system **10** in capturing subsequent echocardiographic images. For example, in some embodiments, block **208** may direct the analyzer processor **100** to communicate with the user interface system **14** of the system **10** shown in Figure **1** via the interface **122** of the I/O interface **112** shown in

Figure **2** to cause a display **440** as shown in Figure **13** to be presented on the display **15** of the user interface system **14**.

Referring to Figure **13**, the display **440** includes a representation **442** of the quality assessment value determined at block **206** shown in association with a representation **444** of the at least one echocardiographic image received at block **202**.

In some embodiments, block **208** may direct the analyzer processor **100** to transmit the quality assessment value and associated at least one echocardiographic image to another device for storage and/or further analysis. For example, in various embodiments, block **208** may direct the analyzer processor **100** to transmit a representation of the image files stored at block **202** and the quality assessment record generated at block **208** to an archive device in a picture archiving and communication system (PACS) via the interface **124** and the network **126**, for example.

In various embodiments, once block **208** has been executed, the analyzer processor **100** may be directed to return to block **202** to receive further echocardiographic images. In some embodiments, the flowchart **200** may be executed continuously such that the display **440** shown in Figure **13** is updated with near real-time updates of images or image sequences and associated quality assessment values. In some embodiments, an operator may adjust image capture parameters of the system **10** and/or adjust positioning of the transducer until the operator sees a desired quality assessment value.

In some embodiments, the operator may make adjustments until a quality assessment value of greater than a predetermined threshold value is achieved. In some embodiments, for example, where the quality assessment value has been normalized to a possible range of **0**-**5** the threshold value may be about **3**.**0**.

In some embodiments, there may be a maximum achievable quality assessment value for a given patient and the maximum achievable quality assessment value may be dependent on the patient, given their anatomy and/or echogenicity, for example. For example, in some embodiments where the quality assessment value has been normalized to a possible range of **0**-**5**, for many patients, the maximum achievable quality assessment value for a given view category may be about **3**.**0**. In some embodiments, the operator may make various adjustments until a near maximum achievable quality assessment value on a given patient has been achieved.

In some embodiments, after capturing images associated with a desired quality assessment value for a first view category, the operator of the system **10** may wish to capture images for a different view category and so reposition the transducer and/or reconfigure the system **10**. For example, in some embodiments, the operator may, after capturing images of the AP**4** view category, wish to capture images of one or more of the AP**2,** AP**3**, $PSAX_A$, and $PSAX_{PM}$ view categories to facilitate quantified clinical measurement of anatomical features and/or to assist in diagnosing a medical condition or a characteristic of the heart. For example, in some embodiments, the operator may, after capturing at least one image of the AP**4** view category, wish to capture at least one image of the AP**2** view category to facilitate quantified clinical measurement of anatomical features for determining an ejection fraction.

Accordingly, the operator may reposition the transducer **16** shown in Figure **1** and/or adjust image receiving parameters to cause the flowchart **200** to be executed one or more further times, but with echocardiographic images which are of different view categories and are to be analyzed using different parameters. In various embodiments, the analyzer **12** being configured as described above to switch between analyses of varying view categories may facilitate ease of use and/or efficient capture of subsequent high quality images of different view categories.

Neural network trainer

As discussed above, in various embodiments, a neural network trainer may first train neural networks to determine the architecture and/or parameters to be used by the neural networks at block **204** and/or block **206** of the flowchart **200** shown in Figure **3**. Referring to Figure **14**, there is shown a system **500** for facilitating training of neural networks. The system includes a neural network trainer **502** in communication with a training image source **504** and a user interface system **506**. In some embodiments, the neural network trainer **502** may also be in communication with the analyzer **12** via the network **126**.

The training image source **504** stores echocardiographic images and associated view category information which indicates what view category each of the images falls within. For example, in some embodiments, the training image source **504** may include a server computer for storing and archiving medical electronic images, such as, for example, an archive device from a picture archiving and communication system (PACS).

The neural network trainer **502** may be configured to retrieve and/or receive the echocardiographic images, which may act as echocardiographic training images, from the training image source **504**. In some embodiments, the neural network trainer **502** may, after receiving the training images, produce signals representing the echocardiographic training images and associated view categories to cause the user interface system **506** to present the echocardiographic images and the view categories to one or more experts, such as, echocardiographers or physicians trained in echocardiography.

The experts may then provide respective quality assessment values for each of the echocardiographic images. For example, in some embodiments, the neural network trainer may be configured to produce signals for causing the user interface system **506** to present the experts with a set of echocardiographic training images and an indication of what view category the set of

echocardiographic training images is to be assessed as. An echocardiographer may assess the set of echocardiographic training images and provide a quality assessment value representing a suitability of the set of images for a quantified clinical measurement. The neural network trainer **502** may store the quality assessment value in memory in association with the assessed set of echocardiographic training images.

After quality assessment values have been received and associated with each set of echocardiographic training images, the neural network trainer **502** may train neural networks using the echocardiographic training images as inputs and the associated expert quality assessment values as desired outputs to determine sets of neural network parameters defining the neural networks, wherein at least a portion of each of the neural networks is associated with one of the image view categories.

In some embodiments, the neural network trainer **502** may also train a view category determining neural network to determine sets of neural network parameters defining the view category determining neural network. The view category determining neural network may be generally as described above with reference to block **262** of the flowchart **260** shown in Figure **5**, configured to receive one or more echocardiographic images as an input, and having a softmax layer as an output layer having outputs which represent whether the input echocardiographic images fall within a particular view category.

In some embodiments, the neural network trainer **502** may produce signals representing the parameters defining the trained neural networks for causing the parameters to be provided to a system or device configured to apply the neural networks. For example, in some embodiments, the neural network trainer **502** may transmit the neural network parameters to the analyzer **12** via the network **126** shown in Figure **14**. Alternatively, in some embodiments, the neural network trainer **502** may produce signals for causing the sets of neural network

parameters to be stored in removable memory which may be provided to the analyzer **12**.

The analyzer **12** may use the sets of neural network parameters to facilitate analysis of echocardiographic images, generally as described above with reference to the flowchart **200** shown in Figure **3**.

Neural network trainer – Processor circuit

Referring now to Figure **15**, a schematic view of the neural network trainer **502** of the system **500** shown in Figure **14** according to an embodiment is shown. In various embodiments, the neural network trainer **502** may be incorporated in one or more computers, for example.

Referring to Figure **15**, the neural network trainer **502** includes a processor circuit including a trainer processor **600** and a program memory **602**, a storage memory **604**, and an I/O interface **612**, all of which are in communication with the trainer processor **600**.

The I/O interface **612** includes an interface **620** for communicating with the training image source **504** and an interface **622** for communicating with the user interface system **506** shown in Figure **14**. In some embodiments, the I/O interface **612** also includes an interface **624** for facilitating networked communication with the analyzer **12** through the network **126**.

Processor-executable program codes for directing the trainer processor **600** to carry out various functions are stored in the program memory **602**. The program memory **602** includes a block of codes **660** for directing the neural network trainer **502** to perform neural network training functions.

The storage memory **604** includes a plurality of storage locations including location **640** for storing training image data, location **642** for storing expert

assessment data, location **644** for storing image assessment neural network parameter data and location **646** for storing view category neural network parameter data.

Training the neural networks

Referring now to Figure **16**, a flowchart depicting blocks of code for directing the trainer processor **600** shown in Figure **15** to perform image assessment neural network training functions in accordance with one embodiment is shown generally at **700**. The blocks of code included in the flowchart **700** may be encoded in the block of codes **660** of the program memory **602** shown in Figure **15** for example.

Referring to Figure **16**, the flowchart **700** begins with block **702** which directs the trainer processor **600** shown in Figure **15** to receive signals representing a plurality of echocardiographic training images, each of the plurality of echocardiographic training images associated with one of a plurality of predetermined echocardiographic image view categories. In some embodiments, block **702** may direct the trainer processor **600** to receive echocardiographic training images from the training image source **504** shown in Figure **14**. For example, in some embodiments, block **702** may direct the trainer processor **600** to receive sets of associated image files, which may represent respective sequences of images or videos and include common image group identifiers, from the training image source **504**. Each set of image files may make up an echo cine, which is associated with a view category.

An exemplary training image file that may be received at block **702** is shown at **740** in Figure **17**. The training image file **740** includes an image identifier field **742** for storing a unique identifier for identifying an image included in the file, an image group identifier field **744** for storing an identifier common to a set of image files which include images that are to be analyzed together, a view category identifier field **746** for storing an identifier for identifying the view category within

which the image falls and by which the image should be analyzed, and an image data field **748** for storing information representing the image.

Block **702** may direct the trainer processor **600** to store the training image files received at block **702** in the location **640** of the storage memory **604**.

After block **702** of the flowchart **700** shown in Figure **16** has been executed, the location **640** of the storage memory **604** shown in Figure **17** may store a large number of image files, each having generally similar format to the training image file **740** shown in Figure **17**. For example, in some embodiments, about **2**,**500** echo cines of about **40** images each (about **500** echo cines of each view category) may be stored in the location **640** of the storage memory **604** and therefore about **100**,**000** training image files generally similar to the training image file **740** shown in Figure **17** may be stored in the location **640** of the storage memory **104**.

Referring back to Figure **16**, block **704** directs the trainer processor **600** to receive signals representing expert quality assessment values representing view category specific quality assessments of the echocardiographic training images, each of the expert quality assessment values provided by an expert echocardiographer and associated with one of the received sets of echocardiographic training images.

In some embodiments, the neural network trainer **502** may cause the echocardiographic training images to be presented to an expert and the expert may provide the expert quality assessment values. For example, block **704** may direct the trainer processor **600** to transmit the training image files to the user interface system **506** via the interface **622** of the I/O interface **612** shown in Figure **15** to cause a display of the user interface system **506** to present one or more experts with the echocardiographic images and an indication of what view category the images are to be assessed as.

In some embodiments, the echocardiographers may be directed to provide a quality assessment value representing a suitability of the images for a quantified clinical measurement. For example, the echocardiographers may be directed to provide a quality assessment value, which represents an aggregation of scores derived using semi-quantitative evaluation of component structures and parameter optimization features such as centering, depth, gain, axis, focus, frequency or another parameter optimization feature or image capture parameter, generally as described above, with reference to flowchart **400** shown in Figure **11**.

Block **704** may direct the trainer processor **600** to receive signals representing the expert quality assessment values and to store representations of the received expert quality assessment values in the location **642** of the storage memory **604**. For example, in some embodiments, block **704** may direct the trainer processor **600** to receive representations of expert quality assessment records from the user interface system **506** and to store the expert quality assessment records in the location **642** of the storage memory. An exemplary expert quality assessment record that may be received at block **704** and stored in the location **642** of the storage memory **604** is shown at **780** in Figure **18**.

Referring to Figure **18**, the expert quality assessment record **780** includes an image group identifier field **782** for storing the group identifier which identifies the set of images for which the expert quality assessment was made and an expert quality assessment value field **784** for storing the view category specific expert quality assessment value provided by the expert.

Referring back to Figure **16**, the flowchart **700** continues at block **706** which directs the trainer processor **600** shown in Figure **15** to train neural networks using the echocardiographic training images and the associated expert quality assessment values to determine sets of neural network parameters defining the neural networks, at least a portion of each of said neural networks associated

with one of the plurality of predetermined echocardiographic image view categories.

In some embodiments, block **706** may direct the trainer processor **600** to train the neural network **360** shown in Figure **8** to determine values to be included in a common neural network record and view category specific neural network records stored in the location **644** of the storage memory **104**. In various embodiments, the common neural network record stored in the location **644** may have a generally similar format to that of the common neural network record **320** shown in Figure **9** and each of the view category specific neural network records stored in the location **644** of the storage memory **604** may have a generally similar format to that of the view category specific neural network record **340** shown in Figure **10**.

In some embodiments, the sequences of images received at block **702** may include a different number of images than can be analyzed by the neural network to be applied. For example, in some embodiments, the neural network **360** shown in Figure **8** may be configured to take as an input **20** images and the sequences of images received at block **702** may include more than **40** images each. Accordingly, in some embodiments, before training the neural networks, block **706** may direct the trainer processor **600** to split one or more groups of echocardiographic images received at block **702** into subsets.

For example, block **706** may direct the trainer processor **600** to split each sequence of images into one or more groups of **20** image files each. In order to do this, block **706** may direct the trainer processor **600** to change the value stored in the image group identifier field for each file. Block **706** may further direct the trainer processor **600** to generate and store further expert quality assessment records as necessary such that each of the new groups of images is associated with the same quality assessment value as the original sequence of images.

Due to the storage length of heart cycles and different frame acquisition rates, number of images per cardiac cycle may vary for different image sequences. Accordingly, in some embodiments the neural network may be defined to take as input a static sequence size of nearly half the average heart cycle in the echocardiographic images received at block **702** (for example, in some embodiments **20** images), to capture the quality distribution of the echo imaging view categories. In various embodiments, by choosing a static sequence size of about half the average heart cycle, images in each sequence may not be synced with the heart cycle and this may, in some embodiments, help to ensure that the estimated quality assessment value provided after training for a given input sequence may be independent of the starting phase of the cardiac data.

Block **706** may direct the trainer processor **600** to, for each **20** image sequence of images having a common group identifier value, select a set of layers of the neural network **360** shown in Figure **8** to train, and to train those layers. For example, for a **20** image sequence associated with the AP**4** view category, block **706** may direct the trainer processor **600** to train the neural network including the shared layers **362** and the AP**4** view category specific layers **374**. Block **706** may direct the trainer processor **600** to use the **20** images as inputs and to use the expert quality assessment value from an associated expert quality assessment record stored in the location **642** of the storage memory **604** as the desired output.

In some embodiments, block **706** may direct the trainer processor **600** work towards optimizing network hyper-parameters by cross-validation to try to ensure that the network can sufficiently learn the distribution of all view categories without overfitting to the training data. In some embodiments, after finalizing the network architecture, the network may be trained on all of the images stored in the location **640** of the storage memory **604**.

In various embodiments, the shared layer **362** and the view category specific layers **370**, **372**, **374**, **376**, and **378** may be trained simultaneously. In some embodiments, batch training may be used and each batch may consist of eight sequences (or groups of images) from each view, for example, wherein each sequence is a set of **20** consecutive gray-scale images of **200**x**200** pixels, with no preprocessing applied to the images.

In some embodiments, the neural networks may be trained using the adam optimizer with hyper-parameters as suggested by Kingma, D.P., Ba, J.L.: Adam: a Method for Stochastic Optimization, International Conference on Learning Representations **2015** pp. **1**-**15** (**2015**). The weight of the conv layers may be initialized randomly from a zero-mean Gaussian distribution. To try to prevent the neural network from overfitting on the training data, ℓ_2 norm regularization may be added to the weights of the conv kernels. In some embodiments, Keras deep learning library with TensorFlow™ backend, may be used to train and test the models.

In some embodiments, to prevent co-adaptation of features and overfitting on the training data, a dropout layer with the dropout probability of **0**.**5** may be used after the third pooling layer.

After training has been completed, the sets of parameters stored in the location **646** of the storage memory **104** may represent a trained echocardiographic image quality assessment neural network that includes shared layers and a plurality of view category specific layers.

Referring back to Figure **16**, in some embodiments, the flowchart **700** may include a further block **708** which directs the trainer processor **600** to produce signals representing the parameters defining the trained neural networks for causing the parameters to be provided to a system or device configured to apply the neural networks. In some embodiments, for example, block **708** may direct

the trainer processor **600** to retrieve the neural network records from the location **644** and to produce signals representing the records for causing the records to be provided to the analyzer **12**.

For example, in some embodiments, block **708** may direct the trainer processor **600** to retrieve the common neural network record and the view category specific neural network records stored in the location **644** and transmit signals representing the records to the analyzer **12** via the interface **624** and the network **126**. Alternatively, in some embodiments, block **708** may direct the trainer processor **600** to cause the records to be stored in removable memory which may be provided to the analyzer **12**.

The analyzer **12** may be configured as described above to receive the neural network records and to perform image assessment by applying the neural networks represented thereby.

In some embodiments, the block of codes **660** of the program memory **602** shown in Figure **16** may include a block that directs the trainer processor **600** to train a view category determining neural network that is configured to take as an input at least one echocardiographic image and to output an indication of what view category should be associated with the input at least one echocardiographic image. The block may use the image data from the training image files stored in the location **640** of the storage memory **104** as inputs and indications of the associated view categories (as determined by the view category identifiers included in the image files) as desired outputs.

The neural network may include convolutional layers, max-pooling layers, and fully connected layers, the fully connected layers including a softmax layer as an output layer having outputs which represent respective determinations that an input set of echocardiographic images fall within a particular view category. In some embodiments, the block may direct the trainer processor **600** to store

parameters defining the trained neural network in a view category determining neural network record in the location **648** of the storage memory **604**.

Embodiments using distributed processing and/or separate devices

In some embodiments, separation of the neural network trainer **502**, the training image source **504**, and the analyzer **12** into different computers or systems may facilitate control of and access to information. This may be particularly desirable with the systems described herein where personal and/or confidential information may be managed. Further, in some embodiments, separation of the neural network training from the analysis, for example, may allow different or faster computers to train the neural network.

In some embodiments, the functionality of aspects of the system **10** and/or the system **500** may be further modularized and/or distributed between different devices. For example, in some embodiments, a system **800** as shown in Figure **19** may perform generally similar functions to the system **10** shown in Figure **1**. The system **800** includes a user interface system **802** generally similar to the user interface system **14** shown in Figure **1**, and a transducer **804** generally similar to the transducer **16** shown in Figure **1**. The system **800** also includes a scanner **806** and an image analyzer **808** which are in communication with one another via a network **810** and configured to together perform generally similar functions to the analyzer **12** described above. The scanner **806** may be configured to receive signals from the transducer and generate and store echocardiographic images in memory generally as described above. The scanner **806** may be configured to send the echocardiographic images to the image analyzer **808** which is configured to receive the images from the scanner **806** and generally perform image analysis steps as described above with reference to the flowchart **200** shown in Figure **3**. The image analyzer **808** may be configured to send signals to the scanner **806** for causing the scanner **806** to cause representations of the echocardiographic images and associated quality

assessment values to be displayed on the display of the user interface system **802**.

In some embodiments, the functionality of any or all of the devices included in the systems **10**, **500**, and/or **800** as shown in Figures **1**, **13**, and **18** may be performed by multiple devices which are in communication with one another via a network. In such embodiments, the devices may be distributed in a cloud computing context, for example. For example, in some embodiments, a system that functions generally similar to the system **800** shown in Figure **19** may include a mobile device, such as a smart phone, acting similar to the user interface system **802**, in communication with a scanner generally similar to the scanner **806**, via a wireless connection, for example. An image analyzer acting as the image analyzer **808** may be remotely located in comparison to the scanner and the mobile device and may be in communication with the scanner **806** and/or the mobile device via a network connection, for example, over the Internet. In some embodiments, allowing the image analyzer **808** to be remotely located and accessible via a network, may facilitate the use of low cost or fast computing resources to carry the load of intensive processing during training and/or application of the neural networks.

In some embodiments, execution of block **206** may be performed by more than one analyzer device. For example, in some embodiments a first analyzer may apply the shared layers of an image quality assessment neural network to the received at least one echocardiographic image and then send the output of the shared layers to a second analyzer, which may apply one of the view specific layers to the received output. In such embodiments, the shared layers may act as a small neural network. In some embodiments, the shared layers may facilitate data compression. In some embodiments, the first analyzer may be in communication with the second analyzer via a network connection, such as, for example, an Internet connection. In some embodiments, the first analyzer may be implemented on a mobile device and the second analyzer may be in the cloud. In various embodiments, using a neural network with common shared layers may facilitate compressing the

echocardiographic image data before sending the data to the second analyzer and may reduce the bandwidth needed to transfer data to the second analyzer.

In some embodiments, the first analyzer may use the shared layers of a neural network to generate a coarse quality score, and a finer quality score may be calculated by a larger architecture which is deployed in the cloud, for example, and uses the output of the shared layers.

Stored image analysis

In some embodiments, the analyzer **12** may be used to analyze stored images, rather than echocardiographic images received in real-time or near real-time. For example, in some embodiments, the analyzer **12** may be in communication with an image source, which may, for example, be implemented as a PACS. In some embodiments, the analyzer **12** may be in communication with the image source via a network, such as, the Internet, for example. In some embodiments, the analyzer **12** may be integrated with the image source as a single device.

In some embodiments where the analyzer **12** is used to analyze stored images from an image source, block **202** may direct the analyzer processor **100** to receive at least one echocardiographic image from the image source. Blocks 204 and 206 may direct the analyzer processor 100 to perform functions generally as described above. In some embodiments, block **208** may direct the analyzer processor **100** to produce signals for causing the quality assessment value to be stored in association with the at least one echocardiographic image at the image source. In some embodiments, using the analyzer **12** to analyze stored echocardiographic images from an image source may facilitate use of the previously captured echocardiographic images for later quantified clinical measurement of anatomical features and/or to assist in diagnosing a medical condition or a characteristic of the heart.

Embodiments using integrated devices

In some embodiments, the functionality of some or all of the neural network trainer **502**, the training image source **504** and/or the analyzer **12** of the systems **500** and **10** may be provided by a single integrated device or system, for example. By way of example, in various embodiments, aspects of the neural network trainer **502** and the analyzer **12** may be integrated, such that a single device performs the neural network training and the analysis. In some embodiments, some of the blocks of code may be altered and/or omitted to facilitate the execution of the functionality of the processes described herein by one or more integrated device or system. In some embodiments, a system including such integrated devices may provide advantages such as, for example, reduction in implementation and/or operating costs.

3D representations

In some embodiments, block **202** may direct the analyzer processor **100** to receive or derive one or more **3**D model representations of the patient's heart from the signals received from the scanner **16**. In such embodiments, each of the **3**D model representations may represent one or more echocardiographic images which may be derived or extracted from the **3**D model representation by taking slices or planar sections from the **3**D model, for example. In such embodiments, the flowchart **200** may be executed to analyze echocardiographic images derived or extracted from the **3**D model representation.

Various embodiments

In some embodiments, echocardiographers may have previously provided the expert quality assessment values, and the training image source **504** may store respective expert quality assessment values in association with each of the images. In such embodiments, block **704** may direct the trainer processor **600** to receive the expert quality assessment values from the training image source **504**.

Certain embodiments of the systems **10**, **500**, and **800** have been described above, wherein a plurality of images, in some embodiments a sequence of **20** images, for example, are analyzed together to generate a single quality assessment value. In various embodiments, analyzing more than one image together may facilitate determining accurate and contextualized quality assessment values.

However, in some embodiments, the systems **10**, **500**, or **800** may be configured to analyze a single image at a time. In such embodiments, the flowchart **200** shown in Figure **3**, or a generally similar flowchart, may be executed to determine a quality assessment value for a single image received at block **202** of the flowchart **200**. In various embodiments, analyzing a single image at a time may facilitate fast processing of the flowchart **200** and/or real-time or near real-time feedback for the operator. In embodiments where a single image is analyzed at a time, the systems **10**, **500**, and/or **800** may be configured to train and/or apply functions or neural networks to the single image to determine quality assessment values of each image. In such embodiments, different neural networks from those shown in Figures 6 and 8, as defined by different neural network records, may be trained and applied.

For example, an exemplary view category determining neural network that may be trained and/or applied to a single echocardiographic image to determine a view category to be associated with the echocardiographic image, in accordance with some embodiments, is shown at **950** in Figure **20**. In some embodiments, the neural network **950** may be configured to take as input an image having a size of **200**x**200** pixels, and may include one convolutional layer with **12** kernels of each **11**x**11** pixels, one pooling layer with a kernel of **3**x**3** and stride of **2**, one convolutional layer with **24** kernels of each **7**x**7** pixels, one pooling layer with a kernel of **3**x**3** and stride of **2**, one convolutional layer with **48** kernels of each **3**x**3** pixels, one pooling layer with a kernel of **3**x**3** and stride of **2**, a fully connected layer with **2048** outputs, a fully connected layer with **1024** outputs, and a fully connected layer with **5** outputs.

An exemplary image assessment neural network that may be trained and/or applied to a single echocardiographic image to determine a quality assessment value for the echocardiographic image, in accordance with some embodiments, is shown at **980** in Figure **21**.

5

While specific embodiments of the invention have been described and illustrated, such embodiments should be considered illustrative of the invention only and not as limiting the invention as construed in accordance with the accompanying claims.

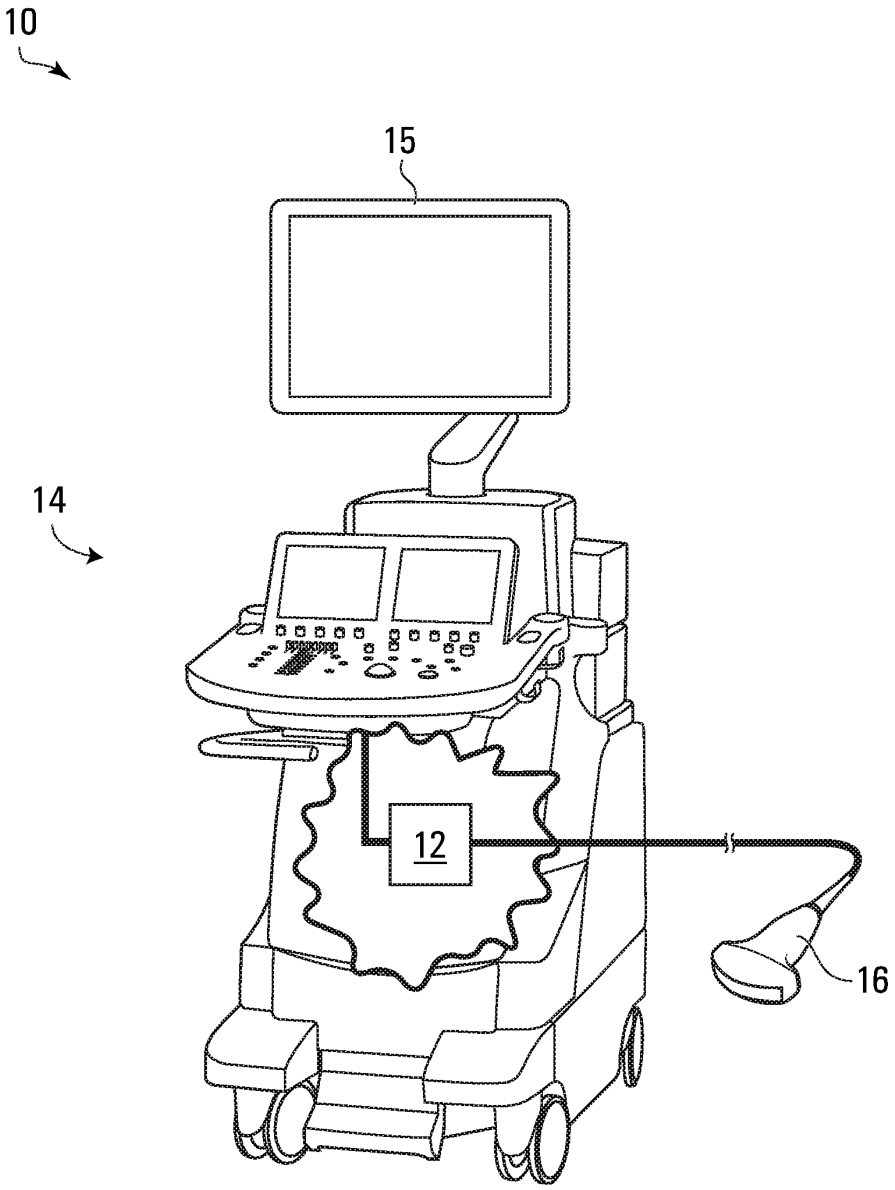


FIG. 1

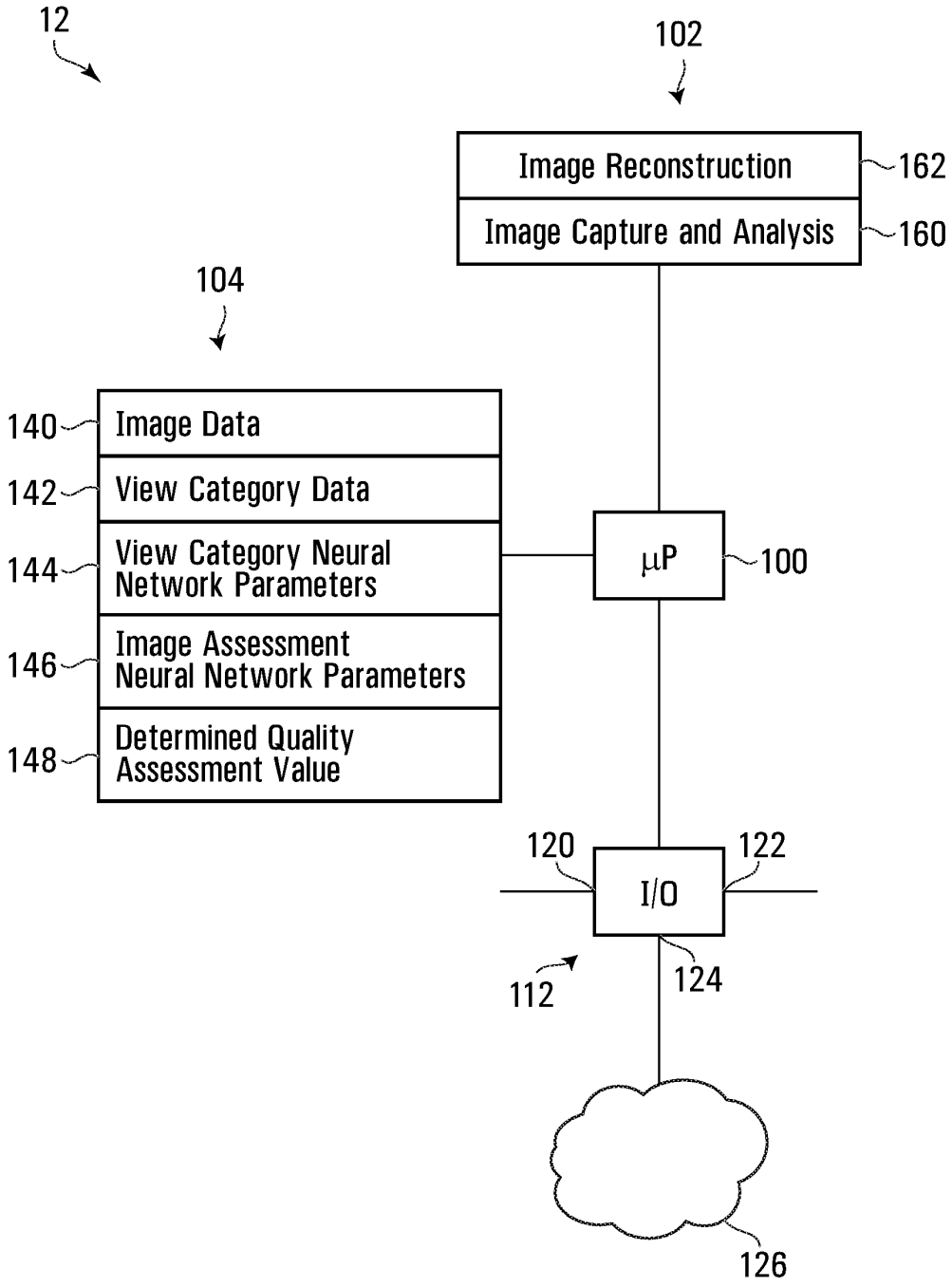

12
102
Image Reconstruction
162
Image Capture and Analysis
160
104
140
Image Data
142
View Category Data
144
View Category Neural Network Parameters
146
Image Assessment Neural Network Parameters
148
Determined Quality Assessment Value
μP
100
120
122
I/O
112
124
126

FIG. 2

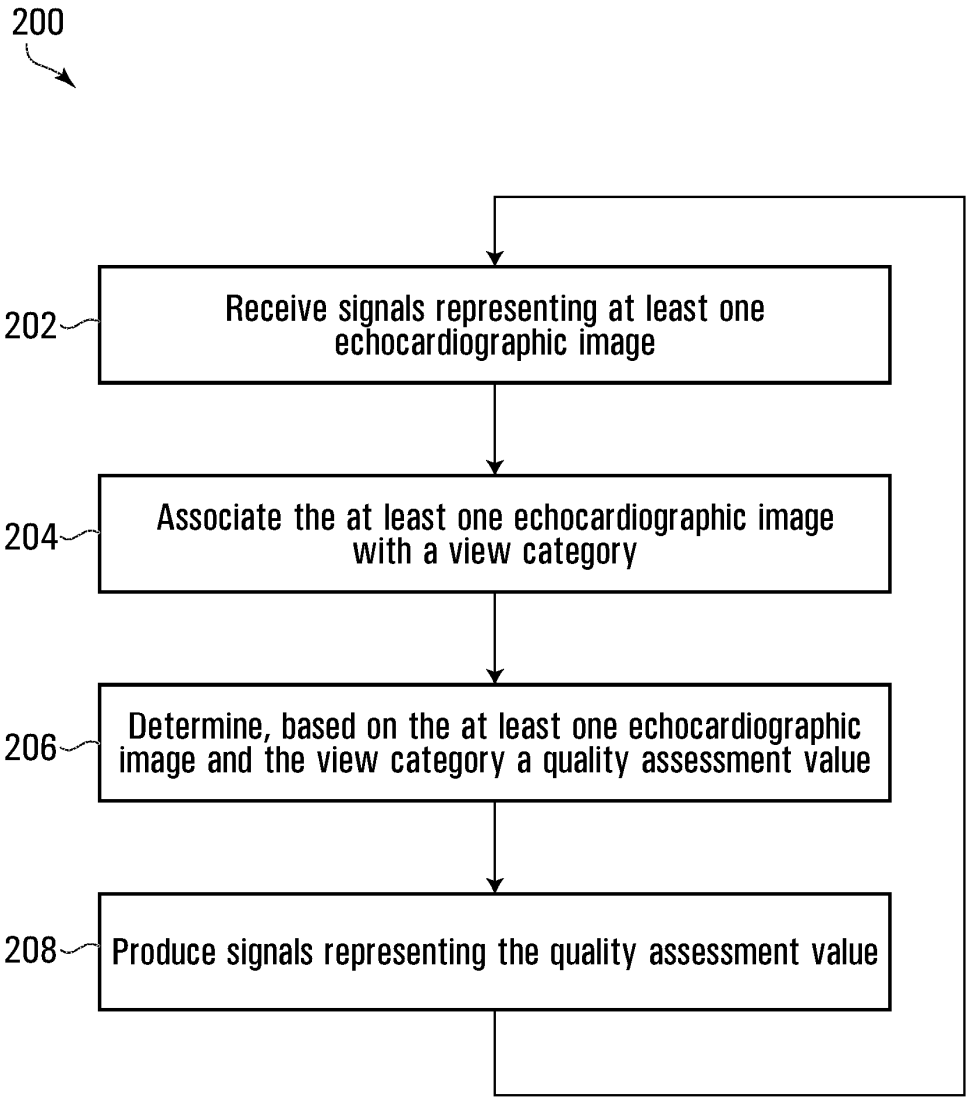

200
202
Receive signals representing at least one echocardiographic image
204
Associate the at least one echocardiographic image with a view category
206
Determine, based on the at least one echocardiographic image and the view category a quality assessment value
208
Produce signals representing the quality assessment value

FIG. 3

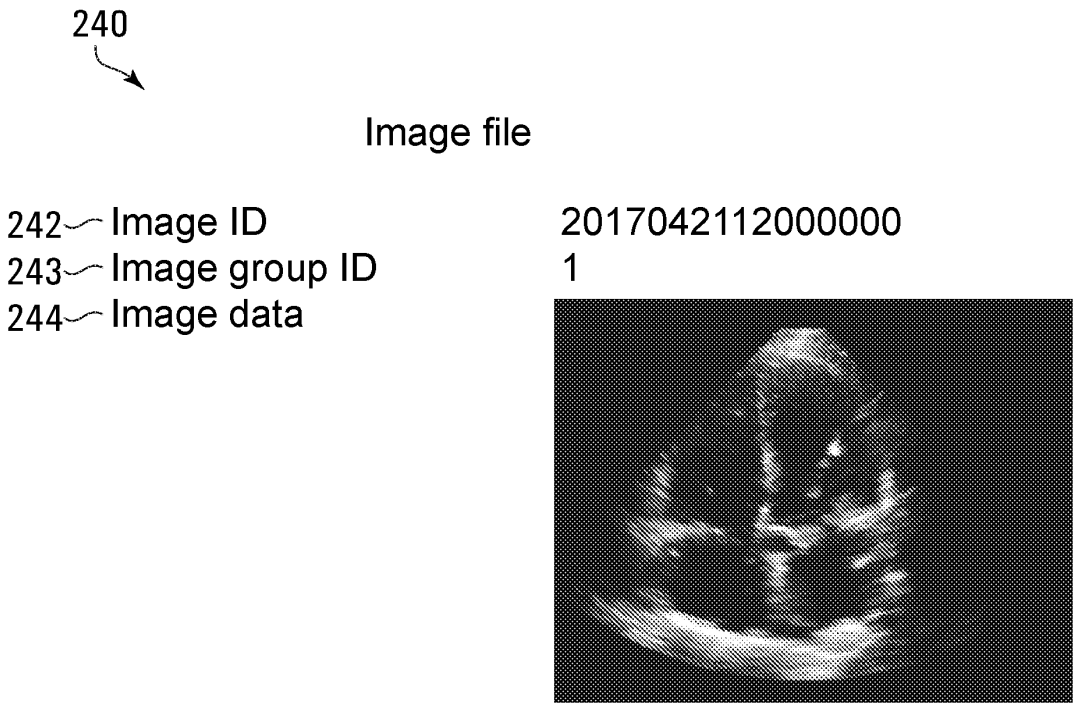

240
Image file
242 Image ID
2017042112000000
243 Image group ID
1
244 Image data

FIG. 4

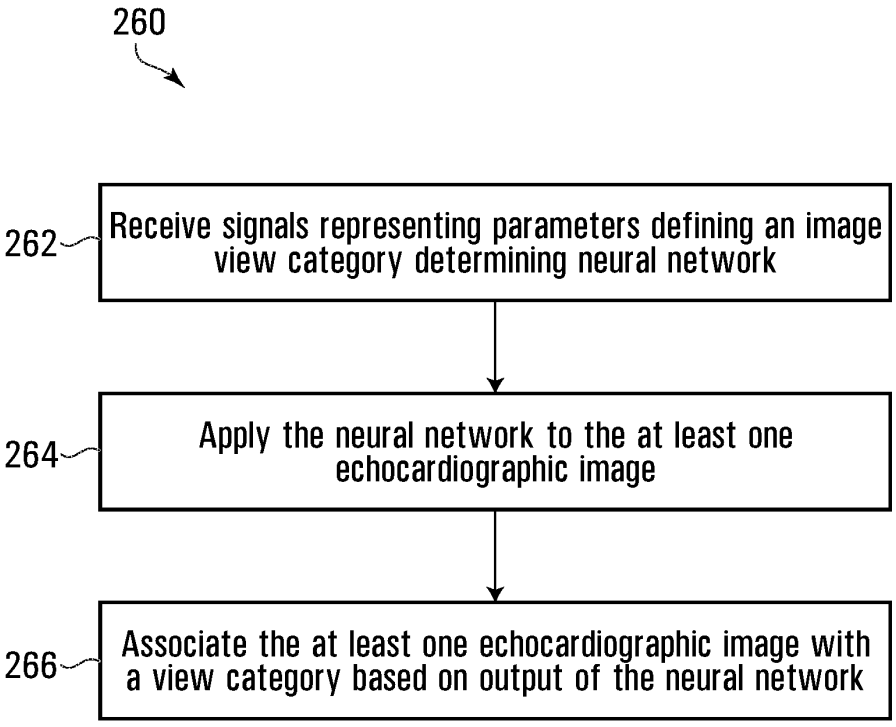

260
262
Receive signals representing parameters defining an image view category determining neural network
264
Apply the neural network to the at least one echocardiographic image
266
Associate the at least one echocardiographic image with a view category based on output of the neural network

FIG. 5

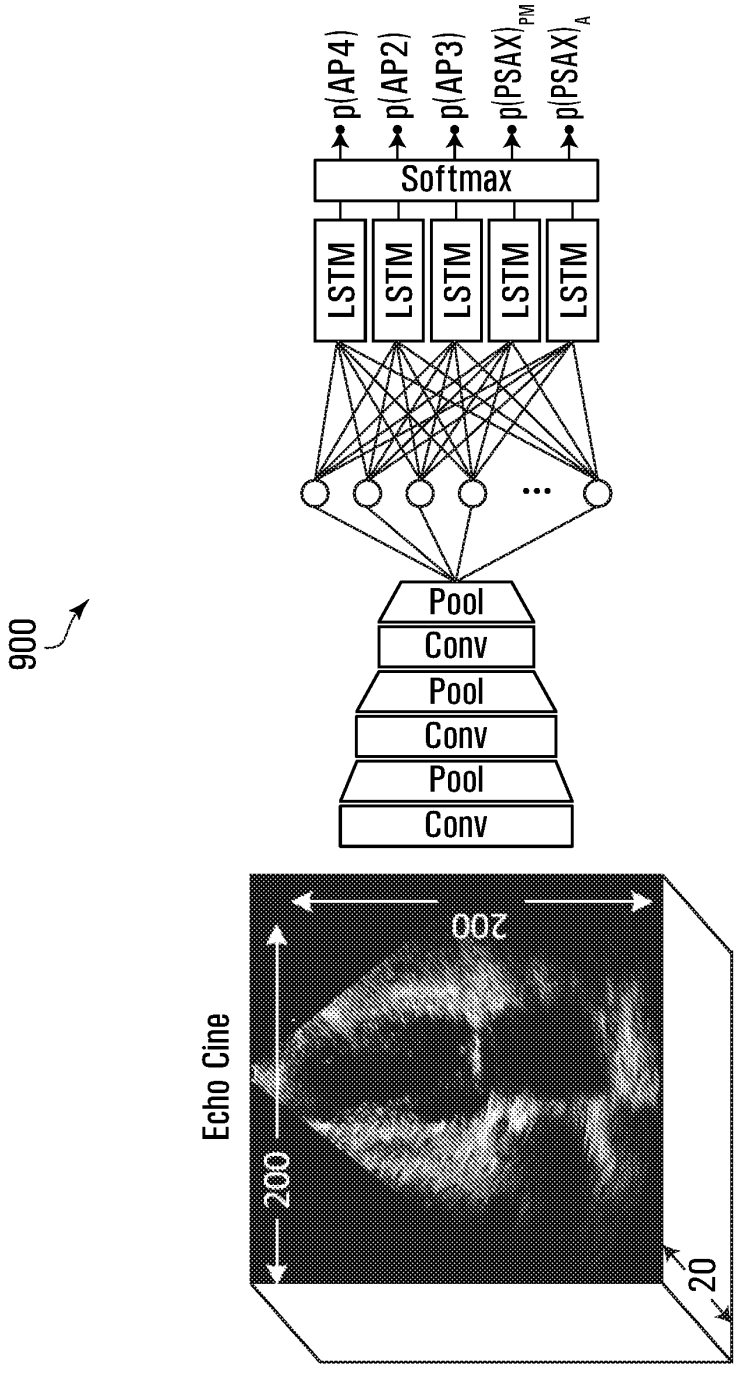

900
Echo Cine
200
200
20
Pool
Conv
Pool
Conv
Pool
Conv
LSTM
LSTM
LSTM
LSTM
LSTM
Softmax
p(AP4)
p(AP2)
p(AP3)
p(PSAX)PM
p(PSAX)A

FIG. 6



View category record

302	View category ID	AP4
304	Image group ID	1

FIG. 7

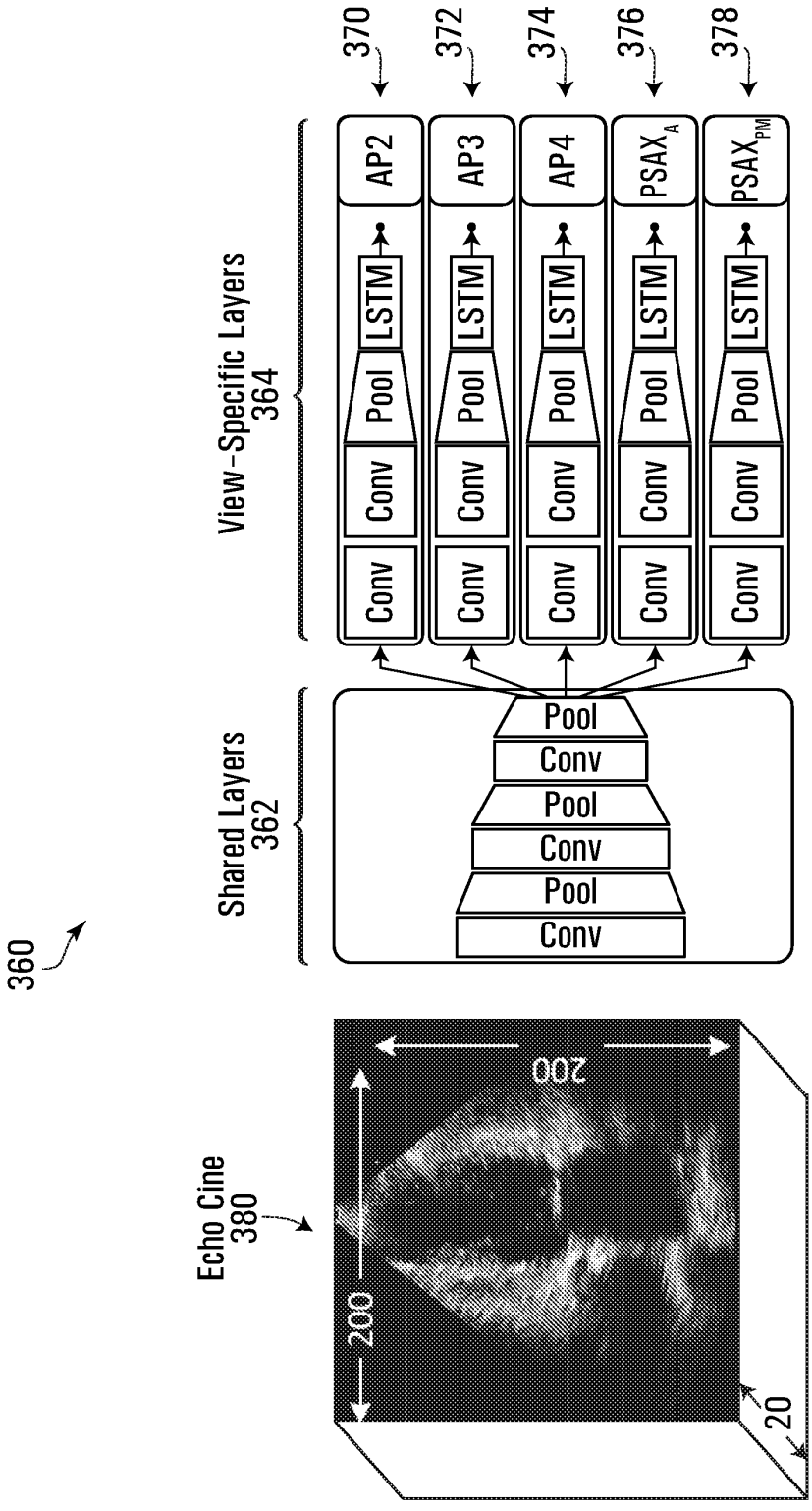

360
Echo Cine
380
200
200
20
Shared Layers
362
Pool
Conv
Pool
Conv
Pool
Conv
View-Specific Layers
364
Conv
Conv
Pool
LSTM
370
AP2
372
AP3
374
AP4
376
PSAX$_A$
378
PSAX$_{PM}$

FIG. 8



Common neural network record

324	Layer number	1
	Layer type	Convolutional
	Stride	1
	Kernel 1	[...]
	...	
	Kernel 8	[...]
326	Layer number	2
	Layer type	Max pool
	Stride	2
	Kernel size	2x2
328	Layer number	3
	Layer type	Convolutional
	Stride	1
	Kernel 1	[...]
	...	
	Kernel 16	[...]
330	Layer number	4
	Layer type	Max pool
	Stride	2
	Kernel size	2x2
332	Layer number	5
	Layer type	Convolutional
	Stride	1
	Kernel 1	[...]
	...	
	Kernel 32	[...]
334	Layer number	6
	Layer type	Max pool
	Stride	2
	Kernel size	2x2

FIG. 9

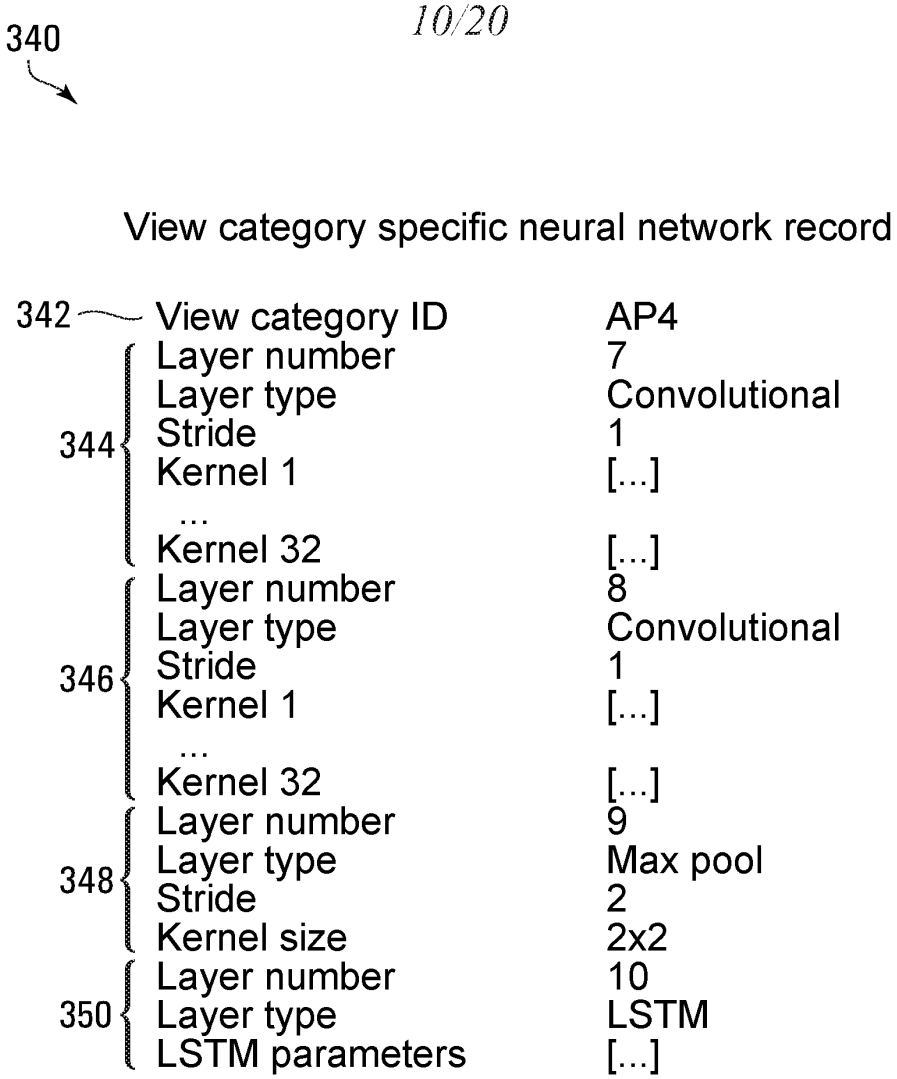

340
View category specific neural network record
342
View category ID
AP4
344
Layer number
7
Layer type
Convolutional
Stride
1
Kernel 1
[...]
...
Kernel 32
[...]
346
Layer number
8
Layer type
Convolutional
Stride
1
Kernel 1
[...]
...
Kernel 32
[...]
348
Layer number
9
Layer type
Max pool
Stride
2
Kernel size
2x2
350
Layer number
10
Layer type
LSTM
LSTM parameters
[...]

FIG. 10

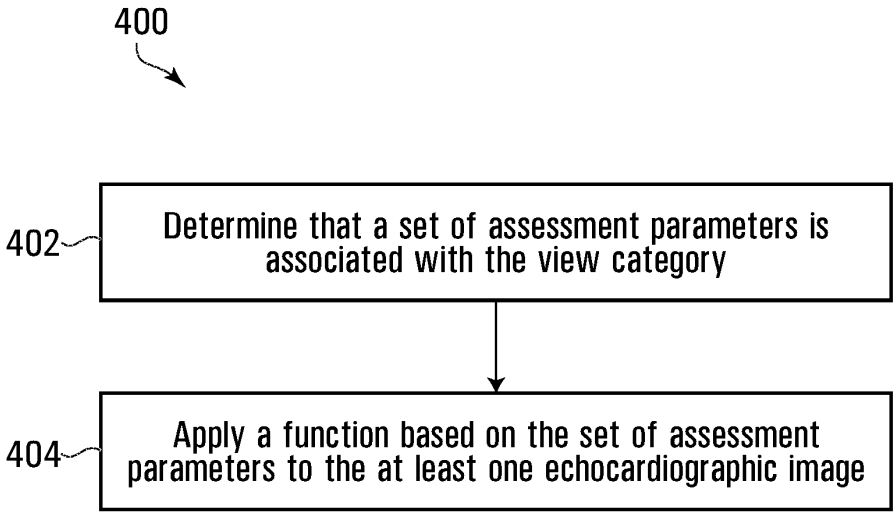

400
402
Determine that a set of assessment parameters is associated with the view category
404
Apply a function based on the set of assessment parameters to the at least one echocardiographic image

FIG. 11



Quality assessment record

422	Image group ID	1
424	Quality assessment	3.08

FIG. 12

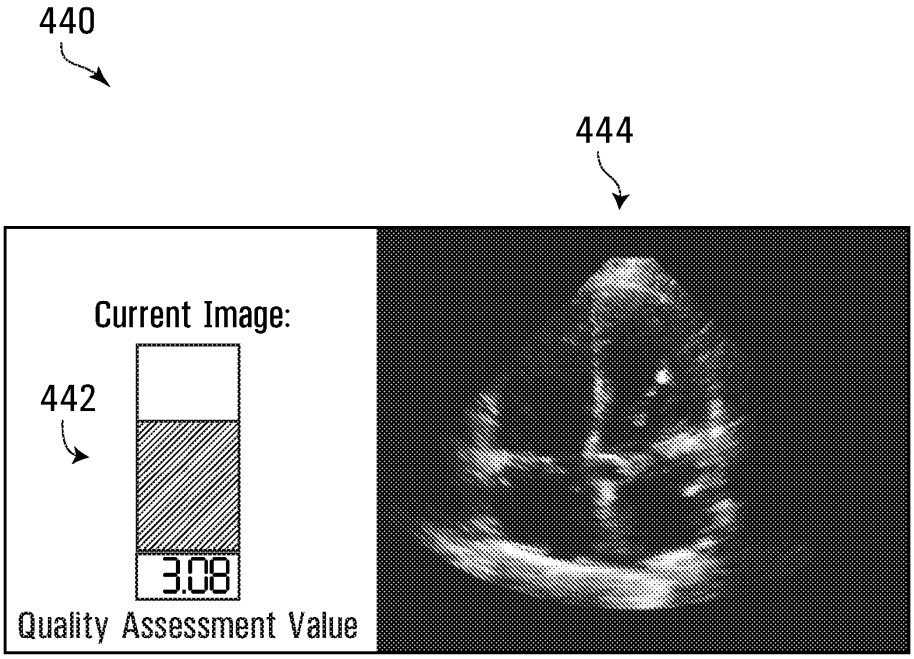


FIG. 13

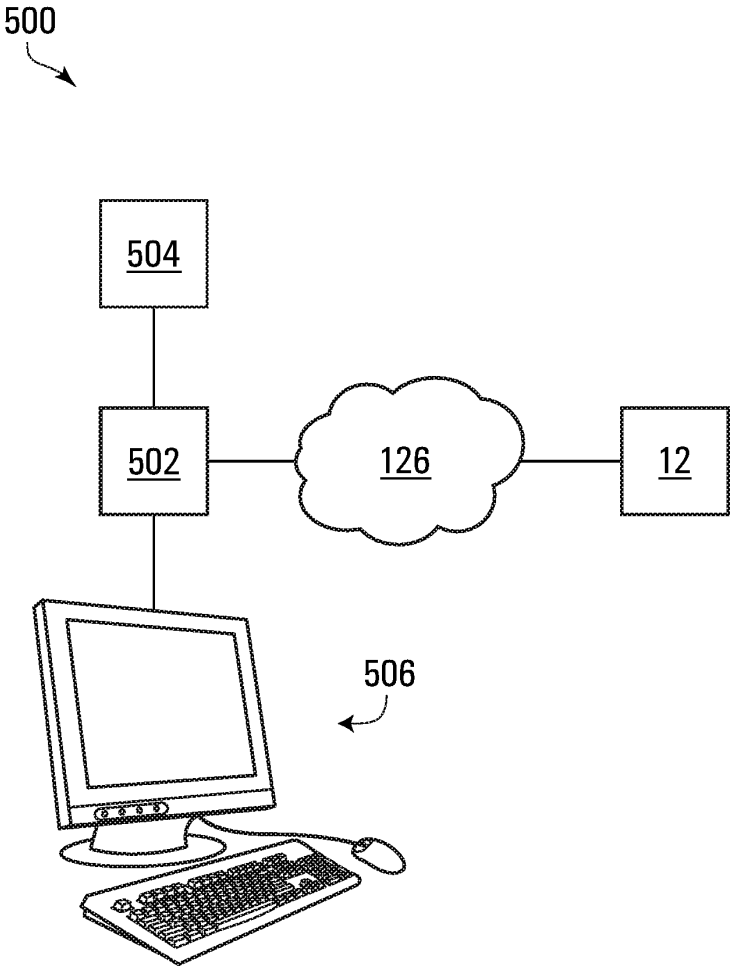


FIG. 14

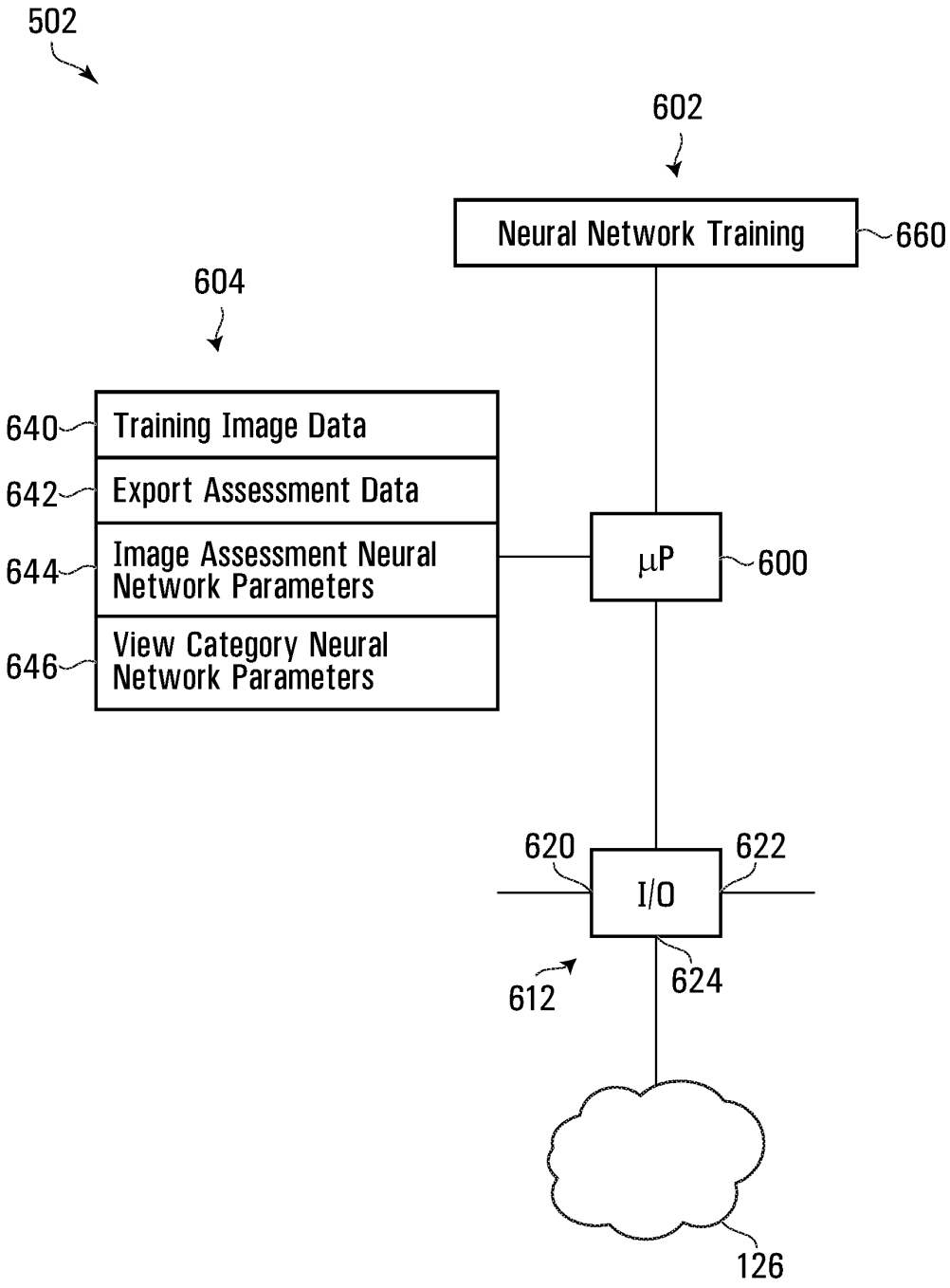

502
602
Neural Network Training
660
604
640
Training Image Data
642
Export Assessment Data
644
Image Assessment Neural Network Parameters
646
View Category Neural Network Parameters
μP
600
620
622
I/O
612
624
126

FIG. 15

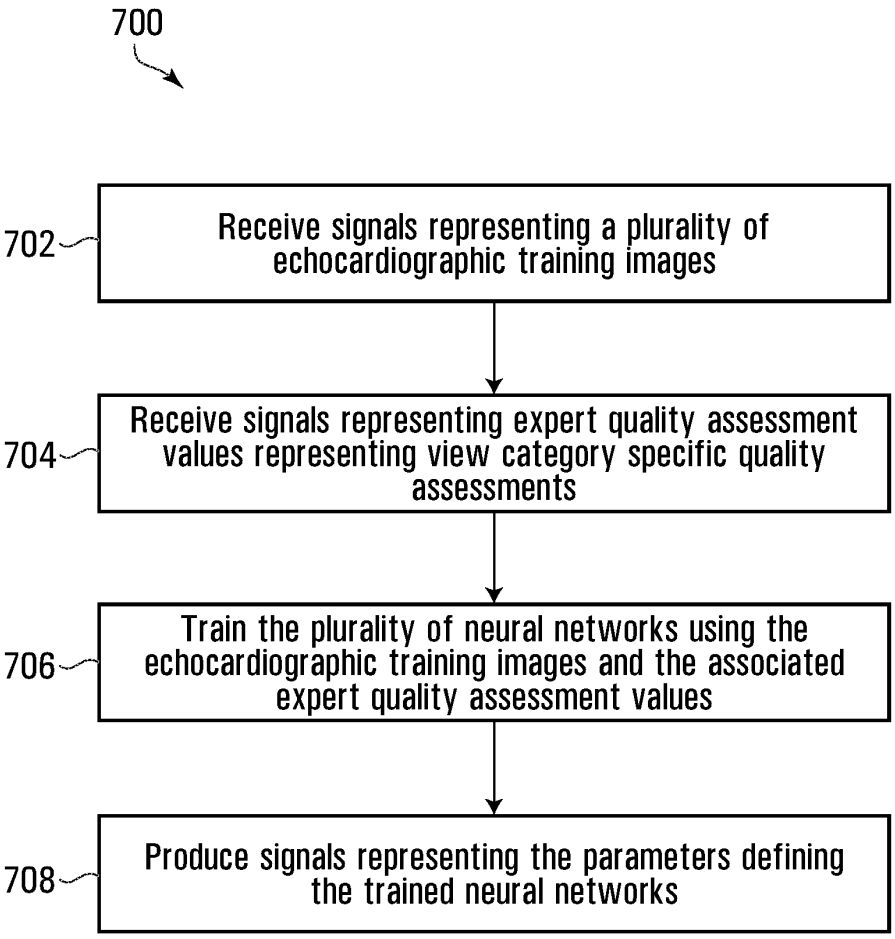

700
702
Receive signals representing a plurality of echocardiographic training images
704
Receive signals representing expert quality assessment values representing view category specific quality assessments
706
Train the plurality of neural networks using the echocardiographic training images and the associated expert quality assessment values
708
Produce signals representing the parameters defining the trained neural networks

FIG. 16

740

Training image file

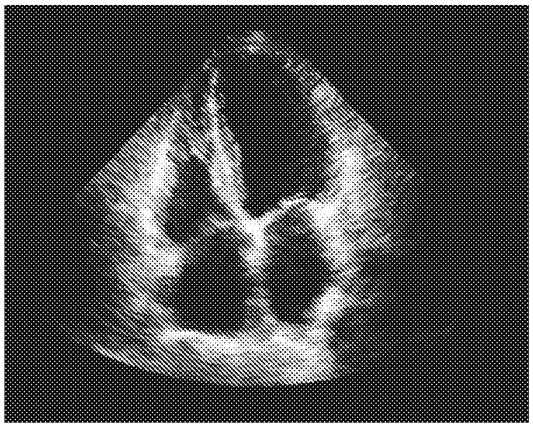
742	Image ID	2015082018120000
744	Image group ID	1
746	View category ID	AP4
748	Image data	

FIG. 17

780

Expert quality assessment record

782	Image group ID	1
784	Expert quality assessment	4

FIG. 18

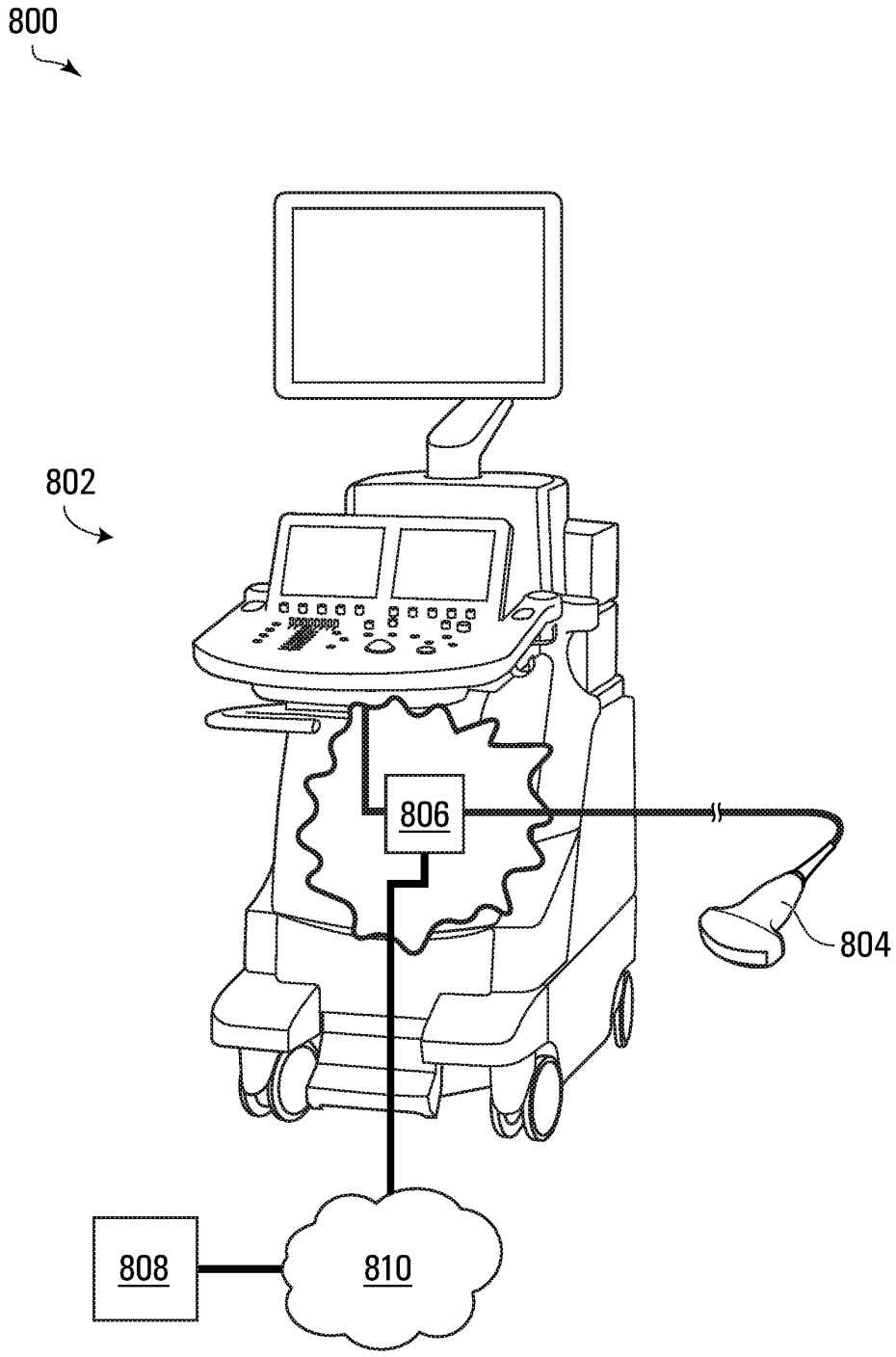


FIG. 19

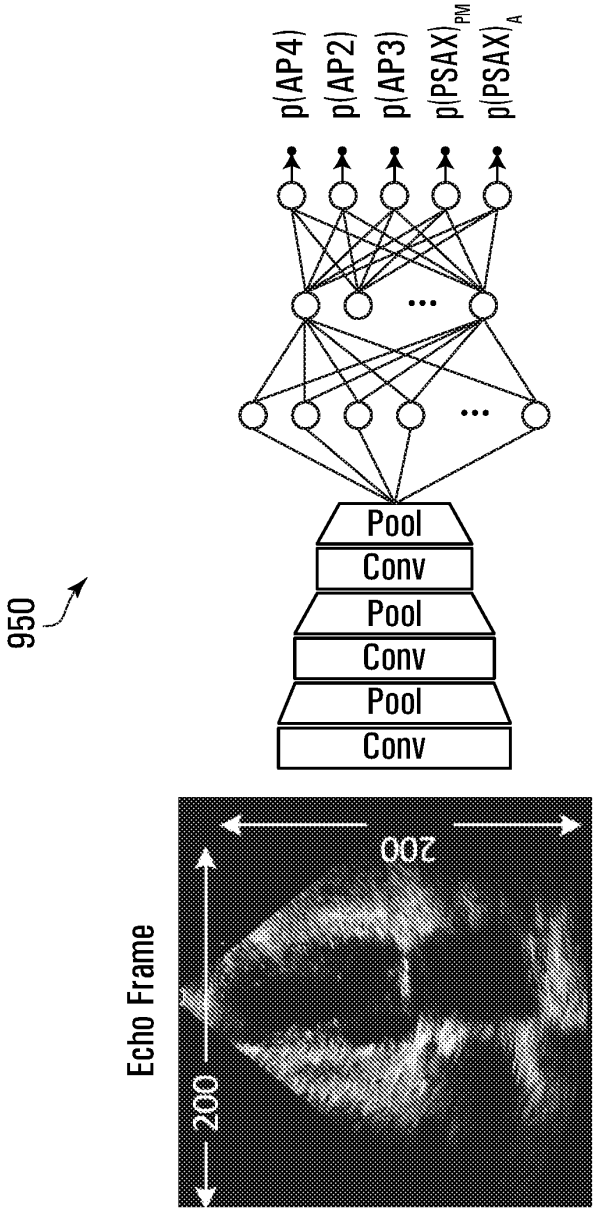

950
Echo Frame
200
200
Conv
Pool
Conv
Pool
Conv
Pool
p(AP4)
p(AP2)
p(AP3)
p(PSAX)PM
p(PSAX)A

FIG. 20

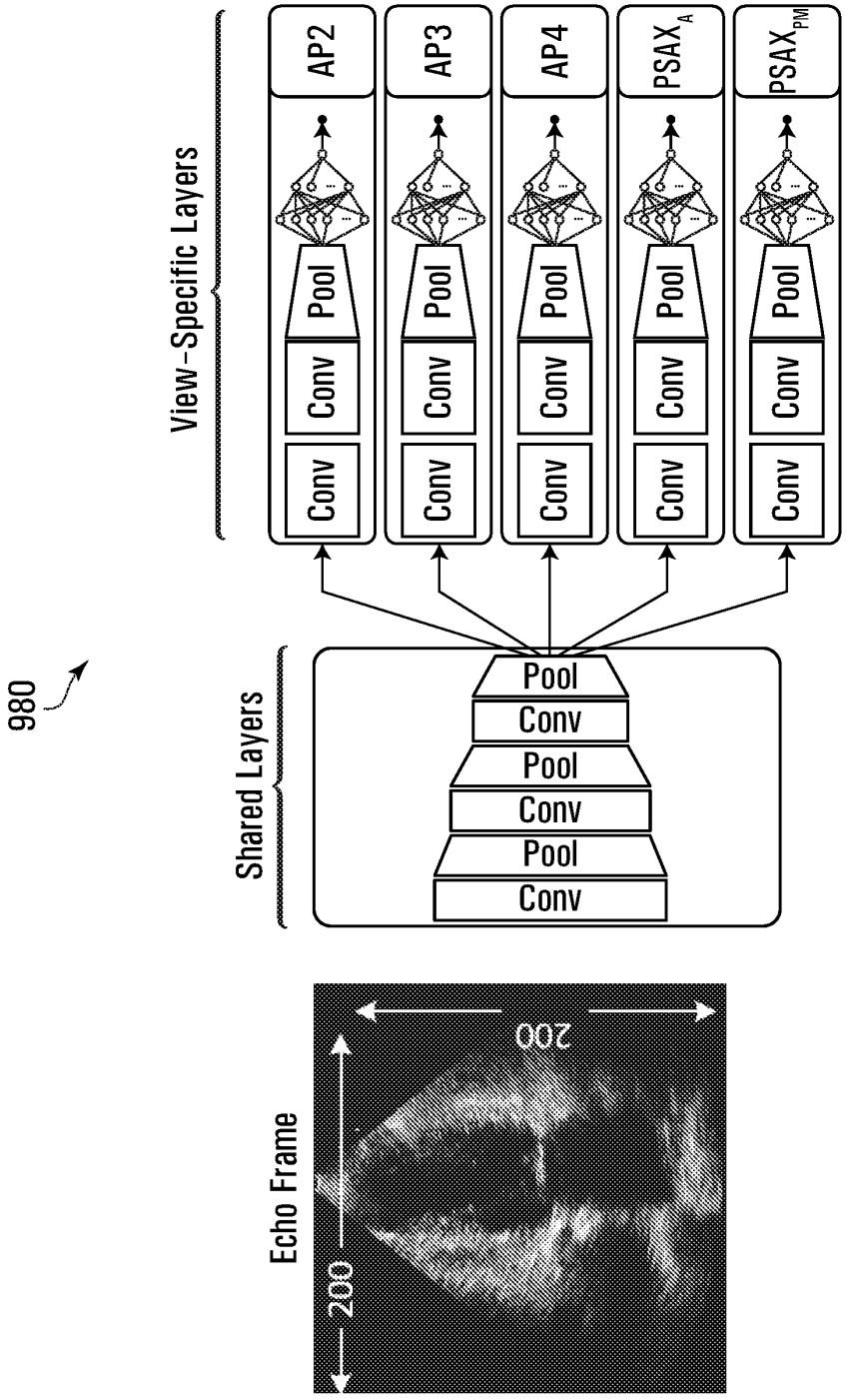

980
Shared Layers
Pool
Conv
Pool
Conv
Pool
Conv
View-Specific Layers
AP2
AP3
AP4
PSAX$_A$
PSAX$_{PM}$
Conv
Pool
Conv
Echo Frame
200
200

FIG. 21

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

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

Application Number	
Filing Date	2018-10-22
First Named Inventor	ABOLMAESUMI et al.
Art Unit	
Examiner Name	
Attorney Docket Number	CRB313

U.S.PATENTS Remove

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
	1	5776063	A	1998-07-07	DITTRICH et al.	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

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	20050020903	A1	2005-01-27	KRISHNAN et al.	
	2	20090074280	A1	2009-03-19	LU et al.	
	3	20090088640	A1	2009-04-02	PARK et al.	
	4	20110082371	A1	2011-04-07	Tomoaki CHONO	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

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]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2018-10-22
	First Named Inventor	ABOLMAESUMI et al.
	Art Unit	
	Examiner Name	
	Attorney Docket Number	CRB313

	1							

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

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]
	1	CANADIAN INTELLECTUAL PROPERTY OFFICE, International Search Report and Written Opinion of the International Searching Authority in PCT/CA2017/050496, dated July 13, 2017, which is the international application to this U.S. application.	

If you wish to add additional non-patent literature document citation information please click the Add button Add

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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2018-10-22
	First Named Inventor	ABOLMAESUMI et al.
	Art Unit	
	Examiner Name	
	Attorney Docket Number	CRB313

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	/Dave Bourgeau/	Date (YYYY-MM-DD)	2018-10-22
Name/Print	Dave BOURGEAU	Registration Number	72711

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.**

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 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.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	ECHOCARDIOGRAPHIC IMAGE ANALYSIS
First Named Inventor/Applicant Name:	Purang ABOLMAESUMI
Filer:	David Charles Bourgeau III/Amy Kuntz-Presting
Attorney Docket Number:	CRB313

Filed as Small Entity

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

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
BASIC NATIONAL STAGE FEE	2631	1	150	150
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**150**

Electronic Acknowledgement Receipt	
EFS ID:	34073378
Application Number:	16095601
International Application Number:	PCT/CA2017/050496
Confirmation Number:	6264
Title of Invention:	ECHOCARDIOGRAPHIC IMAGE ANALYSIS
First Named Inventor/Applicant Name:	Purang ABOLMAESUMI
Customer Number:	157691
Filer:	David Charles Bourgeau III/Amy Kuntz-Presting
Filer Authorized By:	David Charles Bourgeau III
Attorney Docket Number:	CRB313
Receipt Date:	22-OCT-2018
Filing Date:	
Time Stamp:	16:41:37
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$150
RAM confirmation Number	102318INTEFSW16424800
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	Application Data Sheet	WebADS.pdf	137935 617dd0c7cfbe0558d2fdd2a37cd6f81ee1670398	no	8
Warnings:					
Information:					
2	Transmittal of New Application	20181022_371_Transmittal_CRB313.pdf	286959 5b34e8d603a70a4bd3f01bd01bf1ad05a279c312	no	4
Warnings:					
Information:					
3		20181022_US_Natl_Phase_Patent_Application_CRB313.pdf	273241 3aba53ddde3b679ba7bb11cd6e46826e40b9f636	yes	68

Multipart Description/PDF files in .zip description

Document Description	Start	End
Abstract	68	68
Claims	48	67
Specification	1	47

Warnings:					
Information:					
4	Drawings-only black and white line drawings	20181022_Drawings_CRB313.pdf	890514 6c57ce1dc7529d428b1266498b758fadcc205740	no	20
Warnings:					
Information:					
5	Documents submitted with 371 Applications	20181022_Docs_ISO_371_PUBLISHED_PCT_Application_Under_WO2017181288A1_CRB313.pdf	5274331 4a34c8f7dcca90dd45906f3509fb707428adaae7	no	90

Warnings:					
Information:					
6	Documents submitted with 371 Applications	20181022_Docs_ISO_371_ISR_Provided_CRB313.pdf	3060139 a549923568dc15ad698df745ca215ebc1a9937e5	no	4
Warnings:					
Information:					
7	Documents submitted with 371 Applications	20181022_Docs_ISO_371_Priority_Doc_Transmitted_CRB313.pdf	989317 dcd6c7758d8a767cb0dcde647a10c79eb9c9a44f	no	1
Warnings:					
Information:					
8	Documents submitted with 371 Applications	20181022_Docs_ISO_371_Second_Notice_30_Month_Time_Limit_CRB313.pdf	1050624 a6ebd364e946d5f047339a1a7ab947fadd0a01be	no	1
Warnings:					
Information:					
9	Information Disclosure Statement (IDS) Form (SB08)	20181022_IDS_CRB313.pdf	1034629 685826441b8b3817c9dc3bac41fdcf7b86176a80	no	4
Warnings:					
Information:					
10	Other Reference-Patent/App/Search documents	NPL1_20170713_ISR_and_WO_from_PCTCA2017050496_CRB313.pdf	6260440 18577676bd467f53e3cb10bcf6efad114b967f79	no	8
Warnings:					
Information:					
11	Fee Worksheet (SB06)	fee-info.pdf	29956 2ae269e21a358dce99d98aeec6f4d029a269afb2	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	19288085		

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.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	CRB313
	Application Number	
Title of Invention	ECHOCARDIOGRAPHIC IMAGE ANALYSIS	

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.)

Inventor Information:

Inventor 1

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Purang		ABOLMAESUMI	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Vancouver, British Columbia	Country of Residence i	CA

Mailing Address of Inventor:

Address 1	2123 West 15th Ave		
Address 2			
City	Vancouver, British Columbia	State/Province	OT
Postal Code	V6K 2Y4	Country i	CA

Inventor 2

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Robert		ROHLING	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Vancouver, British Columbia	Country of Residence i	CA

Mailing Address of Inventor:

Address 1	133 West 20th Avenue		
Address 2			
City	Vancouver, British Columbia	State/Province	OT
Postal Code	V5Y 2C4	Country i	CA

Inventor 3

Legal Name

PTO/AIA/14 (08-15)
Approved for use through 04/30/2017. 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	CRB313
	Application Number	
Title of Invention	ECHOCARDIOGRAPHIC IMAGE ANALYSIS	

Prefix	**Given Name**	**Middle Name**	**Family Name**	**Suffix**
	Amir	H.	ABDI	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Vancouver, British Columbia	Country of Residence i	CA

Mailing Address of Inventor:

Address 1	802 - 2725 Melfa Road		
Address 2			
City	Vancouver, British Columbia	**State/Province**	OT
Postal Code	V6T 1N4	**Country** i	CA

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	157691		
Email Address		Add Email	Remove Email

Application Information:

Title of the Invention	ECHOCARDIOGRAPHIC IMAGE ANALYSIS		
Attorney Docket Number	CRB313	**Small Entity Status Claimed**	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	20	**Suggested Figure for Publication (if any)**	19

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country i

PTO/AIA/14 (08-15)
Approved for use through 04/30/2017. 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	CRB313
	Application Number	
Title of Invention	ECHOCARDIOGRAPHIC IMAGE ANALYSIS	

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:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	◯ US Patent Practitioner	◯ Limited Recognition (37 CFR 11.9)		
Customer Number	157691				
Prefix	**Given Name**	Middle Name	**Family Name**	Suffix	Remove
Registration Number					
Prefix	**Given Name**	Middle Name	**Family Name**	Suffix	Remove
Registration Number					

Additional Representative Information blocks may be generated within this form by selecting the **Add** button.

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim 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.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	a 371 of international	PCT/CA2017/050496	2017-04-21

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	CRB313
	Application Number	
Title of Invention	ECHOCARDIOGRAPHIC IMAGE ANALYSIS	

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCT/CA2017/050496	Claims benefit of provisional	62/325,779	2016-04-21
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.			

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. 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. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.			

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	CRB313
	Application Number	
Title of Invention	ECHOCARDIOGRAPHIC IMAGE ANALYSIS	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

PTO/AIA/14 (08-15)
Approved for use through 04/30/2017. 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	CRB313
	Application Number	
Title of Invention	ECHOCARDIOGRAPHIC IMAGE ANALYSIS	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◉ Assignee	○ Legal Representative under 35 U.S.C. 117	○ Joint Inventor
○ Person to whom the inventor is obligated to assign.	○ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:	

If the Applicant is an Organization check here. ☒

Organization Name	THE UNIVERSITY OF BRITISH COLUMBIA

Mailing Address Information For Applicant:

Address 1	c/o University - Industry Liaison Office,		
Address 2	#103 - 6109 Agronomy Road		
City	Vancouver, British Columbia	**State/Province**	OT
Country[i]	CA	Postal Code	V6T 1Z3
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button.

PTO/AIA/14 (08-15)
Approved for use through 04/30/2017. 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	CRB313
	Application Number	
Title of Invention	ECHOCARDIOGRAPHIC IMAGE ANALYSIS	

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

If the Assignee or Non-Applicant Assignee is an Organization check here. ☒

Organization Name	THE UNIVERSITY OF BRITISH COLUMBIA

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1	c/o University - Industry Liaison Office,		
Address 2	#103 - 6109 Agronomy Road		
City	Vancouver, British Columbia	**State/Province**	OT
Country i	CA	Postal Code	V6T 1Z3
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	CRB313
	Application Number	
Title of Invention	ECHOCARDIOGRAPHIC IMAGE ANALYSIS	

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e. g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Dave Bourgeau/			Date (YYYY-MM-DD)	
First Name	Dave	Last Name	BOURGEAU	Registration Number	72711

Additional Signature may be generated within this form by selecting the Add button.

PCT REQUEST

Print Out (Original in Electronic Form)

0	**For receiving Office use only**	
0-1	International Application No.	PCT/CA2017/050496
0-2	International Filing Date	21 April 2017 (21.04.2017)
0-3	Name of receiving Office and "PCT International Application"	RO/CA

0-4	**Form PCT/RO/101 PCT Request**	
0-4-1	Prepared Using	ePCT-Filing Version 4.0.005 MT/FOP 20151028/0.20.5.24
0-5	**Petition** The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	**Receiving Office (specified by the applicant)**	Canadian Intellectual Property Office (RO/CA)
0-7	**Applicant's or agent's file reference**	P1496PC00
I	**Title of Invention**	ECHOCARDIOGRAPHIC IMAGE ANALYSIS
II	**Applicant**	
II-1	This person is	Applicant only
II-2	Applicant for	All designated States
II-4	Name	THE UNIVERSITY OF BRITISH COLUMBIA
II-5	Address	c/o University - Industry Liaison Office #103 - 6190 Agronomy Road Vancouver, British Columbia V6T 1Z3 Canada
II-6	State of nationality	CA
II-7	State of residence	CA
II-10	e-mail	patents@carbonpatents.org
II-10(a)	E-mail authorization The receiving Office, the International Searching Authority, the International Bureau and the International Preliminary Examining Authority are authorized to use this e-mail address, if the Office or Authority so wishes, to send notifications issued in respect of this international application:	as advance copies followed by paper notifications

PCT REQUEST

Print Out (Original in Electronic Form)

III-1	**Applicant and/or inventor**	
III-1-1	This person is	Inventor only
III-1-3	Inventor for	All designated States
III-1-4	Name (LAST, First)	ABOLMAESUMI, PURANG
III-1-5	Address	2123 West 15th Ave Vancouver, British Columbia V6K 2Y4 Canada
III-2	**Applicant and/or inventor**	
III-2-1	This person is	Inventor only
III-2-3	Inventor for	All designated States
III-2-4	Name (LAST, First)	ROHLING, ROBERT
III-2-5	Address	133 West 20th Avenue Vancouver, British Columbia V5Y 2C4 Canada
III-3	**Applicant and/or inventor**	
III-3-1	This person is	Inventor only
III-3-3	Inventor for	All designated States
III-3-4	Name (LAST, First)	ABDI, AMIR H.
III-3-5	Address	802 - 2725 Melfa Road Vancouver, British Columbia V6T 1N4 Canada
III-4	**Applicant and/or inventor**	
III-4-1	This person is	Inventor only
III-4-3	Inventor for	All designated States
III-4-4	Name (LAST, First)	TSANG, TERESA S. M.
III-4-5	Address	1225 West 20 Street Vancouver, British Columbia V7P 2B8 Canada

PCT REQUEST

Print Out (Original in Electronic Form)

IV-1	**Agent or common representative; or address for correspondence**	
	The person identified below is hereby/ has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	Agent
IV-1-1	Name (LAST, First)	CHARLTON, Graeme H. F.
IV-1-2	Address	Unit 203A - 116 Geary Avenue Toronto, Ontario M6H 4H1 Canada
IV-1-3	Telephone No.	604-839-2180
IV-1-5	e-mail	gcharlton@carbonpatents.org
IV-1-5(a)	E-mail authorization The receiving Office, the International Searching Authority, the International Bureau and the International Preliminary Examining Authority are authorized to use this e-mail address, if the Office or Authority so wishes, to send notifications issued in respect of this international application:	as advance copies followed by paper notifications
IV-1-6	Agent's registration No.	11788
V	**DESIGNATIONS**	
V-1	**The filing of this request constitutes under Rule 4.9(a), the designation of all Contracting States bound by the PCT on the international filing date, for the grant of every kind of protection available and, where applicable, for the grant of both regional and national patents.**	
VI-1	**Priority claim of earlier national application**	
VI-1-1	Filing date	21 April 2016 (21.04.2016)
VI-1-2	Number	62/325,779
VI-1-3	Country or Member of WTO	US
VI-2	**Priority document request**	
	The International Bureau is requested to obtain from a digital library a certified copy of the earlier application(s) identified above as item(s), using, where applicable, the access code(s) indicated:	VI-1 Access code: 1022
VI-3	**Incorporation by reference :**	
	where an element of the international application referred to in Article 11(1)(iii)(d) or (e) or a part of the description, claims or drawings referred to in Rule 20.5(a) is not otherwise contained in this international application but is completely contained in an earlier application whose priority is claimed on the date on which one or more elements referred to in Article 11(1)(iii) were first received by the receiving Office, that element or part is, subject to confirmation under Rule 20.6, incorporated by reference in this international application for the purposes of Rule 20.6.	

PCT REQUEST

Print Out (Original in Electronic Form)

VII-1	**International Searching Authority Chosen**	Canadian Intellectual Property Office (ISA/CA)	
VIII	**Declarations**	Number of declarations	
VIII-1	Declaration as to the identity of the inventor	–	
VIII-2	Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent	–	
VIII-3	Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application	–	
VIII-4	Declaration of inventorship (only for the purposes of the designation of the United States of America)	–	
VIII-5	Declaration as to non-prejudicial disclosures or exceptions to lack of novelty	–	
IX	**Check list**	Number of sheets	Electronic file(s) attached
IX-1	Request (including declaration sheets)	5	✓
IX-2	Description	47	✓
IX-3	Claims	18	✓
IX-4	Abstract	1	✓
IX-5	Drawings	20	✓
IX-7	TOTAL	91	
	Accompanying Items	Paper document(s) attached	Electronic file(s) attached
IX-8	Fee calculation sheet	–	✓
IX-19	Other	Cover letter	✓
IX-20	**Figure of the drawings which should accompany the abstract**	1	
IX-21	**Language of filing of the international application**	English	
X-1	**Signature of applicant, agent or common representative**	/Graeme H. F. Charlton/	
X-1-1	Name (LAST, First)	CHARLTON, Graeme H. F.	
X-1-3	Capacity (if such capacity is not obvious from reading the request)	Agent	

PCT REQUEST

Print Out (Original in Electronic Form)

FOR RECEIVING OFFICE USE ONLY

10-1	**Date of actual receipt of the purported international application**	21 April 2017 (21.04.2017)
10-2	**Drawings:**	
10-2-1	Received	
10-2-2	Not received	
10-3	**Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application**	
10-4	**Date of timely receipt of the required corrections under PCT Article 11(2)**	
10-5	**International Searching Authority**	ISA/CA
10-6	**Transmittal of search copy delayed until search fee is paid**	

FOR INTERNATIONAL BUREAU USE ONLY

11-1	**Date of receipt of the record copy by the International Bureau**	

OPIC Notes de l'examen / CIPO Examination Notes

Ce document est un supplément d'information aux RRI et OE / This document is a supplement to the information contained in the ISR and WO.

1. Renseignements généraux / General Information			
No. de la demande/ Application No.	**PCT/CA2017/050496**	Date de dépôt / Filing Date	21 April 2017 (21-04-2017)
No. de référence / Reference Number	P1496PC00	Date de priorité / Priority Date	21 April 2016 (21-04-2016)
Déposant / Applicant	THE UNIVERSITY OF BRITISH COLUMBIA		
CIB / IPC	IPC: ***A61B 8/00*** (2006.01) , ***A61B 8/06*** (2006.01) , ***A61B 8/14*** (2006.01) , ***G06N 3/08*** (2006.01) ,		
Titre / Title	ECHOCARDIOGRAPHIC IMAGE ANALYSIS		

2. Détails de la recherche / Search Details		Ch. I
	(Cocher toutes les cases pertinentes) / (check all that apply)	*Commentaires / Comments*
restrictions de dates / date restrictions	◉ Date de dépôt / Filing ○ Aucune / None	*(détails / details)* Priority Date: 21 April 2016
Antériorités relevées par le déposant ont été considérées / prior art noted by applicant considered	○ Oui / Yes ◉ SO / N/A	*(détails / details)*
Divulgations antérieures par le déposant et l'inventeur(s) ont été considérées / applicant and inventor(s) prior disclosures considered	◉ Oui / Yes ○ SO / N/A	*(détails / details)*

3. Documentation de la recherche / Search Documentation

(Indiquer clairement les bases de données /les outils de recherche utilisés et ajouter les chaînes de recherche/l'historique de recherche/stratégies de recherche) / (Clearly identify database(s) /search tool(s) used and append search strings/search history/search strategy)

Questel Orbit
(echocardiograph+ AND images AND assess+ AND (categor+ OR classif+) AND (neural 2D network))/TI/AB/IW/CLMS/DESC/ODES/TX
Result = 109
(abolmaesumi D purang)/IN/OIN/INH/INV
Result = 10
(rohling D robert)/IN/OIN/INH/INV
Result = 17
(abdi D amir)/IN/OIN/INH/INV
Result = 1
(tsang D teresa)/IN/OIN/INH/INV
Result = 0

Intellect
(A61B 8/00 <IN> ipc) <AND> (filing-date <= 2017-04-21 <AND> filing-date >= 2012-04-21)
Result = 110
echocardiograph* <AND> images <AND> assess* <AND> categor* <AND> (neural <NEAR/2> network)
Result = 19
(abolmaesumi <IN> inventor) <AND> (purang <IN> inventor)
Result = 5
(rohling <IN> inventor) <AND> (robert <IN> inventor)
Result = 2
(abdi <IN> inventor) <AND> (amir <IN> inventor)
Result = 0
(tsang <IN> inventor) <AND> (teresa <IN> inventor)
Result = 0

Google Patents

echocardiograph$ AND images AND assess$ AND categor$ AND (neural network)
Result = 218
Inventor:"abolmaesumi purang"
Result = 8
inventor:"rohling robert"
Result = 16
inventor:"abdi amir"
Result = 1
inventor:"abdi amir"
Result = 0

IEEE Xplore
echocardiograph* AND (categor* OR classif*) AND neural AND train*
Result = 33

4. Documents pertinents identifiés / Relevant Documents Found

(En plus des documents cités par le RRI, d'autres documents qui pourraient s'avérer pertinents lors d'un traitement supplémentaire (p.ex., Chapitre II) peuvent être inclus. Les documents devraient être identifiés en tant que document X, Y ou A. Cependant, une explication supplémentaire de chaque document n'est pas nécessaire. / In addition to the documents cited in the ISR, other documents which may be considered relevant in further prosecution (e.g. Ch. II) may be included. Documents should be identified as either X, Y or A document, however, no further explanation of each document is necessary.)

List of "X" document:

US 2009/0088640 (PARK et al.) 2 April 2009 (02-04-2009)

List of "Y" document:

US 2005/0020903 (KRISHNAN et al.) 27 January 2005 (27-01-2005)

5. CIB additionels / Additional IPCs

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
16/095,601	10/22/2018		150	CRB313	35	6

CONFIRMATION NO. 6264

157691
KOLITCH ROMANO LLP
520 SW Yamhill Street, Suite 200
Portland, OR 97204

FILING RECEIPT

OC000000105301089

Date Mailed: 01/25/2019

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**

Inventor(s)

Purang ABOLMAESUMI, Vancouver, BC, CANADA;
Robert ROHLING, Vancouver, BC, CANADA;
Amir H. ABDI, Vancouver, BC, CANADA;

Applicant(s)

THE UNIVERSITY OF BRITISH COLUMBIA, Vancouver, BC, CANADA;

Assignment For Published Patent Application

THE UNIVERSITY OF BRITISH COLUMBIA, Vancouver, BC, CANADA

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a 371 of PCT/CA2017/050496 04/21/2017
which claims benefit of 62/325,779 04/21/2016

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 01/23/2019

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/095,601**

Projected Publication Date: 05/02/2019

Non-Publication Request: No

Early Publication Request: No
** **SMALL ENTITY** **
Title

ECHOCARDIOGRAPHIC IMAGE ANALYSIS

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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 (1-866-999-4258).

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).

SelectUSA

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 U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 16/095,601

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	150		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	260		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	380		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	39 minus 20 =	* 19	x 50 =	950	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	6 minus 3 =	* 3	x 230 =	690			
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).			0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				410			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	2840		TOTAL	

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($)	ADDITIONAL FEE($)	OR	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

U.S. APPLICATION NUMBER NO.	FIRST NAMED INVENTOR	ATTY. DOCKET NO.
16/095,601	Purang ABOLMAESUMI	CRB313

157691
KOLITCH ROMANO LLP
520 SW Yamhill Street, Suite 200
Portland, OR 97204

INTERNATIONAL APPLICATION NO.	
PCT/CA2017/050496	
I.A. FILING DATE	PRIORITY DATE
04/21/2017	04/21/2016

CONFIRMATION NO. 6264
371 FORMALITIES LETTER

OC000000105301090

Date Mailed: 01/25/2019

Notification of Insufficiency Under 37 CFR 1.492 and/or 1.495 (DO/EO/US)

The following items have been submitted by the applicant or the International Bureau to the United States Patent and Trademark Office as a Designated / Elected Office (37 CFR 1.495).

- Indication of Small Entity Status
- Priority Document
- Copy of the International Application filed on 10/22/2018
- Copy of the International Search Report filed on 10/22/2018
- Information Disclosure Statements filed on 10/22/2018
- U.S. Basic National Fees filed on 10/22/2018
- Authorize Access to Search Results filed on 10/22/2018
- Priority Documents filed on 10/22/2018
- Authorization to Permit Access filed on 10/22/2018
- Application Data Sheet (37 CFR 1.76) filed on 10/22/2018

The following items **MUST** be furnished within the period set forth below:

- Additional claim fees of $**2050** as a small entity, including any required multiple dependent claim fee, are required. Applicant must submit the additional claim fees or cancel the additional claims for which fees are due.
- To avoid abandonment, a surcharge (for late submission of search fee, examination fee or inventor's oath or declaration) as set forth in 37 CFR 1.492(h) of $70 for a small entity in compliance with 37 CFR 1.27 , must be submitted with the missing items identified in this letter.

SUMMARY OF FEES DUE:

Total additional fees required for this application is $**2760** for a Small Entity:
- $**70** Surcharge.

Applicant is notified that the above-identified application contains the deficiencies noted below. No period for reply is set forth in this notice for correction of these deficiencies. However, if a deficiency relates to the inventor's oath or declaration, the applicant must file an oath or declaration in compliance with 37 CFR 1.63, or a substitute statement in compliance with 37 CFR 1.64, executed by or with respect to each actual inventor no later than the expiration of the time period set in the "Notice of Allowability" to avoid abandonment. See 37 CFR 1.495(c).

- Properly executed inventor's oath or declaration for the following inventor(s) has not been submitted: **Purang ABOLMAESUMI**, **Robert ROHLING**, and **Amir H. ABDI**
- The application search fee has not been paid. Applicant must submit $**260** to complete the search fee. Note a surcharge will be required if submitted later than commencement of the national stage (37 CFR 1.492(h)).

FORM PCT/DO/EO/923 (371 Formalities Notice)

- The application examination fee has not been paid. Applicant must submit $**380** to complete the examination fee for a small entity in compliance with 37 CFR 1.27. Note a surcharge will be required if submitted later than commencement of the national stage (37 CFR 1.492(h)) and the basic national fee was not paid before July 1, 2005.

Total additional claim fee(s) for this application is $**2050**
- $**690** for **3** independent claims over 3.
- $**950** for **19** total claims over 20.
- $**410** for multiple dependent claim surcharge.

ALL OF THE ITEMS SET FORTH ABOVE MUST BE SUBMITTED WITHIN TWO (2) MONTHS FROM THE DATE OF THIS NOTICE. FAILURE TO PROPERLY RESPOND WILL RESULT IN ABANDONMENT.

The time period set above may be extended by filing a petition and fee for extension of time under the provisions of 37 CFR 1.136(a).

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)

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web.
https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

For more information about EFS-Web please call the USPTO Electronic Business Center at **1-866-217-9197** or visit our website at http://www.uspto.gov/ebc.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

TONI M HOOD

Telephone: (571) 272-3654

FORM PCT/DO/EO/923 (371 Formalities Notice)

MULTIPLE DEPENDENT CLAIM FEE CALCULATION SHEET

Substitute for Form PTO-1360
(For use with Form PTO/SB/06)

Application Number	Filing Date
16095601	

Applicant(s) Purang ABOLMAESUMI

* 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				
3		2				
4		(1)				
5		(1)				
6		(1)				
7		(1)				
8		(1)				
9		(1)				
10		(1)				
11		(1)				
12		(1)				
13	1					
14		1				
15		2				
16		(1)				
17	1					
18		1				
19		2				
20		(1)				
21		(1)				
22		(1)				
23		(1)				
24		(1)				
25		(1)				
26		(1)				
27		(1)				
28		(1)				
29	1					
30		1				
31		2				
32		(1)				
33		(1)				
34	1					
35	1					
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
Total Indep	6		0		0	
Total Depend	33	↵	0	↵	0	↵
Total Claims	39		0		0	

	*		*		*	
	Indep	Depend	Indep	Depend	Indep	Depend
51						
52						
53						
54						
55						
56						
57						
58						
59						
60						
61						
62						
63						
64						
65						
66						
67						
68						
69						
70						
71						
72						
73						
74						
75						
76						
77						
78						
79						
80						
81						
82						
83						
84						
85						
86						
87						
88						
89						
90						
91						
92						
93						
94						
95						
96						
97						
98						
99						
100						

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor:	Purang ABOLMAESUMI	Dated:	January 30, 2019
Applicant:	The University of British Columbia	Attorney Docket:	CRB313
Filing/371:	October 22, 2018	Art Unit:	---
Serial No.:	16/095,601	Examiner:	---

For: **ECHOCARDIOGRAPHIC IMAGE ANALYSIS**

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

Commissioner:

REQUEST FOR CORRECTION OF INVENTORSHIP UNDER 37 C.F.R. § 1.48

Applicant respectfully requests that inventorship on the above-identified patent application be corrected because it was noted after filing that the Application Data Sheet (ADS) incorrectly failed the provide the fourth inventor. The requested correction to the inventorship is set out below:

CURRENT INVENTORSHIP	CORRECTED INVENTORSHIP (*CHANGES SHOWN*)
Purang ABOLMAESUMI Vancouver, BC (CA)	Purang ABOLMAESUMI Vancouver, BC (CA)
Robert ROHLING Vancouver, BC (CA)	Robert ROHLING Vancouver, BC (CA)
Amir H. ABDI Vancouver, BC (CA)	Amir H. ABDI Vancouver, BC (CA)
	Teresa S.M. TSANG **Vancouver, BC (CA)**

This request is accompanied by (1) a marked-up version of the Application Data Sheet (ADS) originally submitted on October 22, 2018; (2) Declarations executed by the inventors; (3) an executed Power of Attorney signed by Applicant The University of British Columbia; and (4) the $70 processing fee set forth in 1.17(i).

The Commissioner is hereby authorized to charge or credit any deficiencies or over-payments to Deposit Account No. 11-1540. Please contact the undersigned with any questions regarding this filing.

Respectfully submitted,



David Charles BOURGEAU III
Registration No. 72,711
520 SW Yamhill Street, Ste. 200
Portland, Oregon 97204
Telephone: (503) 994-1650
Of Attorneys for Applicant

CERTIFICATE OF EFS-WEB TRANSMISSION

I hereby certify that this correspondence is being transmitted via the U.S. Patent and Trademark Office electronic filing system (EFS-Web) to the USPTO on January 30, 2019.



Amy Elizabeth KUNTZ-PRESTING

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. 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	CRB313
	Application Number	
Title of Invention	ECHOCARDIOGRAPHIC IMAGE ANALYSIS	

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.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Purang		ABOLMAESUMI	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Vancouver, British Columbia	Country of Residence [i]	CA

Mailing Address of Inventor:

Address 1	2123 West 15th Ave		
Address 2			
City	Vancouver	State/Province	BC
Postal Code	V6K 2Y4	Country [i]	CA

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Robert		ROHLING	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Vancouver, British Columbia	Country of Residence [i]	CA

Mailing Address of Inventor:

Address 1	133 West 20th Avenue		
Address 2			
City	Vancouver	State/Province	BC
Postal Code	V5Y 2C4	Country [i]	CA

Inventor 3 Remove

Legal Name

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	CRB313
	Application Number	
Title of Invention	ECHOCARDIOGRAPHIC IMAGE ANALYSIS	

Prefix	Given Name	Middle Name	Family Name	Suffix
	Amir	H.	ABDI	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Vancouver, British Columbia	Country of Residence [i]	CA

Mailing Address of Inventor:

Address 1	802 - 2725 Melfa Road		
Address 2			
City	Vancouver	State/Province	BC
Postal Code	V6T 1N4	Country [i]	CA

Inventor 4 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Teresa	**S. M.**	**TSANG**	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	**Vancouver, BC**	Country of Residence [i]	**CA**

Mailing Address of Inventor:

Address 1	**1225 West 20 Street**		
Address 2			
City	**Vancouver**	State/Province	**BC**
Postal Code	**V7P 2B8**	Country [i]	**CA**

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	157691		
Email Address		Add Email	Remove Email

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	CRB313
	Application Number	
Title of Invention	ECHOCARDIOGRAPHIC IMAGE ANALYSIS	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/David Bourgeau/			Date (YYYY-MM-DD)	2019-01-30
First Name	David	Last Name	BOURGEAU III	Registration Number	72711

Additional Signature may be generated within this form by selecting the Add button.

PTO/AIA/01 (06-12)
Approved for use through 11/30/2020. 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 displays a valid OMB control number.

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	ECHOCARDIOGRAPHIC IMAGE ANALYSIS

As the below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☒ United States application or PCT international application number 16/095,601 filed on October 22, 2018.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Purang ABOLMAESUMI Date (Optional): 10/29/2018

Signature: _____

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. 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 1 minute 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.

PTO/AIA/01 (06-12)
Approved for use through 11/30/2020. 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 displays a valid OMB control number.

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	ECHOCARDIOGRAPHIC IMAGE ANALYSIS

As the below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☒ United States application or PCT international application number 16/095,601

filed on October 22, 2018.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Robert ROHLING Date (Optional): _____

Signature: _____

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. 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 1 minute 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.

PTO/AIA/01 (06-12)
Approved for use through 11/30/2020. 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 displays a valid OMB control number.

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	ECHOCARDIOGRAPHIC IMAGE ANALYSIS

As the below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☒ United States application or PCT international application number 16/095,601 filed on October 22, 2018.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Amir H. ABDI Date (Optional): Oct 21, 2018

Signature:

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. 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 1 minute 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.

PTO/AIA/01 (06-12)
Approved for use through 11/30/2020. 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 displays a valid OMB control number.

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	ECHOCARDIOGRAPHIC IMAGE ANALYSIS

As the below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☒ United States application or PCT international application number 16/095,601 filed on October 22, 2018.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Teresa S. M. TSANG Date (Optional): 29-Oct-2018

Signature: Tsang

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. 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 1 minute 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.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82A (07-13)
Approved for use through 01/31/2018. OMB 0651-0035
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 displays a valid OMB control number.

TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	
Filing Date	January 28, 2019
First Named Inventor	Jode Robert Alan HIMANN
Title	Processing User Provided Information for Ranking Information Modules
Art Unit	
Examiner Name	
Attorney Docket Number	CRB302

SIGNATURE of Applicant or Patent Practitioner

Signature	/David Bourgeau/	Date (Optional)	January 28, 2019
Name	David Charles BOURGEAU III	Registration Number	72711
Title (if Applicant is a juristic entity)	Of Attorneys for Applicant		
Applicant Name (if Applicant is a juristic entity)	1974226 ALBERTA LTD.		

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. 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 3 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.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82B (07-13)
Approved for use through 01/31/2018. OMB 0651-0035
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 displays a valid OMB control number

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 157691

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☑ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

1974226 Alberta Ltd.

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature	[signature]	Date (Optional)	January 1st 2019
Name	Jade Himmi		
Title	CEO		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. 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 3 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.

Electronic Patent Application Fee Transmittal

Application Number:	16095601
Filing Date:	22-Oct-2018
Title of Invention:	ECHOCARDIOGRAPHIC IMAGE ANALYSIS
First Named Inventor/Applicant Name:	Purang ABOLMAESUMI
Filer:	David Charles Bourgeau III/Amy Kuntz-Presting
Attorney Docket Number:	CRB313

Filed as Small 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:				
PROCESSING FEE, EXCEPT PROV. APPLS.	2830	1	70	70
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**70**

Electronic Acknowledgement Receipt	
EFS ID:	35013505
Application Number:	16095601
International Application Number:	
Confirmation Number:	6264
Title of Invention:	ECHOCARDIOGRAPHIC IMAGE ANALYSIS
First Named Inventor/Applicant Name:	Purang ABOLMAESUMI
Customer Number:	157691
Filer:	David Charles Bourgeau III/Amy Kuntz-Presting
Filer Authorized By:	David Charles Bourgeau III
Attorney Docket Number:	CRB313
Receipt Date:	30-JAN-2019
Filing Date:	22-OCT-2018
Time Stamp:	21:50:50
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$70
RAM confirmation Number	013119INTEFSW00017519602562
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	Request under Rule 48 correcting inventorship	20190130_Request_for_Correction_of_Inventorship_under_37CFR148_CRB313.pdf	137294 71f6e7e2aa656812a17c5b8033c7d18a30f1727c	no	2
Warnings:					
Information:					
2	Application Data Sheet	20190130_ADS_Marked-Up_for_Correcting_Inventorship_CRB313.pdf	96160 3e4cd1434ee613bb619d18df9ffcf3d282f00796	no	3
Warnings:					
Information:					
This is not an USPTO supplied ADS fillable form					
3	Oath or Declaration filed	20190130_Declaration_1_of_4_ABOLMAESUMI_CRB313.pdf	104981 1f44b16a6a40be921a735f262d970d3eb1ad58e2	no	1
Warnings:					
Information:					
4	Oath or Declaration filed	20190130_Declaration_2_of_4_ROHLING_CRB313.pdf	104062 d2ff4948e84e142ef82e2cc45dd9edc751333bde	no	1
Warnings:					
Information:					
5	Oath or Declaration filed	20190130_Declaration_3_of_4_ABDI_CRB313.pdf	137222 995fba46134319e42715a346f1654b70587f5b09	no	1
Warnings:					
Information:					
6	Oath or Declaration filed	20190130_Declaration_4_of_4_TSANG_CRB313.pdf	105930 3c785b5e304614ebe41aed0adf5b315f8ae4aac2	no	1
Warnings:					

Information:					
7	Power of Attorney	20190128_POA_CRB302.pdf	790135 416b335b8e05e327af812ea72421cdbc08e13887	no	2
Warnings:					
Information:					
8	Fee Worksheet (SB06)	fee-info.pdf	30732 af4848816958070b8eea4b8590800630b5f14320	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	1506516	

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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor:	Purang ABOLMAESUMI	Dated:	March 15, 2019
Applicant:	The University Of British Columbia	Attorney Docket:	CRB313
Filing/371:	October 22, 2018	Group Art Unit:	3737
Serial No.:	16/095,601	Examiner:	---

For: **ECHOCARDIOGRAPHIC IMAGE ANALYSIS**

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

Commissioner:

Applicant preliminarily amends the above-identified application as follows:

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

Amendments to the Claims begin on page 14 of this paper.

Remarks begin on page 22 of this paper.

Amendments to the Specification

Please make the following amendments to the specification. Material to be inserted in replacement paragraphs or sections is in **bold and underline**, and material to be deleted is in ~~strikethrough~~ or (if the deletion is of five or fewer consecutive characters or would be difficult to see) in double brackets [[ ]].

Please add the paragraphs below after the final paragraph on page 47 of the application, prior to the claims:

The series of paragraphs below recites various illustrative combinations of features of the present disclosure. These paragraphs are intended to represent a non-limiting presentation of suitable combinations, and are alphanumerically designated for clarity and efficiency:

A0. A computer-implemented system for facilitating echocardiographic image analysis, the system comprising at least one processor configured to:

receive signals representing a first at least one echocardiographic image;

associate the first at least one echocardiographic image with a first view category of a plurality of predetermined echocardiographic image view categories;

determine, based on the first at least one echocardiographic image and the first view category, a first quality assessment value representing a view category specific quality assessment of the first at least one echocardiographic image;

produce signals representing the first quality assessment value for causing the first quality assessment value to be associated with the first at least one echocardiographic image;

receive signals representing a second at least one echocardiographic image;

associate the second at least one echocardiographic image with a second view category of the plurality of predetermined echocardiographic image view categories, said second view category being different from the first view category;

determine, based on the second at least one echocardiographic image and the second view category, a second quality assessment value representing a view category specific quality assessment of the second at least one echocardiographic image; and

produce signals representing the second quality assessment value for causing the second quality assessment value to be associated with the second at least one echocardiographic image.

A1. The system of paragraph A0 wherein the first quality assessment value represents an assessment of suitability of the first at least one echocardiographic image for quantified clinical measurement of anatomical features and wherein the second quality assessment value represents an assessment of suitability of the second at least one echocardiographic image for quantified measurement of anatomical features.

A2. The system of paragraph A0 or A1 wherein the at least one processor is configured to:

produce signals for causing a representation of the first quality assessment value to be transmitted to at least one display for causing the at least one display to display the first quality assessment value in association with the first at least one echocardiographic image, to assist one or more operators of an echocardiographic device in capturing at least one subsequent echocardiographic image; and

produce signals for causing a representation of the second quality assessment value to be transmitted to the at least one display for causing the at least one display to display the second quality assessment value in association with the second at least one echocardiographic image, to assist the one or more operators in capturing at least one subsequent echocardiographic image.

A3. The system of any one of paragraphs A0 to A2 wherein the at least one processor is configured to:

apply one or more view categorization functions to the first at least one echocardiographic image to determine that the first at least one echocardiographic image falls within the first view category; and

apply one or more view categorization functions to the second at least one echocardiographic image to determine that the second at least one echocardiographic image falls within the second view category.

A4. The system of any one of paragraphs A0 to A3 wherein the first at least one echocardiographic image comprises a plurality of echocardiographic images and

wherein the at least one processor is configured to determine the first quality assessment value by determining a single quality assessment value representing a view category specific assessment of the plurality of echocardiographic images.

A5. The system of any one of paragraphs A0 to A4 wherein each of the plurality of predetermined echocardiographic image view categories is associated with a respective set of assessment parameters and wherein the at least one processor is configured to:

determine that a first set of assessment parameters of the sets of assessment parameters is associated with the first view category;

in response to determining that the first set of assessment parameters is associated with the first view category, apply a first function based on the first set of assessment parameters to the first at least one echocardiographic image;

determine that a second set of assessment parameters of the sets of assessment parameters is associated with the second view category; and

in response to determining that the second set of assessment parameters is associated with the second view category, apply a second function based on the second set of assessment parameters to the second at least one echocardiographic image.

A6. The system of paragraph A5 wherein each of the sets of assessment parameters includes:

a set of common assessment parameters, which are common to each of the sets of assessment parameters; and

a set of view category specific assessment parameters, which are unique to the set of assessment parameters.

A7. The system of paragraph A5 or A6 wherein each of the sets of assessment parameters is a set of neural network parameters that defines a neural network having a plurality of layers including an input layer configured to receive one or more echocardiographic images and an output layer configured to output one or more quality assessment values and wherein the at least one processor is configured to:

apply the first function based on the first set of assessment parameters to the first at least one echocardiographic image by inputting the first at least one echocardiographic image into the neural network defined by the first set of assessment parameters; and

apply the second function based on the second set of assessment parameters to the second at least one echocardiographic image by inputting the second at least one echocardiographic image into the neural network defined by the second set of assessment parameters.

A8. The system of paragraph A7 wherein the at least one processor is configured to train the neural networks by:

receiving signals representing a plurality of echocardiographic training images, each of the plurality of echocardiographic training images associated with one of the plurality of predetermined echocardiographic image view categories;

receiving signals representing respective expert quality assessment values representing view category specific quality assessments of the plurality of echocardiographic training images, each of the expert quality assessment values provided by an expert echocardiographer and associated with one of the plurality of echocardiographic training images; and

training the neural networks using the plurality of echocardiographic training images as inputs and the associated expert quality assessment values as desired outputs to determine the sets of neural network parameters defining the neural networks.

A9. The system of paragraph A8 wherein each of the expert quality assessment values represents an assessment of suitability of the associated echocardiographic image for quantified clinical measurement of anatomical features.

A10. The system of paragraph A8 or A9 wherein the at least one processor is configured to derive each of the expert quality assessment values at least in part from a clinical plane assessment value representing an expert opinion whether the associated echocardiographic training image was taken in an anatomical plane suitable for quantified clinical measurement of anatomical features.

A11. The system of any one of paragraphs A8 to A10 wherein each of the sets of neural network parameters includes:

a set of common neural network parameters, which are common to each of the sets of neural network parameters; and

a set of view category specific neural network parameters, which are unique to the set of neural network parameters; and

wherein the at least one processor is configured to, for each echocardiographic training image:

select one of the sets of view category specific neural network parameters based on the predetermined echocardiographic image view category associated with the echocardiographic training image; and

using the echocardiographic training image as an input and the associated expert quality assessment values as a desired output, train a neural network defined by the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters to update the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters.

B0. A computer-implemented system for training neural networks to facilitate echocardiographic image analysis, the system comprising at least one processor configured to:

receive signals representing a plurality of echocardiographic training images, each of the plurality of echocardiographic training images associated with one of a plurality of predetermined echocardiographic image view categories;

receive signals representing expert quality assessment values representing view category specific quality assessments of the plurality of echocardiographic training images, each of the expert quality assessment values provided by an expert echocardiographer and associated with one of the plurality of echocardiographic training images; and

train the neural networks using the plurality of echocardiographic training images and the associated expert quality assessment values to determine sets of neural network parameters defining the neural networks, at least a portion of each of said neural networks associated with one of the plurality of predetermined echocardiographic image view categories.

B1. The system of paragraph B0 wherein each of the expert quality assessment values represents an assessment of suitability of the associated echocardiographic image for quantified clinical measurement of anatomical features.

B2. The system of paragraph B0 or B1 wherein the at least one processor is configured to derive each of the expert quality assessment values at least in part from a clinical plane assessment value representing an expert opinion whether the associated echocardiographic training image was taken in an anatomical plane suitable for a quantified clinical measurement of anatomical features.

B3. The system of any one of paragraphs B0 to B2 wherein each of the sets of neural network parameters includes:

a set of common neural network parameters, which are common to each of the sets of neural network parameters; and

a set of view category specific neural network parameters, which are unique to the set of neural network parameters; and

wherein the at least one processor is configured to, for each echocardiographic training image:

select one of the sets of view category specific neural network parameters based on the predetermined echocardiographic image view category associated with the echocardiographic training image; and

using the echocardiographic training image as an input and the associated expert quality assessment value as a desired output, train a neural network defined by the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters to update the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters.

C0. A computer-implemented method of facilitating echocardiographic image analysis, the method comprising:

receiving signals representing a first at least one echocardiographic image;

associating the first at least one echocardiographic image with a first view category of a plurality of predetermined echocardiographic image view categories;

determining, based on the first at least one echocardiographic image and the first view category, a first quality assessment value representing a view category specific quality assessment of the first at least one echocardiographic image;

producing signals representing the first quality assessment value for causing the first quality assessment value to be associated with the first at least one echocardiographic image;

receiving signals representing a second at least one echocardiographic image;

associating the second at least one echocardiographic image with a second view category of the plurality of predetermined echocardiographic image view categories, said second view category being different from the first view category;

determining, based on the second at least one echocardiographic image and the second view category, a second quality assessment value representing a view category specific quality assessment of the second at least one echocardiographic image; and

producing signals representing the second quality assessment value for causing the second quality assessment value to be associated with the second at least one echocardiographic image.

C1. The method of paragraph C0 wherein the first quality assessment value represents an assessment of suitability of the first at least one echocardiographic image for quantified clinical measurement of anatomical features and wherein the second quality assessment value represents an assessment of suitability of the second at least one echocardiographic image for quantified measurement of anatomical features.

C2. The method of paragraph C0 or C1 wherein:

producing the signals representing the first quality assessment value comprises producing signals for causing a representation of the first quality assessment value to be transmitted to at least one display for causing the at least one display to display the first quality assessment value in association with the first at least one echocardiographic image, to assist one or more operators of an echocardiographic device in capturing at least one subsequent echocardiographic image; and

producing the signals representing the second quality assessment value comprises producing signals for causing a representation of the second quality assessment value to be transmitted to the at least one display for causing the at least one display to display the second quality assessment value in association with the second at least one echocardiographic image, to assist the one or more operators in capturing at least one subsequent echocardiographic image.

C3. The method of any one of paragraphs C0 to C2 wherein:

associating the first at least one echocardiographic image with the first view category comprises applying one or more view categorization functions to the first at least one echocardiographic image to determine that the first at least one echocardiographic image falls within the first view category; and

associating the second at least one echocardiographic image with the second view category comprises applying one or more view categorization functions to the second at least one echocardiographic image to determine that the second at least one echocardiographic image falls within the second view category.

C4. The method of any one of paragraphs C0 to C3 wherein the first at least one echocardiographic image comprises a plurality of echocardiographic images and wherein determining the first quality assessment value comprises determining a single quality assessment value representing a view category specific assessment of the plurality of echocardiographic images.

C5. The method of any one of paragraphs C0 to C4 wherein each of the plurality of predetermined echocardiographic image view categories is associated with a respective set of assessment parameters and wherein:

determining the first quality assessment value comprises:

determining that a first set of assessment parameters of the sets of assessment parameters is associated with the first view category; and

in response to determining that the first set of assessment parameters is associated with the first view category, applying a first function based on the first set of assessment parameters to the first at least one echocardiographic image; and

determining the second quality assessment value comprises:

determining that a second set of assessment parameters of the sets of assessment parameters is associated with the second view category; and

in response to determining that the second set of assessment parameters is associated with the second view category, applying a second function based on the second set of assessment parameters to the second at least one echocardiographic image.

C6. The method of paragraph C5 wherein each of the sets of assessment parameters includes:

a set of common assessment parameters, which are common to each of the sets of assessment parameters; and

a set of view category specific assessment parameters, which are unique to the set of assessment parameters.

C7. The method of paragraph C5 or C6 wherein each of the sets of assessment parameters is a set of neural network parameters that defines a neural network having a plurality of layers including an input layer configured to receive one or more echocardiographic images and an output layer configured to output one or more quality assessment values and wherein:

applying the first function based on the first set of assessment parameters to the first at least one echocardiographic image comprises inputting the first at least one echocardiographic image into the neural network defined by the first set of assessment parameters; and

applying the second function based on the second set of assessment parameters to the second at least one echocardiographic image comprises inputting the second at least one echocardiographic image into the neural network defined by the second set of assessment parameters.

C8. The method of paragraph C7 further comprising training the neural networks, said training comprising:

receiving signals representing a plurality of echocardiographic training images, each of the plurality of echocardiographic training images associated with one of the plurality of predetermined echocardiographic image view categories;

receiving signals representing respective expert quality assessment values representing view category specific quality assessments of the plurality of echocardiographic training images, each of the expert quality assessment values provided by an expert echocardiographer and associated with one of the plurality of echocardiographic training images; and

training the neural networks using the plurality of echocardiographic training images as inputs and the associated expert quality assessment values as desired outputs to determine the sets of neural network parameters defining the neural networks.

C9. The method of paragraph C8 wherein each of the expert quality assessment values represents an assessment of suitability of the associated echocardiographic image for quantified clinical measurement of anatomical features.

C10. The method of paragraph C8 or C9 further comprising deriving each of the expert quality assessment values at least in part from a clinical plane assessment value representing an expert opinion whether the associated echocardiographic training image was taken in an anatomical plane suitable for quantified clinical measurement of anatomical features.

C11. The method of any one of paragraphs C8 to C10 wherein each of the sets of neural network parameters includes:

a set of common neural network parameters, which are common to each of the sets of neural network parameters; and

a set of view category specific neural network parameters, which are unique to the set of neural network parameters; and

wherein training the neural networks using the plurality of echocardiographic training images and the associated expert quality assessment values comprises, for each echocardiographic training image:

selecting one of the sets of view category specific neural network parameters based on the predetermined echocardiographic image view category associated with the echocardiographic training image; and

using the echocardiographic training image as an input and the associated expert quality assessment values as a desired output, training a neural network defined by the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters to update the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters.

D0. A computer-implemented method of training neural networks to facilitate echocardiographic image analysis, the method comprising:

receiving signals representing a plurality of echocardiographic training images, each of the plurality of echocardiographic training images associated with one of a plurality of predetermined echocardiographic image view categories;

receiving signals representing expert quality assessment values representing view category specific quality assessments of the plurality of echocardiographic training images, each of the expert quality assessment values provided by an expert echocardiographer and associated with one of the plurality of echocardiographic training images; and

training the neural networks using the plurality of echocardiographic training images and the associated expert quality assessment values to determine sets of neural network parameters defining the neural networks, at least a portion of each of said neural networks associated with one of the plurality of predetermined echocardiographic image view categories.

D1. The method of paragraph D0 wherein each of the expert quality assessment values represents an assessment of suitability of the associated echocardiographic image for quantified clinical measurement of anatomical features.

D2. The method of paragraph D0 or D1 further comprising deriving each of the expert quality assessment values at least in part from a clinical plane assessment value

representing an expert opinion whether the associated echocardiographic training image was taken in an anatomical plane suitable for a quantified clinical measurement of anatomical features.

D3. The method of any one of paragraphs D0 to D2 wherein each of the sets of neural network parameters includes:

a set of common neural network parameters, which are common to each of the sets of neural network parameters; and

a set of view category specific neural network parameters, which are unique to the set of neural network parameters; and

wherein training the neural networks using the plurality of echocardiographic training images and the associated expert quality assessment values comprises, for each echocardiographic training image:

selecting one of the sets of view category specific neural network parameters based on the predetermined echocardiographic image view category associated with the echocardiographic training image; and

using the echocardiographic training image as an input and the associated expert quality assessment value as a desired output, training a neural network defined by the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters to update the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters.

D4. A computer readable medium having stored thereon codes which when executed by at least one processor cause the at least one processor to perform the method of any one of paragraphs C0 to D3.

E0. A system for facilitating echocardiographic image analysis, the system comprising:

means for receiving signals representing a first at least one echocardiographic image;

means for associating the first at least one echocardiographic image with a first view category of a plurality of predetermined echocardiographic image view categories;

means for determining, based on the first at least one echocardiographic image and the first view category, a first quality assessment value representing a view category specific quality assessment of the first at least one echocardiographic image;

means for producing signals representing the first quality assessment value for causing the first quality assessment value to be associated with the first at least one echocardiographic image;

means for receiving signals representing a second at least one echocardiographic image;

means for associating the second at least one echocardiographic image with a second view category of the plurality of predetermined echocardiographic image view categories, said second view category being different from the first view category;

means for determining, based on the second at least one echocardiographic image and the second view category, a second quality assessment value representing a view category specific quality assessment of the second at least one echocardiographic image; and

means for producing signals representing the second quality assessment value for causing the second quality assessment value to be associated with the second at least one echocardiographic image.

F0. A system for training neural networks to facilitate echocardiographic image analysis, the system comprising:

means for receiving signals representing a plurality of echocardiographic training images, each of the plurality of echocardiographic training images associated with one of a plurality of predetermined echocardiographic image view categories;

means for receiving signals representing expert quality assessment values representing view category specific quality assessments of the plurality of echocardiographic training images, each of the expert quality assessment values provided by an expert echocardiographer and associated with one of the plurality of echocardiographic training images; and

means for training the neural networks using the plurality of echocardiographic training images and the associated expert quality assessment values to determine sets of neural network parameters defining the neural networks, at least a portion of each of said neural networks associated with one of the plurality of predetermined echocardiographic image view categories.

Amendments to the Claims

This listing of claims replaces all prior versions, and listings, of claims in the application. Material to be inserted is in **bold and underline**, and material to be deleted is in ~~strikeout~~ or (if the deletion is of five or fewer consecutive characters or would be difficult to see) in double brackets [[ ]].

1. (Original) A computer-implemented system for facilitating echocardiographic image analysis, the system comprising at least one processor configured to:

receive signals representing a first at least one echocardiographic image;

associate the first at least one echocardiographic image with a first view category of a plurality of predetermined echocardiographic image view categories;

determine, based on the first at least one echocardiographic image and the first view category, a first quality assessment value representing a view category specific quality assessment of the first at least one echocardiographic image;

produce signals representing the first quality assessment value for causing the first quality assessment value to be associated with the first at least one echocardiographic image;

receive signals representing a second at least one echocardiographic image;

associate the second at least one echocardiographic image with a second view category of the plurality of predetermined echocardiographic image view categories, said second view category being different from the first view category;

determine, based on the second at least one echocardiographic image and the second view category, a second quality assessment value representing a view category specific quality assessment of the second at least one echocardiographic image; and

produce signals representing the second quality assessment value for causing the second quality assessment value to be associated with the second at least one echocardiographic image.

2. (Original) The system of claim 1 wherein the first quality assessment value represents an assessment of suitability of the first at least one echocardiographic image for quantified clinical measurement of anatomical features and wherein the second quality assessment value represents an assessment of suitability of the second at least one echocardiographic image for quantified measurement of anatomical features.

3. (Currently Amended) The system of claim 1 [[or 2]]wherein the at least one processor is configured to:

produce signals for causing a representation of the first quality assessment value to be transmitted to at least one display for causing the at least one display to display the first quality assessment value in association with the first at least one echocardiographic image, to assist one or more operators of an echocardiographic device in capturing at least one subsequent echocardiographic image; and

produce signals for causing a representation of the second quality assessment value to be transmitted to the at least one display for causing the at least one display to display the second quality assessment value in association with the second at least one echocardiographic image, to assist the one or more operators in capturing at least one subsequent echocardiographic image.

4. (Currently Amended) The system of ~~any one of~~ claim[[s]] 1 [[to 3]]wherein the at least one processor is configured to:

apply one or more view categorization functions to the first at least one echocardiographic image to determine that the first at least one echocardiographic image falls within the first view category; and

apply one or more view categorization functions to the second at least one echocardiographic image to determine that the second at least one echocardiographic image falls within the second view category.

5. (Currently Amended) The system of ~~any one of~~ claim[[s]] 1 [[to 4]]wherein the first at least one echocardiographic image comprises a plurality of echocardiographic images and wherein the at least one processor is configured to determine the first quality assessment value by determining a single quality assessment value representing a view category specific assessment of the plurality of echocardiographic images.

6. (Currently Amended) The system of ~~any one of~~ claim[[s]] 1 [[to 5]] wherein each of the plurality of predetermined echocardiographic image view categories is associated with a respective set of assessment parameters and wherein the at least one processor is configured to:

determine that a first set of assessment parameters of the sets of assessment parameters is associated with the first view category;

in response to determining that the first set of assessment parameters is associated with the first view category, apply a first function based on the first set of assessment parameters to the first at least one echocardiographic image;

determine that a second set of assessment parameters of the sets of assessment parameters is associated with the second view category; and

in response to determining that the second set of assessment parameters is associated with the second view category, apply a second function based on the second set of assessment parameters to the second at least one echocardiographic image.

7. (Original) The system of claim 6 wherein each of the sets of assessment parameters includes:

a set of common assessment parameters, which are common to each of the sets of assessment parameters; and

a set of view category specific assessment parameters, which are unique to the set of assessment parameters.

8. (Currently Amended) The system of claim 6 [[or 7]]wherein each of the sets of assessment parameters is a set of neural network parameters that defines a neural network having a plurality of layers including an input layer configured to receive one or more echocardiographic images and an output layer configured to output one or more quality assessment values and wherein the at least one processor is configured to:

apply the first function based on the first set of assessment parameters to the first at least one echocardiographic image by inputting the first at least one echocardiographic image into the neural network defined by the first set of assessment parameters; and

apply the second function based on the second set of assessment parameters to the second at least one echocardiographic image by inputting the second at least one echocardiographic image into the neural network defined by the second set of assessment parameters.

9. (Original) The system of claim 8 wherein the at least one processor is configured to train the neural networks by:

receiving signals representing a plurality of echocardiographic training images, each of the plurality of echocardiographic training images associated with one of the plurality of predetermined echocardiographic image view categories;

receiving signals representing respective expert quality assessment values representing view category specific quality assessments of the plurality of echocardiographic training images, each of the expert quality assessment values provided by an expert echocardiographer and associated with one of the plurality of echocardiographic training images; and

training the neural networks using the plurality of echocardiographic training images as inputs and the associated expert quality assessment values as desired outputs to determine the sets of neural network parameters defining the neural networks.

10. (Original) The system of claim 9 wherein each of the expert quality assessment values represents an assessment of suitability of the associated echocardiographic image for quantified clinical measurement of anatomical features.

11. (Currently Amended) The system of claim 9 ~~or 10~~ wherein the at least one processor is configured to derive each of the expert quality assessment values at least in part from a clinical plane assessment value representing an expert opinion whether the associated echocardiographic training image was taken in an anatomical plane suitable for quantified clinical measurement of anatomical features.

12. (Currently Amended) The system of ~~any one of~~ claim[[s]] 9 ~~to 11~~ wherein each of the sets of neural network parameters includes:

a set of common neural network parameters, which are common to each of the sets of neural network parameters; and

a set of view category specific neural network parameters, which are unique to the set of neural network parameters; and

wherein the at least one processor is configured to, for each echocardiographic training image:

select one of the sets of view category specific neural network parameters based on the predetermined echocardiographic image view category associated with the echocardiographic training image; and

using the echocardiographic training image as an input and the associated expert quality assessment values as a desired output, train a neural network

defined by the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters to update the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters.

13. (Original) A computer-implemented system for training neural networks to facilitate echocardiographic image analysis, the system comprising at least one processor configured to:

receive signals representing a plurality of echocardiographic training images, each of the plurality of echocardiographic training images associated with one of a plurality of predetermined echocardiographic image view categories;

receive signals representing expert quality assessment values representing view category specific quality assessments of the plurality of echocardiographic training images, each of the expert quality assessment values provided by an expert echocardiographer and associated with one of the plurality of echocardiographic training images; and

train the neural networks using the plurality of echocardiographic training images and the associated expert quality assessment values to determine sets of neural network parameters defining the neural networks, at least a portion of each of said neural networks associated with one of the plurality of predetermined echocardiographic image view categories.

14. (Original) The system of claim 13 wherein each of the expert quality assessment values represents an assessment of suitability of the associated echocardiographic image for quantified clinical measurement of anatomical features.

15. (Currently Amended) The system of claim 13 ~~or 14~~ wherein the at least one processor is configured to derive each of the expert quality assessment values at least in part from a clinical plane assessment value representing an expert opinion whether the associated echocardiographic training image was taken in an anatomical plane suitable for a quantified clinical measurement of anatomical features.

16. (Currently Amended) The system of ~~any one of~~ claim[[s]] 13 ~~to 15~~ wherein each of the sets of neural network parameters includes:

a set of common neural network parameters, which are common to each of the sets of neural network parameters; and

a set of view category specific neural network parameters, which are unique to the set of neural network parameters; and

wherein the at least one processor is configured to, for each echocardiographic training image:

select one of the sets of view category specific neural network parameters based on the predetermined echocardiographic image view category associated with the echocardiographic training image; and

using the echocardiographic training image as an input and the associated expert quality assessment value as a desired output, train a neural network defined by the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters to update the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters.

17. (Original) A computer-implemented method of facilitating echocardiographic image analysis, the method comprising:

receiving signals representing a first at least one echocardiographic image;

associating the first at least one echocardiographic image with a first view category of a plurality of predetermined echocardiographic image view categories;

determining, based on the first at least one echocardiographic image and the first view category, a first quality assessment value representing a view category specific quality assessment of the first at least one echocardiographic image;

producing signals representing the first quality assessment value for causing the first quality assessment value to be associated with the first at least one echocardiographic image;

receiving signals representing a second at least one echocardiographic image;

associating the second at least one echocardiographic image with a second view category of the plurality of predetermined echocardiographic image view categories, said second view category being different from the first view category;

determining, based on the second at least one echocardiographic image and the second view category, a second quality assessment value representing a view category specific quality assessment of the second at least one echocardiographic image; and

producing signals representing the second quality assessment value for causing the second quality assessment value to be associated with the second at least one echocardiographic image.

18. (Original) The method of claim 17 wherein the first quality assessment value represents an assessment of suitability of the first at least one echocardiographic image for quantified clinical measurement of anatomical features and wherein the second quality assessment value represents an assessment of suitability of the second at least one echocardiographic image for quantified measurement of anatomical features.

19. (Currently Amended) The method of claim 17 ~~or 18~~ wherein:

producing the signals representing the first quality assessment value comprises producing signals for causing a representation of the first quality assessment value to be transmitted to at least one display for causing the at least one display to display the first quality assessment value in association with the first at least one echocardiographic image, to assist one or more operators of an echocardiographic device in capturing at least one subsequent echocardiographic image; and

producing the signals representing the second quality assessment value comprises producing signals for causing a representation of the second quality assessment value to be transmitted to the at least one display for causing the at least one display to display the second quality assessment value in association with the second at least one echocardiographic image, to assist the one or more operators in capturing at least one subsequent echocardiographic image.

20. (Currently Amended) The method of ~~any one of~~ claim[[s]] 17 ~~to 19~~ wherein:

associating the first at least one echocardiographic image with the first view category comprises applying one or more view categorization functions to the first at least one echocardiographic image to determine that the first at least one echocardiographic image falls within the first view category; and

associating the second at least one echocardiographic image with the second view category comprises applying one or more view categorization functions to the second at least one echocardiographic image to determine that the second at least one echocardiographic image falls within the second view category.

21. (Currently Amended) The method of ~~any one of~~ claim[[s]] 17 ~~to 20~~ wherein the first at least one echocardiographic image comprises a plurality of echocardiographic images and wherein determining the first quality assessment

value comprises determining a single quality assessment value representing a view category specific assessment of the plurality of echocardiographic images.

22. (Currently Amended) The method of ~~any one of~~ claim[[s]] 17 ~~to 21~~ wherein each of the plurality of predetermined echocardiographic image view categories is associated with a respective set of assessment parameters and wherein:

determining the first quality assessment value comprises:

determining that a first set of assessment parameters of the sets of assessment parameters is associated with the first view category; and

in response to determining that the first set of assessment parameters is associated with the first view category, applying a first function based on the first set of assessment parameters to the first at least one echocardiographic image; and

determining the second quality assessment value comprises:

determining that a second set of assessment parameters of the sets of assessment parameters is associated with the second view category; and

in response to determining that the second set of assessment parameters is associated with the second view category, applying a second function based on the second set of assessment parameters to the second at least one echocardiographic image.

23. (Original) The method of claim 22 wherein each of the sets of assessment parameters includes:

a set of common assessment parameters, which are common to each of the sets of assessment parameters; and

a set of view category specific assessment parameters, which are unique to the set of assessment parameters.

24. (Currently Amended) The method of claim 22 ~~or 23~~ wherein each of the sets of assessment parameters is a set of neural network parameters that defines a neural network having a plurality of layers including an input layer configured to receive one or more echocardiographic images and an output layer configured to output one or more quality assessment values and wherein:

applying the first function based on the first set of assessment parameters to the first at least one echocardiographic image comprises inputting the

first at least one echocardiographic image into the neural network defined by the first set of assessment parameters; and

applying the second function based on the second set of assessment parameters to the second at least one echocardiographic image comprises inputting the second at least one echocardiographic image into the neural network defined by the second set of assessment parameters.

25-35. (Canceled)

REMARKS

Applicant hereby submits the above preliminary amendments for reasons unrelated to patentability. Any cancelation of claims is done without prejudice or disclaimer. Claims 1-24 are now pending in the application. No new matter has been added through these amendments.

Please proceed with examination of the pending claims. If the Examiner has any questions, or if a telephone interview would in any way advance prosecution of the application, please contact the undersigned attorney of record. No fee is believed to be necessary in connection with the filing of this amendment. Should any fee be required, the Commissioner is hereby authorized to charge Deposit Account No. 602562.

Respectfully submitted,



David Charles BOURGEAU III
Registration No. 72,711
520 SW Yamhill Street, Ste. 200
Portland, Oregon 97204
Telephone: (503) 994-1650
Of Attorneys for Applicant

CERTIFICATE OF EFS-WEB TRANSMISSION

I hereby certify that this correspondence is being transmitted via the U.S. Patent and Trademark Office electronic filing system (EFS-Web) to the USPTO on March 15, 2019.

/Sara Taylor/
Sara TAYLOR

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

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

Application Number	16095601
Filing Date	2018-10-22
First Named Inventor	Purang ABOLMAESUMI
Art Unit	TBD
Examiner Name	Not yet assigned
Attorney Docket Number	CRB313

U.S.PATENTS Remove

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
	1	7912528	B2	2011-03-22	Sriram KRISHNAN, et al.	
	2	8594398	B2	2013-11-26	David James BEYMER, et al.	
	3	8744152	B2	2014-06-03	David J. BEYMER, et al.	
	4	8750375	B2	2014-06-10	David James BEYMER, et al.	
	5	8891881	B2	2014-11-18	Mithun Das GUPTA, et al.	
	6	8917917	B2	2014-12-23	David James BEYMER, et al.	
	7	9652846	B1	2017-05-16	Noel CODELLA, et al.	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI
	Art Unit	TBD
	Examiner Name	Not yet assigned
	Attorney Docket Number	CRB313

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	20100168578	A1	2010-07-01	Arthur GARSON, JR.; et al.	
	2	20150086093	A1	2015-03-26	Timothy A. FONTE, et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

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							

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

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]
	1	A. S. MILLER, et al., "Review of Neural Network Applications in Medical Imaging and Signal Processing," published in Medical & Biological Engineering & Computing in September 1992. Volume 30, pages 449-464.	
	2	R. H. CLAYTON, et al., "Recognition of Ventricular Fibrillation Using Neural Networks," published in Medical & Biological Engineering & Computing in March 1994. Volume 32, pages 217-220.	
	3	DIPTI ITCHHAPORIA, MD; et al., "Artificial Neural Networks: Current Status in Cardiovascular Medicine," published in the Journal of the American College of Cardiology (JACC) in August 1996. Volume 28, issue 2, pages 515-521.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI
	Art Unit	TBD
	Examiner Name	Not yet assigned
	Attorney Docket Number	CRB313

	4	CURT G. DEGROFF, MD; et al., "Artificial Neural Network-Based Method of Screening Heart Murmurs in Children," published in Circulation by the American Heart Association on June 5, 2001. Volume 103, issue 22, pages 2711-2716.
	5	S. KEVIN ZHOU, et al., "Image-based Multiclass Boosting and Echocardiographic View Classification," in 2006 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR'06). Volume 2, pages 1559-1565.
	6	ALISON NOBLE, et al., "Ultrasound Image Segmentation: A Survey," published in IEEE Transactions on Medical Imaging from the Institute of Electrical and Electronics Engineers in August 2006. Volume 25, issue 8, pages 987-1010.
	7	XIAOGUANG LU, et al., "AutoMPR: Automatic Detection of Standard Planes in 3D Echocardiography," published in 2008 5th IEEE International Symposium on Biomedical Imaging: From Nano to Macro in June 2008. Pages 1279-1282.
	8	J. JIANG, et al., "Medical Imaging Analysis with Artificial Neural Networks," published in Computerized Medical Imaging and Graphics in 2010. Volume 34, issue 8, pages 617-631.
	9	NEELAM SINHA, et al., "Quality Assessment in Magnetic Resonance Images," published in Critical Reviews™ in Biomedical Engineering (CRMBE) in 2010. Volume 38, issue 2, pages 127-141.
	10	SRI-KAUSHIK PAVANI, et al., "Quality Metric for Parasternal Long Axis B-Mode Echocardiograms," published in Medical Image Computing and Computer Assisted Intervention (MICCAI) in January 2012. Volume 15, part 2, pages 478-485.
	11	XIAOMING LIU, et al., "Learning-based Scan Plane Identification from Fetal Head Ultrasound Images," published in Medical Imaging 2012: Ultrasonic Imaging, Tomography, and Therapy; 83200A in February 2012. Proceedings SPIE Volume 8320.
	12	STEN ROAR SNARE, et al., "Real-Time Scan Assistant for Echocardiography," in IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control in March 2012. Volume 59, issue 3, pages 583-589.
	13	SHIJUN WANG, et al., "Machine Learning and Radiology," published in Medical Image Analysis by Elsevier in July 2012. Volume 16, issue 5, pages 993-951.
	14	NOHA EL-ZEHIRY, et al., "Learning the Manifold of Quality Ultrasound Acquisition," published in Medical Image Computing and Computer Assisted Intervention, Part 1 (MCCAI) in September 2013.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI
	Art Unit	TBD
	Examiner Name	Not yet assigned
	Attorney Docket Number	CRB313

	15	NIMA TORBATI, et al., "An Efficient Neural Network Based Method for Medical Image Segmentation," published in Computers in Biology and Medicine by Elsevier on January 1, 2014. Volume 44, pages 76-87.	
	16	HOO-CHANG SHIN, et al., "Deep Convolutional Neural Networks for Computer-Aided Detection: CNN Architectures, Dataset Characteristics and Transfer Learning," submitted to https://www.arXiv.org on February 10, 2016.	
	17	HAO CHEN, et al., "Iterative Multi-domain Regularized Deep Learning for Anatomical Structure Detection and Segmentation from Ultrasound Images," submitted to Medical Image Computing and Computer Assisted Intervention, Part 2 (MICCAI) in July 2016.	
	18	TIMOTHY J. W. DAWES, FRCA, PhD; et al., "Machine Learning of Three-dimensional Right Ventricular Motion Enables Outcome Prediction in Pulmonary Hypertension: A Cardiac MR Imaging Study," published online in Radiology in January 2017	

If you wish to add additional non-patent literature document citation information please click the Add button Add

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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI
	Art Unit	TBD
	Examiner Name	Not yet assigned
	Attorney Docket Number	CRB313

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	/David Bourgeau/	Date (YYYY-MM-DD)	2019-03-15
Name/Print	David BOURGEAU	Registration Number	72711

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.**

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 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.

Electronic Patent Application Fee Transmittal

Application Number:	16095601
Filing Date:	22-Oct-2018
Title of Invention:	ECHOCARDIOGRAPHIC IMAGE ANALYSIS
First Named Inventor/Applicant Name:	Purang ABOLMAESUMI
Filer:	David Charles Bourgeau III/Sara Taylor
Attorney Docket Number:	CRB313

Filed as Small Entity

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

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
NATL STAGE SEARCH FEE - REPORT PROVIDED	2642	1	260	260
NATL STAGE EXAM FEE - ALL OTHER CASES	2633	1	380	380
Pages:				
Claims:				
CLAIMS IN EXCESS OF 20	2615	4	50	200
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**840**

Electronic Acknowledgement Receipt	
EFS ID:	35437383
Application Number:	16095601
International Application Number:	
Confirmation Number:	6264
Title of Invention:	ECHOCARDIOGRAPHIC IMAGE ANALYSIS
First Named Inventor/Applicant Name:	Purang ABOLMAESUMI
Customer Number:	157691
Filer:	David Charles Bourgeau III/Sara Taylor
Filer Authorized By:	David Charles Bourgeau III
Attorney Docket Number:	CRB313
Receipt Date:	15-MAR-2019
Filing Date:	22-OCT-2018
Time Stamp:	14:39:40
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$840
RAM confirmation Number	031819INTEFSW14400600
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		20190315_Preliminary_Amendment_CRB313.pdf	163995 72c6409076f60abef4b5eed8d61eacd4eac6ec04	yes	23

Multipart Description/PDF files in .zip description

Document Description	Start	End
Preliminary Amendment	1	1
Specification	2	13
Claims	14	22
Applicant Arguments/Remarks Made in an Amendment	23	23

Warnings:

Information:

2	Information Disclosure Statement (IDS) Form (SB08)	20190315_IDS_CRB313.pdf	1036888 314e7ab032eb84e4d71f90d673c0e880655ea7d0	no	6

Warnings:

Information:

3	Non Patent Literature	NPL01_MedBiolEngComp_Miller.pdf	2913632 460f7bdff0106e74738a74448f532d315a548ba7	no	16

Warnings:

Information:

4	Non Patent Literature	NPL02_MedBioEngComp_Clayton.pdf	739701 61453f5c80b7be6a8ec6e0759e554aaf2a8e7081	no	4

Warnings:

Information:

5	Non Patent Literature	NPL03_JACC_Itchhaporioa.pdf	823809 694babe8f93c40e2db3131af3b084d49d2e6735f	no	7
Warnings:					
Information:					
6	Non Patent Literature	NPL04_Circulation_DeGroff.pdf	3283699 b4c8bde8e712d90c6def65d3d12ccc239d00a43c	no	7
Warnings:					
Information:					
7	Non Patent Literature	NPL05_IEEE_CVPR_Zhou.pdf	490302 3b03b219d568d2d3f3a9fbdf77e798884b7227fe	no	7
Warnings:					
Information:					
8	Non Patent Literature	NPL06_IEEE_MEd_Trans_Noble.pdf	19980031 67288f9d233579de6db2de6de403b743b7f0c27f	no	25
Warnings:					
Information:					
9	Non Patent Literature	NPL07_Lu_AutoMPR.pdf	339457 210633e85d9b4c8b7ba2d4bcdb4c4ca242001446	no	4
Warnings:					
Information:					
10	Non Patent Literature	NPL08_CompMedImaging_Jiang.pdf	534860 4c870695329 51f75b6ec8e3e76b33ea14c35c228	no	35
Warnings:					
Information:					
11	Non Patent Literature	NPL09_CRBME_Sinha.pdf	1213432 0881a1a1591339849f8e655c85cba750e8a669d6	no	15
Warnings:					
Information:					

12	Non Patent Literature	NPL10_MICCAI_Pavani.pdf	1328961 2428264055590db7403aa78eeb4cfa6b9c2b2ae1	no	8
Warnings:					
Information:					
13	Non Patent Literature	NPL11_ProcSPIEMedImag_Liu.pdf	680680 3a8c869777c70ed856edb34765757f1ba5bb3197	no	6
Warnings:					
Information:					
14	Non Patent Literature	NPL12_IEEETrans_Snare.pdf	608404 eeea91045e0b7b0172442b27fc28fa0bf5e25243	no	7
Warnings:					
Information:					
15	Non Patent Literature	NPL13_Med_Imag_AN_Wang.pdf	1863189 aa0bca16ec95f6bf4337fd4fbd1472b777be577e	no	44
Warnings:					
Information:					
16	Non Patent Literature	NPL14_Siemens_ElZehiry.pdf	10591598 a23e21a7f43bdffd7eaf164cb588ceedb6b8c47e	no	8
Warnings:					
Information:					
17	Non Patent Literature	NPL15_CompBioMed_Torbati.pdf	5641148 ba89dbe15cfac58bc97030566cfbd89915083120	no	12
Warnings:					
Information:					
18	Non Patent Literature	NPL16_arXiv1602_Shin.pdf	6458335 d233f266fb766fccd393eea4c38a377b71c9ec1f	no	14
Warnings:					
Information:					

19	Non Patent Literature	NPL17_Miccai_Chen.pdf	1369044 787336cae0a0b73d23c637d4f637b89ca426a376	no	9
Warnings:					
Information:					
20	Non Patent Literature	NPL18_Radiology_Dawes.pdf	1916281 08efa1d4c1b7e96037159b077d8526579bd58e27	no	10
Warnings:					
Information:					
21	Fee Worksheet (SB06)	fee-info.pdf	35707 1ce1f20f3f1fc107458671271ac49b17443eb5a3	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	62013153		

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.

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
16/095,601	10/22/2018	3793	1060	CRB313	24	3

CONFIRMATION NO. 6264

UPDATED FILING RECEIPT

157691
KOLITCH ROMANO LLP
520 SW Yamhill Street, Suite 200
Portland, OR 97204

OC000000106723195

Date Mailed: 03/21/2019

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**

Inventor(s)

Purang ABOLMAESUMI, Vancouver, BC, CANADA;
Robert ROHLING, Vancouver, BC, CANADA;
Amir H. ABDI, Vancouver, BC, CANADA;
Teresa S.M. TSANG, Vancouver, BC, CANADA;

Applicant(s)

THE UNIVERSITY OF BRITISH COLUMBIA, Vancouver, BC, CANADA;

Assignment For Published Patent Application

THE UNIVERSITY OF BRITISH COLUMBIA, Vancouver, BC, CANADA

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a 371 of PCT/CA2017/050496 04/21/2017
which claims benefit of 62/325,779 04/21/2016

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 01/23/2019

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/095,601**

Projected Publication Date: 05/02/2019

Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****
Title

ECHOCARDIOGRAPHIC IMAGE ANALYSIS

Preliminary Class

600

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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 (1-866-999-4258).

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).

SelectUSA

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 U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 16/095,601

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	150		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	260		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	380		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	24 minus 20 =	* 4	x 50 =	200	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	*	x 230 =	0.00			
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).			0.00			
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	990		TOTAL	

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($)	ADDITIONAL FEE($)	OR	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

U.S. APPLICATION NUMBER NO.	FIRST NAMED INVENTOR	ATTY. DOCKET NO.
16/095,601	Purang ABOLMAESUMI	CRB313

157691
KOLITCH ROMANO LLP
520 SW Yamhill Street, Suite 200
Portland, OR 97204

INTERNATIONAL APPLICATION NO.	
PCT/CA2017/050496	
I.A. FILING DATE	PRIORITY DATE
04/21/2017	04/21/2016

CONFIRMATION NO. 6264
371 ACCEPTANCE LETTER

OC000000106723196

Date Mailed: 03/21/2019

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 ACCEPTED the above identified international application for national patentability examination in the United States Patent and Trademark Office.

The United States Application Number assigned to the application is shown above. A Filing Receipt will be issued for the present application in due course. **THE DATE APPEARING ON THE FILING RECEIPT AS THE "FILING DATE or 371(c) DATE" IS THE DATE ON WHICH THE LAST OF THE 35 U.S.C. 371 (c)(1) and (c)(2) REQUIREMENTS HAS BEEN RECEIVED IN THE OFFICE. THIS DATE IS SHOWN BELOW.** 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)

10/22/2018
DATE OF RECEIPT OF 35 U.S.C.
371(c)(1) and (c)(2) REQUIREMENTS

The following items have been received:

- Indication of Small Entity Status
- Copy of the International Application filed on 10/22/2018
- Copy of the International Search Report filed on 10/22/2018
- Preliminary Amendments filed on 03/15/2019
- Information Disclosure Statements filed on 10/22/2018
- Inventor's Oath or Declaration filed on 01/30/2019
- U.S. Basic National Fees filed on 10/22/2018
- Authorize Access to Search Results filed on 10/22/2018
- Priority Documents filed on 10/22/2018
- Power of Attorney filed on 01/30/2019
- Authorization to Permit Access filed on 10/22/2018
- 37 CFR 1.48(a) request to correct inventorship filed on 03/15/2019
- Application Data Sheet (37 CFR 1.76) filed on 10/22/2018

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)

TONI M HOOD

Telephone: (571) 272-3654

FORM PCT/DO/EO/903 (371 Acceptance Notice)

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	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/095,601	10/22/2018	Purang ABOLMAESUMI	CRB313

CONFIRMATION NO. 6264

157691
KOLITCH ROMANO LLP
520 SW Yamhill Street, Suite 200
Portland, OR 97204

37 CFR 1.48 ACKNOWLEDGEMENT LETTER

OC000000106723202

Date Mailed: 03/21/2019

NOTICE OF ACCEPTANCE OF REQUEST UNDER 37 CFR 1.48(a)

This is in response to the applicant's request under 37 CFR 1.48(a) submitted on 03/15/2019.

The request under 37 CFR 1.48(a) to correct the inventorship, to correct or update the name of an inventor, or to correct the order of names of joint inventors is accepted.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/tmhood/

MULTIPLE DEPENDENT CLAIM FEE CALCULATION SHEET

Substitute for Form PTO-1360
(For use with Form PTO/SB/06)

Application Number	Filing Date
16095601	

Applicant(s) Purang ABOLMAESUMI

* 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		
3				1		
4				1		
5				1		
6				1		
7				1		
8				1		
9				1		
10				1		
11				1		
12				1		
13			1			
14				1		
15				1		
16				1		
17			1			
18				1		
19				1		
20				1		
21				1		
22				1		
23				1		
24				1		
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
Total Indep	0		3		0	
Total Depend	0	↵	21	↵	0	↵
Total Claims	0		24		0	

	*		*		*	
	Indep	Depend	Indep	Depend	Indep	Depend
51						
52						
53						
54						
55						
56						
57						
58						
59						
60						
61						
62						
63						
64						
65						
66						
67						
68						
69						
70						
71						
72						
73						
74						
75						
76						
77						
78						
79						
80						
81						
82						
83						
84						
85						
86						
87						
88						
89						
90						
91						
92						
93						
94						
95						
96						
97						
98						
99						
100						

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	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/095,601	10/22/2018	Purang ABOLMAESUMI	CRB313

CONFIRMATION NO. 6264

157691
KOLITCH ROMANO LLP
520 SW Yamhill Street, Suite 200
Portland, OR 97204

PUBLICATION NOTICE

OC000000107860652

Title:ECHOCARDIOGRAPHIC IMAGE ANALYSIS

Publication No.US-2019-0125298-A1
Publication Date:05/02/2019

NOTICE OF PUBLICATION OF APPLICATION

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.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently https://portal.uspto.gov/pair/PublicPair. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

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

Application Number	16095601
Filing Date	2018-10-22
First Named Inventor	Purang ABOLMAESUMI
Art Unit	3793
Examiner Name	WILLIAM D THOMSON
Attorney Docket Number	CRB313

U.S.PATENTS Remove

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
	1					

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

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	20050251013	A1	2005-11-10	KRISHNAN et al.	
	2	20090088640	A1	2009-04-02	PARK et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

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	2014/155272	WO	A1	2014-10-02	KONINKLIJKE PHILIPS N.V.		

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI
	Art Unit	3793
	Examiner Name	WILLIAM D THOMSON
	Attorney Docket Number	CRB313

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]
	1	November 8, 2019, Extended European Search Report from the EUROPEAN PATENT OFFICE in European Patent Application Serial No. 17785210.0, which is a foreign counterpart to this application.	

If you wish to add additional non-patent literature document citation information please click the Add button Add

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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI
	Art Unit	3793
	Examiner Name	WILLIAM D THOMSON
	Attorney Docket Number	CRB313

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	/David C. Bourgeau/	Date (YYYY-MM-DD)	2020-01-10
Name/Print	David C. Bourgeau	Registration Number	72711

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.**

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 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.

Electronic Acknowledgement Receipt

EFS ID:	38263094
Application Number:	16095601
International Application Number:	
Confirmation Number:	6264
Title of Invention:	ECHOCARDIOGRAPHIC IMAGE ANALYSIS
First Named Inventor/Applicant Name:	Purang ABOLMAESUMI
Customer Number:	157691
Filer:	David Charles Bourgeau III/Sara Taylor
Filer Authorized By:	David Charles Bourgeau III
Attorney Docket Number:	CRB313
Receipt Date:	10-JAN-2020
Filing Date:	22-OCT-2018
Time Stamp:	13:48:38
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	Information Disclosure Statement (IDS) Form (SB08)	20200110_IDS_CRB313.pdf	1034527 f7f3b41476aa15999f28d37d9c439e297c1f2c4a	no	4

Warnings:

Information:					
2	Foreign Reference	20200110_FP01_WO2014155272A1_CRB313.pdf	971463 69ce3583d70b61a1ee9ac14c7866834909a0c39f	no	27
Warnings:					
Information:					
3	Non Patent Literature	20200110_NPL01_EESR_from_EP177852100_CRB313.pdf	557319 c7f0a0983a4c64373dbcb677ebdfe7ace18d76ed	no	7
Warnings:					
Information:					
		Total Files Size (in bytes):	2563309		

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.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82B (07-13)
Approved for use through 01/31/2018. OMB 0651-0035
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 displays a valid OMB control number

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date
16/095,601	October 22, 2018

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☐ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 157691

OR

☑ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☑ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

THE UNIVERSITY OF BRITISH COLUMBIA

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature		Date (Optional)	
Name	Brett Sharp Ph.D.		
Title	Associate Director University - Industry Liaison Office		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. 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 3 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.

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

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

Application Number	16095601
Filing Date	2018-10-22
First Named Inventor	Purang ABOLMAESUMI et al.
Art Unit	3793
Examiner Name	William D. THOMSON
Attorney Docket Number	CRB313

U.S.PATENTS Remove

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
	1	7672491	B2	2010-03-02	KRISHNAN, et al.	
	2	7672517	B2	2010-03-02	BUSCEMA; Paolo Massimo	
	3	7680308	B2	2010-03-16	DALE	
	4	8712157	B2	2014-04-29	MARCHESOTTI, et al.	
	5	9918701	B2	2018-03-20	HEDLUND, et al.	
	6	10074038	B2	2018-09-11	HSIEH, et al.	
	7	10127659	B2	2018-11-13	HSIEH, et al.	
	8	10140734	B2	2018-11-27	CHEN	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI et al.
	Art Unit	3793
	Examiner Name	William D. THOMSON
	Attorney Docket Number	CRB313

	9	10242443	B2	2019-03-26	HSIEH, et al.	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

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	20050020903	A1	2005-01-27	KRISHNAN, et al.	
	2	20060147107	A1	2006-07-06	ZHANG, et al.	
	3	20090034808	A1	2009-02-05	ZHOU, et al.	
	4	20150302638	A1	2015-10-22	JAGO, et al.	
	5	20170026298	A1	2017-01-26	HUO	
	6	20170143312	A1	2017-05-25	HEDLUND, et al.	
	7	20170360401	A1	2017-12-21	ROTHBERG, et al.	
	8	20170360402	A1	2017-12-21	DEJONGE, et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI et al.
	Art Unit	3793
	Examiner Name	William D. THOMSON
	Attorney Docket Number	CRB313

	9	20170360403	A1	2017-12-21	ROTHBERG, et al.	
	10	20170360411	A1	2017-12-21	ROTHBERG, et al.	
	11	20170360412	A1	2017-12-21	ROTHBERG, et al.	
	12	20180144214	A1	2018-05-24	HSIEH, et al.	
	13	20180153505	A1	2018-06-07	CADIEU, et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	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	2014097090	WO	A1	2014-06-26	Koninkl Philips NV [NL]		
	2	2017181288	WO	A1	2017-10-26	University of British Columbia [CA]		

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

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)		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI et al.
	Art Unit	3793
	Examiner Name	William D. THOMSON
	Attorney Docket Number	CRB313

	1	ABDI, A.H. et al., "Automatic Quality Assessment of Apical Four-Chamber Echocardiograms Using Deep Convolutional Neural Networks", SPIE Medical Imaging 2017: Image Processing, edited by Martin A. Styner, Elsa D. Angelini, Proceedings of SPIE, Vol. 10133, 101330S, February 2017.
	2	HOCHREITER, Set al., "Long Short-Term Memory"; Neural Computation 1735-1780, 1997.
	3	IOFFE, Sergey et al., "Batch Normalization: Accelerating Deep Network Training by Reducing Internal Covariate Shift" Proceedings of the 32nd International Conference on Machine Learning; ICML'15, JMLR March 2, 2015.
	4	LU, Xiaoguang et al., "AutoMPR: Automatic Detection of Standard Planes in 3D Echocardiography"; 5th IEEE International Symposium on ISBI 2008.
	5	NAIR, Vinod et al., "Rectified Linear Units Improve Restricted Boltzmann Machines"; Proceedings of the 27th International Conference on Machine Learning (ICML-10) 2010.
	6	PAVANI, Sri-Kaushik et al., "Quality Metric for Parasternal Long Axis B-Mode Echocardiograms," Published in Medical Image Computing and Computer Assisted Intervention (MICCAI); Vol. 15, Part 2; 2012.
	7	Search Strategy in PCT Application No. PCT/CA2019/051192 mailed November 8, 2019.
	8	International Search Report issued on November 8, 2019 for Application No. PCT/CA2019/051192, 3 pages.
	9	Written Opinion of the International Searching Authority issued on November 8, 2019 for Application No. PCT/CA2019/051192, 5 pages.

If you wish to add additional non-patent literature document citation information please click the Add button Add

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.

EFS Web 2.1.18

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI et al.
	Art Unit	3793
	Examiner Name	William D. THOMSON
	Attorney Docket Number	CRB313

[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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI et al.
	Art Unit	3793
	Examiner Name	William D. THOMSON
	Attorney Docket Number	CRB313

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	/David C. Bourgeau/	Date (YYYY-MM-DD)	2020-04-14
Name/Print	David C. BOURGEAU III	Registration Number	72,711

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.**

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 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.

Electronic Acknowledgement Receipt

EFS ID:	39154322
Application Number:	16095601
International Application Number:	
Confirmation Number:	6264
Title of Invention:	ECHOCARDIOGRAPHIC IMAGE ANALYSIS
First Named Inventor/Applicant Name:	Purang ABOLMAESUMI
Customer Number:	157691
Filer:	David Charles Bourgeau III/Sherry Sutterfield
Filer Authorized By:	David Charles Bourgeau III
Attorney Docket Number:	CRB313
Receipt Date:	14-APR-2020
Filing Date:	22-OCT-2018
Time Stamp:	14:49:20
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	Power of Attorney	20200414_POA_CRB313.pdf	204039 9a75aac557da7ded19b97dc31931170c5cb449b8	no	1
Warnings:					

Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	20200414_IDS_CRB313.pdf	1036004 6e9e9cab9eecb4924b680019f0411a50825eaed7	no	7
Warnings:					
Information:					
3	Non Patent Literature	NPL01_ABDI_CRB313.pdf	2810695 d92cdd7de9be4e6071ba4a547f60d132e5a3c59e	no	8
Warnings:					
Information:					
4	Non Patent Literature	NPL02_HOCHREITER_CRB313.pdf	806508 49df54cdb067cf0a4833006023120563b877bf1d	no	32
Warnings:					
Information:					
5	Non Patent Literature	NPL03_IOFFE_CRB313.pdf	368952 f8206442d025e0dc1298c05c73ccbb029858916c	no	11
Warnings:					
Information:					
6	Non Patent Literature	NPL04_LU_CRB313.pdf	865990 c80bea490d07ccf76ed64f3104482a46f168399b	no	4
Warnings:					
Information:					
7	Non Patent Literature	NPL05_NAIR_CRB313.pdf	513833 dba6d7f96d1a84c33f930a3adb3c9ee5ebe53876	no	8
Warnings:					
Information:					
8	Non Patent Literature	NPL06_PAVANI_CRB313.pdf	1223642 98c4e6a523d73b9d6d1759a23cb5f49e6cdd5ea6	no	8
Warnings:					
Information:					

9	Non Patent Literature	NPL07_Search_Strategy_PCT-CA2019-051192.pdf	248510 3b33d5577f71158bbec27f133c69c7b46a72c829	no	2
Warnings:					
Information:					
10	Non Patent Literature	NPL08_ISR_PCT-CA2019-051192.pdf	364052 d6a8741eb1f8d4380f98ee40d1a99db8483be45d	no	3
Warnings:					
Information:					
11	Non Patent Literature	NPL09_Written_Opinion_PCT-CA2019-051192.pdf	732130 e27a5699c56f3af7403bbfab1f5f70017c1d6088	no	5
Warnings:					
Information:					
12	Foreign Reference	FP01_WO2014097090_CRB313.pdf	4233182 7c54a04740e6f6fdb72d7f1d1964d2b8fdfef43c	no	38
Warnings:					
Information:					
13	Foreign Reference	FP02_WO2017181288_CRB313.pdf	8520851 78eb4668a19d20eb288a4afeb2c64fc29c213ab3	no	88
Warnings:					
Information:					
		Total Files Size (in bytes):	21928388		

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.

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	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/095,601	10/22/2018	Purang ABOLMAESUMI	CRB313

CONFIRMATION NO. 6264

157691
KOLITCH ROMANO LLP
520 SW Yamhill Street, Suite 200
Portland, OR 97204

POA ACCEPTANCE LETTER

OC000000116281827

Date Mailed: 04/22/2020

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 04/14/2020.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/sleutchit/

PLUS Search Results for S/N 16095601, Searched Wed Apr 28 08:39:07 EDT 2021

The Patent Linguistics Utility System (PLUS) is a USPTO automated search system for U.S. Patents from 1971 to the present PLUS is a query-by-example search system which produces a list of patents that are most closely related linguistically to the application searched. This search was prepared by the staff of the Scientific and Technical Information Center, SIRA.

20190125298 83 5535314 53
5178149 71
5419328 71
5732707 71
5749833 71
5860927 71
5871019 71
6106466 71
6149595 71
6379303 71
6385332 71
6682485 71
6711439 71
8219193 71
8821408 71
9433792 71
10653326 71
20030195409 71
20100049082 71
20110093027 71
20110093027 71
20140350630 71
20160325101 71
20170273581 71
20200100768 71
20200237241 71
6154750 60
6171247 60
6346124 60
6381611 60
6708055 60
8073215 60
8073215 60
8092388 60
8172756 60
9011529 60
9526615 60
10402990 60
10930379 60
20030153823 60
20090074280 60
20090088640 60
20090219301 60
20170132796 60
20180286503 60
20210052252 60
4340287 53
4465068 53
4552012 53

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.
16/095,601	10/22/2018	Purang ABOLMAESUMI	CRB313	6264

157691 7590 05/05/2021
KOLITCH ROMANO LLP
520 SW Yamhill Street, Suite 200
Portland, OR 97204

EXAMINER	
HUYNH, VAN D	

ART UNIT	PAPER NUMBER
2665	

NOTIFICATION DATE	DELIVERY MODE
05/05/2021	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@dockettrak.com
docketing@kolitchromano.com

Office Action Summary	Application No. 16/095,601	Applicant(s) ABOLMAESUMI et al.	
	Examiner VAN D HUYNH	Art Unit 2665	AIA (FITF) Status Yes

-- 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 03/15/2019.

☐ 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) 1-24 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) 1-24 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 10/22/2018 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 _____.

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

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a)(1) the claimed invention was patented, described in a printed publication, or in public use, on sale, or otherwise available to the public before the effective filing date of the claimed invention.

3. **Claims 1-24** are rejected under 35 U.S.C. 102(a)(1) as being anticipated by **Krishnan et al, US 2005/0251013**.

Regarding claim 1, Krishnan discloses a computer-implemented system for facilitating echocardiographic image analysis (fig. 1; abstract; para 0005; *systems and methods for processing a medical image to automatically identify the anatomy and view (or pose) from the medical image and automatically assess the diagnostic quality of the medical image*), the system comprising at least one processor (fig. 1, element 101; para 0016; *a data processing module*) configured to:

receive signals representing a first at least one echocardiographic image (fig. 1, element 10; para 0009, 0016, and 0033; *obtain a medical image dataset (e.g., ultrasound image data - echocardiography)*);

associate the first at least one echocardiographic image with a first view category of a plurality of predetermined echocardiographic image view categories (fig. 1, element 104; para 0019 and 0036; *the view identification module implements methods for using the extracted features/parameters to automatically identify the view of an acquired image. In other words, the view identification module implements methods for pose estimation and label a medical image with respect to what view of the anatomy the medical image contains*);

determine, based on the first at least one echocardiographic image and the first view category, a first quality assessment value representing a view category specific quality assessment of the first at least one echocardiographic image (fig. 1, element 105; para 0020 and 0036; *the quality assessment module implements methods for using the extracted features/parameters to assess a level of diagnostic quality of an acquired image data set and determine whether errors occurred in the image acquisition process. In other exemplary embodiments of the invention, the results of anatomy and/or view identification may be used for quality assessment*);

produce signals representing the first quality assessment value for causing the first quality assessment value to be associated with the first at least one echocardiographic image (para 0020 and 0036; *methods can be implemented for providing real-time feedback during image acquisition regarding the diagnostic quality of the acquired images, allowing for changes in the image acquisition. In addition, methods can be implemented for determining a quality measure within a predefined range of values to provide an indication as the quality level of the acquired images based on some specified criteria*);

receive signals representing a second at least one echocardiographic image (fig. 1, element 10; para 0009, 0016, and 0033; *obtain a second medical image dataset (e.g., ultrasound image data - echocardiography*);

associate the second at least one echocardiographic image with a second view category of the plurality of predetermined echocardiographic image view categories, said second view category being different from the first view category (fig. 1, element 104; para 0019 and 0036; *the view identification module implements methods for using the extracted features/parameters to automatically identify the view of an acquired image. In other words, the view identification module implements methods for pose estimation and label a medical image with respect to what view of the anatomy the medical image contains*);

determine, based on the second at least one echocardiographic image and the second view category, a second quality assessment value representing a view category specific quality assessment of the second at least one echocardiographic image (fig. 1, element 105; para 0020 and 0036; *the quality assessment module implements methods for using the extracted features/parameters to assess a level of diagnostic quality of an acquired image data set and determine whether errors occurred in the image acquisition process. In other exemplary embodiments of the invention, the results of anatomy and/or view identification may be used for quality assessment*); and

produce signals representing the second quality assessment value for causing the second quality assessment value to be associated with the second at least one echocardiographic image (para 0020 and 0036; *methods can be implemented for providing real-time feedback during image acquisition regarding the diagnostic quality of*

the acquired images, allowing for changes in the image acquisition. In addition, methods can be implemented for determining a quality measure within a predefined range of values to provide an indication as the quality level of the acquired images based on some specified criteria).

Regarding claim 2, the system of claim 1, Krishnan further discloses wherein the first quality assessment value represents an assessment of suitability of the first at least one echocardiographic image for quantified clinical measurement of anatomical features and wherein the second quality assessment value represents an assessment of suitability of the second at least one echocardiographic image for quantified measurement of anatomical features (para 0030).

Regarding claim 3, the system of claim 1, Krishnan further discloses wherein the at least one processor is configured to:

produce signals for causing a representation of the first quality assessment value to be transmitted to at least one display for causing the at least one display to display the first quality assessment value in association with the first at least one echocardiographic image, to assist one or more operators of an echocardiographic device in capturing at least one subsequent echocardiographic image (para 0032); and

produce signals for causing a representation of the second quality assessment value to be transmitted to the at least one display for causing the at least one display to display the second quality assessment value in association with the second at least one echocardiographic image, to assist the one or more operators in capturing at least one subsequent echocardiographic image (para 0032).

Regarding claim 4, the system of claim 1, Krishnan further discloses wherein the at least one processor is configured to:

apply one or more view categorization functions to the first at least one echocardiographic image to determine that the first at least one echocardiographic image falls within the first view category (fig. 1, element 108; para 0023 and 0043); and

apply one or more view categorization functions to the second at least one echocardiographic image to determine that the second at least one echocardiographic image falls within the second view category (fig. 1, element 108; para 0023 and 0043).

Regarding claim 5, the system of claim 1, Krishnan further discloses wherein the first at least one echocardiographic image comprises a plurality of echocardiographic images (fig. 1, element 10; para 0009, 0016, and 0033) and wherein the at least one processor is configured to determine the first quality assessment value by determining a single quality assessment value representing a view category specific assessment of the plurality of echocardiographic images (fig. 1, element 105; para 0020 and 0036.

Regarding claim 6, the system of claim 1, Krishnan further discloses wherein each of the plurality of predetermined echocardiographic image view categories is associated with a respective set of assessment parameters and wherein the at least one processor is configured to:

determine that a first set of assessment parameters of the sets of assessment parameters is associated with the first view category (fig. 1, element 110; para 0023 and 0043);

in response to determining that the first set of assessment parameters is associated with the first view category, apply a first function based on the first set of assessment parameters to the first at least one echocardiographic image (fig. 1, element 110; para 0023 and 0043);

determine that a second set of assessment parameters of the sets of assessment parameters is associated with the second view category (fig. 1, element 110; para 0023 and 0043); and

in response to determining that the second set of assessment parameters is associated with the second view category, apply a second function based on the second set of assessment parameters to the second at least one echocardiographic image (fig. 1, element 110; para 0023 and 0043).

Regarding claim 7, the system of claim 6, Krishnan further discloses wherein each of the sets of assessment parameters includes:

a set of common assessment parameters, which are common to each of the sets of assessment parameters (fig. 1, element 110; para 0023 and 0043); and

a set of view category specific assessment parameters, which are unique to the set of assessment parameters (fig. 1, element 110; para 0023 and 0043).

Regarding claim 8, the system of claim 6, Krishnan further discloses wherein each of the sets of assessment parameters is a set of neural network parameters that defines a neural network having a plurality of layers including an input layer (fig. 1, element 109; para 0023 and 0043) configured to receive one or more echocardiographic images (fig. 1, element 10; para 0009, 0016, and 0033) and an

output layer configured to output one or more quality assessment values (fig. 1, element 105; para 0020 and 0036) and wherein the at least one processor is configured to:

apply the first function based on the first set of assessment parameters to the first at least one echocardiographic image by inputting the first at least one echocardiographic image into the neural network defined by the first set of assessment parameters (fig. 1, elements 109 and 110; para 0023 and 0043); and

apply the second function based on the second set of assessment parameters to the second at least one echocardiographic image by inputting the second at least one echocardiographic image into the neural network defined by the second set of assessment parameters (fig. 1, elements 109 and 110; para 0023 and 0043).

Regarding claim 9, the system of claim 8, Krishnan further discloses wherein the at least one processor is configured to train the neural networks by:

receiving signals representing a plurality of echocardiographic training images, each of the plurality of echocardiographic training images associated with one of the plurality of predetermined echocardiographic image view categories (fig. 1, elements 109 and 110; para 0023 and 0043);

receiving signals representing respective expert quality assessment values representing view category specific quality assessments of the plurality of echocardiographic training images, each of the expert quality assessment values provided by an expert echocardiographer and associated with one of the plurality of echocardiographic training images (fig. 1, elements 109 and 110; para 0023 and 0043); and

training the neural networks using the plurality of echocardiographic training images as inputs and the associated expert quality assessment values as desired outputs to determine the sets of neural network parameters defining the neural networks (fig. 1, elements 109 and 110; para 0023 and 0043).

Regarding claim 10, the system of claim 9, Krishnan further discloses wherein each of the expert quality assessment values represents an assessment of suitability of the associated echocardiographic image for quantified clinical measurement of anatomical features (para 0032).

Regarding claim 11, the system of claim 9, Krishnan further discloses wherein the at least one processor is configured to derive each of the expert quality assessment values at least in part from a clinical plane assessment value representing an expert opinion whether the associated echocardiographic training image was taken in an anatomical plane suitable for quantified clinical measurement of anatomical features (fig. 1, elements 109 and 110; para 0023 and 0043).

Regarding claim 12, the system of claim 9, Krishnan further discloses wherein each of the sets of neural network parameters includes:

a set of common neural network parameters, which are common to each of the sets of neural network parameters (fig. 1, elements 109 and 110; para 0023 and 0043); and

a set of view category specific neural network parameters, which are unique to the set of neural network parameters (fig. 1, elements 109 and 110; para 0023 and 0043); and

wherein the at least one processor is configured to, for each echocardiographic training image:

select one of the sets of view category specific neural network parameters based on the predetermined echocardiographic image view category associated with the echocardiographic training image (fig. 1, elements 109 and 110; para 0023 and 0043); and

using the echocardiographic training image as an input (fig. 1, element 10; para 0009, 0016, and 0033) and the associated expert quality assessment values as a desired output (fig. 1, element 105; para 0020 and 0036), train a neural network defined by the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters to update the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters (fig. 1, elements 109 and 110; para 0023 and 0043).

Regarding claim 13, this claim recites substantially the same limitations that are performed by claims 1 and 9 above, and it is rejected for the same reasons.

Regarding claim 14, this claim recites substantially the same limitations that are performed by claim 10 above, and it is rejected for the same reasons.

Regarding claim 15, this claim recites substantially the same limitations that are performed by claim 11 above, and it is rejected for the same reasons.

Regarding claim 16, this claim recites substantially the same limitations that are performed by claim 12 above, and it is rejected for the same reasons.

Regarding claim 17, this claim recites substantially the same limitations that are performed by claim 1 above, and it is rejected for the same reasons.

Regarding claim 18, this claim recites substantially the same limitations that are performed by claim 2 above, and it is rejected for the same reasons.

Regarding claim 19, this claim recites substantially the same limitations that are performed by claim 3 above, and it is rejected for the same reasons.

Regarding claim 20, this claim recites substantially the same limitations that are performed by claim 4 above, and it is rejected for the same reasons.

Regarding claim 21, this claim recites substantially the same limitations that are performed by claim 5 above, and it is rejected for the same reasons.

Regarding claim 22, this claim recites substantially the same limitations that are performed by claim 6 above, and it is rejected for the same reasons.

Regarding claim 23, this claim recites substantially the same limitations that are performed by claim 7 above, and it is rejected for the same reasons.

Regarding claim 24, this claim recites substantially the same limitations that are performed by claim 8 above, and it is rejected for the same reasons.

Conclusion

4. Any inquiry concerning this communication or earlier communications from the examiner should be directed to VAN D HUYNH whose telephone number is (571)270-1937. The examiner can normally be reached on 8AM-6PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edward F Urban can be reached on (571) 272-7899. 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 https://ppair-my.uspto.gov/pair/PrivatePair. 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.

/VAN D HUYNH/
Primary Examiner, Art Unit 2665

Notice of References Cited	Application/Control No. 16/095,601	Applicant(s)/Patent Under Reexamination ABOLMAESUMI et al.	
	Examiner VAN D HUYNH	Art Unit 2665	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20090088640-A1	04-2009	Park; Jin Hyeong	G06K9/6257	600/453
*	B	US-20050020903-A1	01-2005	Krishnan, Sriram	G16H50/20	600/407
*	C	US-20050251013-A1	11-2005	Krishnan, Sriram	G06T7/0012	600/407
*	D	US-20090074280-A1	03-2009	Lu; Xiaoguang	A61B8/523	382/131
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/095,601	ABOLMAESUMI et al.
	Examiner	Art Unit
	VAN D HUYNH	2665

CPC - Searched*		
Symbol	Date	Examiner
A61B8/0883, A61B8/463, G06N3/04, A61B8/4405, G06T7/0012, G06N3/08, G06N3/082, G06T2207/10132, G06T2207/20081, G06T2207/20084, G06T2207/30048, G06T2207/30168, G16H50/20, A61B8/5215	05/02/2021	vh

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
382	128	05/02/2021	vh

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

/VAN D HUYNH/ Primary Examiner, Art Unit 2665	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/095,601	ABOLMAESUMI et al.
	Examiner	Art Unit
	VAN D HUYNH	2665

Search Notes		
Search Notes	**Date**	**Examiner**
EAST (US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT ; IBM_TDB)	05/02/2021	vh
382/128 (text search- see EAST search history)	05/02/2021	vh
A61B8/0883, A61B8/463, G06N3/04, A61B8/4405, G06T7/0012, G06N3/08, G06N3/082, G06T2207/10132, G06T2207/20081, G06T2207/20084, G06T2207/30048, G06T2207/30168, G16H50/20, A61B8/5215(text search- see EAST search history)	05/02/2021	vh
Double Patenting Search (text search- see EAST search history)	05/02/2021	vh
Inventor Name/Assignee Search (text search- see EAST search history)	05/02/2021	vh
Search Plus (see EAST search history)	05/02/2021	vh
ip.com (see search history printout)	05/02/2021	vh
Google Patents/Google Scholar (see search history printout)	05/02/2021	vh
NPL Search (see search history printout)	05/02/2021	vh
Checked Global Dossier for all patents family information including foreign searches and Office Actions	05/02/2021	vh

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**

/VAN D HUYNH/ Primary Examiner, Art Unit 2665	

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/095,601	ABOLMAESUMI et al.
	Examiner	Art Unit
	VAN D HUYNH	2665

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

CLAIMS

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

CLAIM		DATE								
Final	Original	05/02/2021								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
	8	✓								
	9	✓								
	10	✓								
	11	✓								
	12	✓								
	13	✓								
	14	✓								
	15	✓								
	16	✓								
	17	✓								
	18	✓								
	19	✓								
	20	✓								
	21	✓								
	22	✓								
	23	✓								
	24	✓								

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

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

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

Application Number	16095601
Filing Date	2018-10-22
First Named Inventor	Purang ABOLMAESUMI et al.
Art Unit	3793
Examiner Name	William D. THOMSON
Attorney Docket Number	CRB313

U.S.PATENTS Remove

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
	1	7672491	B2	2010-03-02	KRISHNAN, et al.	
	2	7672517	B2	2010-03-02	BUSCEMA; Paolo Massimo	
	3	7680308	B2	2010-03-16	DALE	
	4	8712157	B2	2014-04-29	MARCHESOTTI, et al.	
	5	9918701	B2	2018-03-20	HEDLUND, et al.	
	6	10074038	B2	2018-09-11	HSIEH, et al.	
	7	10127659	B2	2018-11-13	HSIEH, et al.	
	8	10140734	B2	2018-11-27	CHEN	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.D.H/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI et al.
	Art Unit	3793
	Examiner Name	William D. THOMSON
	Attorney Docket Number	CRB313

	9	10242443	B2	2019-03-26	HSIEH, et al.	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

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	20050020903	A1	2005-01-27	KRISHNAN, et al.	
	2	20060147107	A1	2006-07-06	ZHANG, et al.	
	3	20090034808	A1	2009-02-05	ZHOU, et al.	
	4	20150302638	A1	2015-10-22	JAGO, et al.	
	5	20170026298	A1	2017-01-26	HUO	
	6	20170143312	A1	2017-05-25	HEDLUND, et al.	
	7	20170360401	A1	2017-12-21	ROTHBERG, et al.	
	8	20170360402	A1	2017-12-21	DEJONGE, et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.D.H/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI et al.
	Art Unit	3793
	Examiner Name	William D. THOMSON
	Attorney Docket Number	CRB313

	9	20170360403	A1	2017-12-21	ROTHBERG, et al.	
	10	20170360411	A1	2017-12-21	ROTHBERG, et al.	
	11	20170360412	A1	2017-12-21	ROTHBERG, et al.	
	12	20180144214	A1	2018-05-24	HSIEH, et al.	
	13	20180153505	A1	2018-06-07	CADIEU, et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

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	2014097090	WO	A1	2014-06-26	Koninkl Philips NV [NL]		
	2	2017181288	WO	A1	2017-10-26	University of British Columbia [CA]		

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

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]

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.D.H/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI et al.
	Art Unit	3793
	Examiner Name	William D. THOMSON
	Attorney Docket Number	CRB313

	1	ABDI, A.H. et al., "Automatic Quality Assessment of Apical Four-Chamber Echocardiograms Using Deep Convolutional Neural Networks", SPIE Medical Imaging 2017: Image Processing, edited by Martin A. Styner, Elsa D. Angelini, Proceedings of SPIE, Vol. 10133, 101330S, February 2017.
	2	HOCHREITER, Set al., "Long Short-Term Memory"; Neural Computation 1735-1780, 1997.
	3	IOFFE, Sergey et al., "Batch Normalization: Accelerating Deep Network Training by Reducing Internal Covariate Shift" Proceedings of the 32nd International Conference on Machine Learning; ICML'15, JMLR March 2, 2015.
	4	LU, Xiaoguang et al., "AutoMPR: Automatic Detection of Standard Planes in 3D Echocardiography"; 5th IEEE International Symposium on ISBI 2008.
	5	NAIR, Vinod et al., "Rectified Linear Units Improve Restricted Boltzmann Machines"; Proceedings of the 27th International Conference on Machine Learning (ICML-10) 2010.
	6	PAVANI, Sri-Kaushik et al., "Quality Metric for Parasternal Long Axis B-Mode Echocardiograms," Published in Medical Image Computing and Computer Assisted Intervention (MICCAI); Vol. 15, Part 2; 2012.
	7	Search Strategy in PCT Application No. PCT/CA2019/051192 mailed November 8, 2019.
	8	International Search Report issued on November 8, 2019 for Application No. PCT/CA2019/051192, 3 pages.
	9	Written Opinion of the International Searching Authority issued on November 8, 2019 for Application No. PCT/CA2019/051192, 5 pages.

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/VAN D HUYNH/	Date Considered	05/02/2021

*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.

EFS Web 2.1.18

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.D.H/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI et al.
	Art Unit	3793
	Examiner Name	William D. THOMSON
	Attorney Docket Number	CRB313

[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.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.D.H/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI et al.
	Art Unit	3793
	Examiner Name	William D. THOMSON
	Attorney Docket Number	CRB313

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	/David C. Bourgeau/	Date (YYYY-MM-DD)	2020-04-14
Name/Print	David C. BOURGEAU III	Registration Number	72,711

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.**

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.D.H/

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 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.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.D.H/

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

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI
	Art Unit	3793
	Examiner Name	WILLIAM D THOMSON
	Attorney Docket Number	CRB313

U.S.PATENTS Remove

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
	1					

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

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	20050251013	A1	2005-11-10	KRISHNAN et al.	
	2	20090088640	A1	2009-04-02	PARK et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

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	2014/155272	WO	A1	2014-10-02	KONINKLIJKE PHILIPS N.V.		

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

EFS Web 2.1.18

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.D.H/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI
	Art Unit	3793
	Examiner Name	WILLIAM D THOMSON
	Attorney Docket Number	CRB313

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]
	1	November 8, 2019, Extended European Search Report from the EUROPEAN PATENT OFFICE in European Patent Application Serial No. 17785210.0, which is a foreign counterpart to this application.	

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/VAN D HUYNH/	Date Considered	05/02/2021

*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.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.D.H/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI
	Art Unit	3793
	Examiner Name	WILLIAM D THOMSON
	Attorney Docket Number	CRB313

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	/David C. Bourgeau/	Date (YYYY-MM-DD)	2020-01-10
Name/Print	David C. Bourgeau	Registration Number	72711

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.**

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.D.H/

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 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.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.D.H/

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

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

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

Application Number	16095601
Filing Date	2018-10-22
First Named Inventor	Purang ABOLMAESUMI
Art Unit	TBD
Examiner Name	Not yet assigned
Attorney Docket Number	CRB313

U.S.PATENTS Remove

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
	1	7912528	B2	2011-03-22	Sriram KRISHNAN, et al.	
	2	8594398	B2	2013-11-26	David James BEYMER, et al.	
	3	8744152	B2	2014-06-03	David J. BEYMER, et al.	
	4	8750375	B2	2014-06-10	David James BEYMER, et al.	
	5	8891881	B2	2014-11-18	Mithun Das GUPTA, et al.	
	6	8917917	B2	2014-12-23	David James BEYMER, et al.	
	7	9652846	B1	2017-05-16	Noel CODELLA, et al.	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.D.H/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI
	Art Unit	TBD
	Examiner Name	Not yet assigned
	Attorney Docket Number	CRB313

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	20100168578	A1	2010-07-01	Arthur GARSON, JR.; et al.	
	2	20150086093	A1	2015-03-26	Timothy A. FONTE, et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

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							

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

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]
	1	A. S. MILLER, et al., "Review of Neural Network Applications in Medical Imaging and Signal Processing," published in Medical & Biological Engineering & Computing in September 1992. Volume 30, pages 449-464.	
	2	R. H. CLAYTON, et al., "Recognition of Ventricular Fibrillation Using Neural Networks," published in Medical & Biological Engineering & Computing in March 1994. Volume 32, pages 217-220.	
	3	DIPTI ITCHHAPORIA, MD; et al., "Artificial Neural Networks: Current Status in Cardiovascular Medicine," published in the Journal of the American College of Cardiology (JACC) in August 1996. Volume 28, issue 2, pages 515-521.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.D.H/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI
	Art Unit	TBD
	Examiner Name	Not yet assigned
	Attorney Docket Number	CRB313

	4	CURT G. DEGROFF, MD; et al., "Artificial Neural Network-Based Method of Screening Heart Murmurs in Children," published in Circulation by the American Heart Association on June 5, 2001. Volume 103, issue 22, pages 2711-2716.
	5	S. KEVIN ZHOU, et al., "Image-based Multiclass Boosting and Echocardiographic View Classification," in 2006 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR'06). Volume 2, pages 1559-1565.
	6	ALISON NOBLE, et al., "Ultrasound Image Segmentation: A Survey," published in IEEE Transactions on Medical Imaging from the Institute of Electrical and Electronics Engineers in August 2006. Volume 25, issue 8, pages 987-1010.
	7	XIAOGUANG LU, et al., "AutoMPR: Automatic Detection of Standard Planes in 3D Echocardiography," published in 2008 5th IEEE International Symposium on Biomedical Imaging: From Nano to Macro in June 2008. Pages 1279-1282.
	8	J. JIANG, et al., "Medical Imaging Analysis with Artificial Neural Networks," published in Computerized Medical Imaging and Graphics in 2010. Volume 34, issue 8, pages 617-631.
	9	NEELAM SINHA, et al., "Quality Assessment in Magnetic Resonance Images," published in Critical Reviews™ in Biomedical Engineering (CRMBE) in 2010. Volume 38, issue 2, pages 127-141.
	10	SRI-KAUSHIK PAVANI, et al., "Quality Metric for Parasternal Long Axis B-Mode Echocardiograms," published in Medical Image Computing and Computer Assisted Intervention (MICCAI) in January 2012. Volume 15, part 2, pages 478-485.
	11	XIAOMING LIU, et al., "Learning-based Scan Plane Identification from Fetal Head Ultrasound Images," published in Medical Imaging 2012: Ultrasonic Imaging, Tomography, and Therapy; 83200A in February 2012. Proceedings SPIE Volume 8320.
	12	STEN ROAR SNARE, et al., "Real-Time Scan Assistant for Echocardiography," in IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control in March 2012. Volume 59, issue 3, pages 583-589.
	13	SHIJUN WANG, et al., "Machine Learning and Radiology," published in Medical Image Analysis by Elsevier in July 2012. Volume 16, issue 5, pages 993-951.
	14	NOHA EL-ZEHIRY, et al., "Learning the Manifold of Quality Ultrasound Acquisition," published in Medical Image Computing and Computer Assisted Intervention, Part 1 (MCCAI) in September 2013.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.D.H/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI
	Art Unit	TBD
	Examiner Name	Not yet assigned
	Attorney Docket Number	CRB313

	15	NIMA TORBATI, et al., "An Efficient Neural Network Based Method for Medical Image Segmentation," published in Computers in Biology and Medicine by Elsevier on January 1, 2014. Volume 44, pages 76-87.	
	16	HOO-CHANG SHIN, et al., "Deep Convolutional Neural Networks for Computer-Aided Detection: CNN Architectures, Dataset Characteristics and Transfer Learning," submitted to https://www.arXiv.org on February 10, 2016.	
	17	HAO CHEN, et al., "Iterative Multi-domain Regularized Deep Learning for Anatomical Structure Detection and Segmentation from Ultrasound Images," submitted to Medical Image Computing and Computer Assisted Intervention, Part 2 (MICCAI) in July 2016.	
	18	TIMOTHY J. W. DAWES, FRCA, PhD; et al., "Machine Learning of Three-dimensional Right Ventricular Motion Enables Outcome Prediction in Pulmonary Hypertension: A Cardiac MR Imaging Study," published online in Radiology in January 2017	

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/VAN D HUYNH/	Date Considered	05/02/2021

*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.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.D.H/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16095601
	Filing Date	2018-10-22
	First Named Inventor	Purang ABOLMAESUMI
	Art Unit	TBD
	Examiner Name	Not yet assigned
	Attorney Docket Number	CRB313

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	/David Bourgeau/	Date (YYYY-MM-DD)	2019-03-15
Name/Print	David BOURGEAU	Registration Number	72711

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.**

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.D.H/

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 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.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.D.H/

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

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	
	Filing Date	2018-10-22
	First Named Inventor	ABOLMAESUMI et al.
	Art Unit	
	Examiner Name	
	Attorney Docket Number	CRB313

U.S.PATENTS Remove

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
	1	5776063	A	1998-07-07	DITTRICH et al.	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

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	20050020903	A1	2005-01-27	KRISHNAN et al.	
	2	20090074280	A1	2009-03-19	LU et al.	
	3	20090088640	A1	2009-04-02	PARK et al.	
	4	20110082371	A1	2011-04-07	Tomoaki CHONO	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

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]

EFS Web 2.1.18

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.D.H/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2018-10-22
	First Named Inventor	ABOLMAESUMI et al.
	Art Unit	
	Examiner Name	
	Attorney Docket Number	CRB313

	1							

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

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]
	1	CANADIAN INTELLECTUAL PROPERTY OFFICE, International Search Report and Written Opinion of the International Searching Authority in PCT/CA2017/050496, dated July 13, 2017, which is the international application to this U.S. application.	

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/VAN D HUYNH/	Date Considered	05/02/2021

*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.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.D.H/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2018-10-22
	First Named Inventor	ABOLMAESUMI et al.
	Art Unit	
	Examiner Name	
	Attorney Docket Number	CRB313

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	/Dave Bourgeau/	Date (YYYY-MM-DD)	2018-10-22
Name/Print	Dave BOURGEAU	Registration Number	72711

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.**

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.D.H/

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 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.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /V.D.H/

Bibliographic Data

Application No: 16/095,601

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☐ No ☐ Met After Allowance

Verified and Acknowledged: /VAN D HUYNH/ Examiner's Signature | Initials

Title: ECHOCARDIOGRAPHIC IMAGE ANALYSIS

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
10/22/2018	382	2665	CRB313
RULE			

APPLICANTS

THE UNIVERSITY OF BRITISH COLUMBIA, Vancouver, BC, CANADA

INVENTORS

Purang ABOLMAESUMI, Vancouver, BC, CANADA

Robert ROHLING, Vancouver, BC, CANADA

Amir H. ABDI, Vancouver, BC, CANADA

Teresa S.M. TSANG, Vancouver, BC, CANADA

CONTINUING DATA

This application is a 371 of PCT/CA2017/050496 04/21/2017

PCT/CA2017/050496 has PRO of 62325779 04/21/2016

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

01/23/2019

**** SMALL ENTITY ****

STATE OR COUNTRY

CANADA

ADDRESS

KOLITCH ROMANO LLP

520 SW Yamhill Street, Suite 200

Portland, OR 97204

UNITED STATES

FILING FEE RECEIVED

$150

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	7	"20190125298"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/22 13:37
S2	9	"20090088640"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/26 10:30
S3	5	"20050020903"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/26 10:56
S5	113	((("ABOLMAESUMI") near3 ("Purang")) OR (("ROHLING") near3 ("Robert")) OR (("ABDI") near3 ("Amir")) OR (("TSANG") near3 ("Teresa"))).INV.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 08:44
S7	1,236	((("THE") near3 ("UNIVERSITY") near3 ("OF") near3 ("BRITISH") near3 ("COLUMBIA"))).AS,AANM.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 08:48
S8	29	S5 and S7	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 08:48

S9	16,030	382/128.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 08:51
S10	220,610	(A61B8/0883 or A61B8/463 or G06N3/04 or A61B8/4405 or G06T7/0012 or G06N3/08 or G06N3/082 or G06T2207/10132 or G06T2207/20081 or G06T2207/20084 or G06T2207/30048 or G06T2207/30168 or G16H50/20 or A61B8/5215).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 08:52
S11	5,429	S9 and S10	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 08:53
S12	1	S8 and S9	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 08:53
S13	9	S8 and S10	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 08:54
S14	156	("20190125298" "5178149" "5419328" "5732707" "5749833" "5860927" "5871019" "6106466" "6149595" "6379303" "6385332" "6682485" "6711439" "8219193" "8821408" "9433792" "10653326" "20030195409" "20100049082" "20110093027" "20110093027" "20140350630" "20160325101" "20170273581" "20200100768" "20200237241" "6154750" "6171247" "6346124" "6381611" "6708055" "8073215" "8073215" "8092388" "8172756" "9011529" "9526615" "10402990" "10930379" "20030153823"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/04/28 08:57

		"20090074280" "20090088640" "20090219301" "20170132796" "20180286503" "20210052252" "4340287" "4465068" "4552012" "5535314").pn.				
S15	6	S9 and S14	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 08:59
S17	24	S10 and S14	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 08:59
S18	21	S14 and (echocardiograph$3 adj (image or picture or photo or photograph or frame or $4shot or clip or video))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 09:16
S19	2	S14 and (echocardiograph$3 adj (image or picture or photo or photograph or frame or $4shot or clip or video) with ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 09:29
S20	2	S14 and (echocardiograph$3 adj (image or picture or photo or photograph or frame or $4shot or clip or video) same ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 09:30
S21	9	S14 and (echocardiograph$3 adj (image or picture or photo or photograph or frame or $4shot or clip or video) and ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	ADJ	ON	2021/04/28 09:31

		neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))	DERWENT; IBM_TDB			
S22	108	("20100168578" | "20150086093" | "10242443" | "20150302638" | "20170360401" | "20090074280" | "8917917" | "20050251013" | "7680308" | "20050020903" | "20090088640" | "7912528" | "20170360403" | "20170360412" | "8891881" | "7672517" | "8712157" | "5776063" | "8744152" | "10140734" | "20170360402" | "8594398" | "9918701" | "8750375" | "10074038" | "10127659" | "20170360411" | "20180144214" | "20110082371" | "9652846" | "20050020903" | "20060147107" | "20090034808" | "20170026298" | "20170143312" | "20180153505" | "7672491").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 09:34
S23	1	S22 and (echocardiograph$3 adj (image or picture or photo or photograph or frame or $4shot or clip or video) with ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 10:21
S24	12	S22 and (echocardiograph$3 adj (image or picture or photo or photograph or frame or $4shot or clip or video))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 10:22
S25	7	S22 and (echocardiograph$3 adj (image or picture or photo or photograph or frame or $4shot or clip or video) same ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 10:23
S26	33	((echocardiograph$3 or (cardiac ultrasound)) adj (image or picture or photo or photograph or frame or $4shot or clip or video) with ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	ADJ	ON	2021/04/28 10:34

		(convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))	DERWENT; IBM_TDB			
S33	1	((echocardiograph$3 or (cardiac ultrasound)) adj (image or picture or photo or photograph or frame or $4shot or clip or video) with (view) with (qualit$3) with ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 10:45
S34	1	((echocardiograph$3 or (cardiac ultrasound)) adj (image or picture or photo or photograph or frame or $4shot or clip or video) with (view) with (qualit$3) same ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 10:45
S35	3	((echocardiograph$3 or (cardiac ultrasound)) adj (image or picture or photo or photograph or frame or $4shot or clip or video) with (view) with (qualit$3) and ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 10:46
S36	3	((echocardiograph$3 or ((cardiac or heart) adj ultrasound)) adj (image or picture or photo or photograph or frame or $4shot or clip or video) with (view) with (qualit$3) and ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 10:46
S37	3	((echocardiograph$3 or ((cardiac or heart) near3 ultrasound)) adj (image or picture or photo or photograph or frame or $4shot or clip or video) with (view) with (qualit$3) and ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 10:47

		neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))				
S38	7	(echocardiograph$3 or ((cardiac or heart) near3 ultrasound)) adj (image or picture or photo or photograph or frame or $4shot or clip or video) with (view) with (qualit$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 10:47
S39	3	"20050251013"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/05/01 12:12
S40	1	((echocardiograph$3 or (cardiac ultrasound)) adj (image or picture or photo or photograph or frame or $4shot or clip or video) with (view or plane or pose) with (qualit$3) with ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/05/01 14:59
S41	7	(echocardiograph$3 or (cardiac ultrasound)) adj (image or picture or photo or photograph or frame or $4shot or clip or video) with (view or plane or pose) with (qualit$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/05/01 15:00
S42	17	(image or picture or photo or photograph or frame or $4shot or clip or video) with (view or plane or pose) with (qualit$3) with (echocardiograph$3 or (cardiac ultrasound))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/05/01 15:02
S43	28	(image or picture or photo or photograph or frame or $4shot or clip or video) with (view or plane or pose) with (qualit$3) same (echocardiograph$3 or (cardiac ultrasound))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/05/01 15:02

S44	17	(image or picture or photo or photograph or frame or $4shot or clip or video) with (view or plane or pose) with (qualit$3) same (echocardiograph$3 or (cardiac ultrasound)) and ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/05/01 15:04

EAST Search History (Interference)

<This search history is empty>

5/2/2021 3:08:15 PM
C:\Users\vhuynh\Documents\EAST\Workspaces\16095601-2-echocardiography.wsp

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. 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 displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/095,601	Filing Date 10/22/2018	☐ 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 $50 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $230 =	
☐ 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

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	08/05/2021	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 24	= 0		x $50 =	0
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0		x $240 =	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

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ 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.	SLIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/DESHONNE T. MARTINO/
*** 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.	

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.**

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

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor:	Purang ABOLMAESUMI	Dated:	August 5, 2021
Applicant:	THE UNIVERSITY OF BRITISH COLUMBIA	Attorney Docket:	CRB313
Filing/371:	October 22, 2018	Group Art Unit:	2665
Serial No.:	16/095,601	Examiner:	VAN D. HUYNH

For: **ECHOCARDIOGRAPHIC IMAGE ANALYSIS**

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

Commissioner:

AMENDMENT AND RESPONSE TO OFFICE ACTION

Please consider the following, which is filed in response to the non-final Office action dated May 5, 2021:

Listing of Claims begin on page 2 of this paper.

Remarks begin on page 12 of this paper.

LISTING OF CLAIMS

This listing of claims replaces all prior versions, and listings, of claims in the application. Material to be inserted is in **bold and underline**, and material to be deleted is in ~~strikeout~~ or (if the deletion is of five or fewer consecutive characters or would be difficult to see) in double brackets [[ ]].

1. (Currently Amended) A computer-implemented system for facilitating echocardiographic image analysis, the system comprising at least one processor configured to:

receive signals representing a first at least one echocardiographic image;

associate the first at least one echocardiographic image with a first view category of a plurality of predetermined echocardiographic image view categories;

determine, based on the first at least one echocardiographic image and the first view category, a first quality assessment value representing a view category specific quality assessment of the first at least one echocardiographic image;

produce signals representing the first quality assessment value for causing the first quality assessment value to be associated with the first at least one echocardiographic image;

receive signals representing a second at least one echocardiographic image;

associate the second at least one echocardiographic image with a second view category of the plurality of predetermined echocardiographic image view categories, said second view category being different from the first view category;

determine, based on the second at least one echocardiographic image and the second view category, a second quality assessment value representing a view category specific quality assessment of the second at least one echocardiographic image; and

produce signals representing the second quality assessment value for causing the second quality assessment value to be associated with the second at least one echocardiographic image;

wherein each of the plurality of predetermined echocardiographic image view categories is associated with a respective set of assessment parameters, each of the sets of assessment parameters being a set of neural network parameters that define a neural network having a plurality of layers including an input layer configured to receive one or more echocardiographic images and an output layer configured to output one or more quality assessment values, and wherein the at least one processor is configured to determine the first quality assessment value by:

determining that a first set of assessment parameters of the sets of assessment parameters is associated with the first view category; and

in response to determining that the first set of assessment parameters is associated with the first view category, inputting the first at least one echocardiographic image into the neural network defined by the first set of assessment parameters; and

wherein the at least one processor is configured to determine the second quality assessment value by:

determining that a second set of assessment parameters of the sets of assessment parameters is associated with the second view category; and

in response to determining that the second set of assessment parameters is associated with the second view category, inputting the second at least one echocardiographic image into the neural network defined by the second set of assessment parameters.

2. (Original) The system of claim 1 wherein the first quality assessment value represents an assessment of suitability of the first at least one echocardiographic image for quantified clinical measurement of anatomical features and wherein the second quality assessment value represents an assessment of suitability of the second at least one echocardiographic image for quantified measurement of anatomical features.

3. (Previously presented) The system of claim 1 wherein the at least one processor is configured to:

produce signals for causing a representation of the first quality assessment value to be transmitted to at least one display for causing the at least one display to display the first quality assessment value in association with the first at least one echocardiographic image, to assist one or more operators

of an echocardiographic device in capturing at least one subsequent echocardiographic image; and

produce signals for causing a representation of the second quality assessment value to be transmitted to the at least one display for causing the at least one display to display the second quality assessment value in association with the second at least one echocardiographic image, to assist the one or more operators in capturing at least one subsequent echocardiographic image.

4. (Previously presented) The system of claim 1 wherein the at least one processor is configured to:

apply one or more view categorization functions to the first at least one echocardiographic image to determine that the first at least one echocardiographic image falls within the first view category; and

apply one or more view categorization functions to the second at least one echocardiographic image to determine that the second at least one echocardiographic image falls within the second view category.

5. (Previously presented) The system of claim 1 wherein the first at least one echocardiographic image comprises a plurality of echocardiographic images and wherein the at least one processor is configured to determine the first quality assessment value by determining a single quality assessment value representing a view category specific assessment of the plurality of echocardiographic images.

6. (Canceled)

7. (Currently Amended) The system of claim **1**[[6]] wherein each of the sets of assessment parameters includes:

a set of common assessment parameters, which are common to each of the sets of assessment parameters; and

a set of view category specific assessment parameters, which are unique to the set of assessment parameters.

8. (Canceled)

9. (Currently Amended) The system of claim **1**[[8]] wherein the at least one processor is configured to train the neural networks by:

receiving signals representing a plurality of echocardiographic training images, each of the plurality of echocardiographic training images

associated with one of the plurality of predetermined echocardiographic image view categories;

receiving signals representing respective expert quality assessment values representing view category specific quality assessments of the plurality of echocardiographic training images, each of the expert quality assessment values provided by an expert echocardiographer and associated with one of the plurality of echocardiographic training images; and

training the neural networks using the plurality of echocardiographic training images as inputs and the associated expert quality assessment values as desired outputs to determine the sets of neural network parameters defining the neural networks.

10. (Original) The system of claim 9 wherein each of the expert quality assessment values represents an assessment of suitability of the associated echocardiographic image for quantified clinical measurement of anatomical features.

11. (Previously presented) The system of claim 9 wherein the at least one processor is configured to derive each of the expert quality assessment values at least in part from a clinical plane assessment value representing an expert opinion whether the associated echocardiographic training image was taken in an anatomical plane suitable for quantified clinical measurement of anatomical features.

12. (Previously presented) The system of claim 9 wherein each of the sets of neural network parameters includes:

a set of common neural network parameters, which are common to each of the sets of neural network parameters; and

a set of view category specific neural network parameters, which are unique to the set of neural network parameters; and

wherein the at least one processor is configured to, for each echocardiographic training image:

select one of the sets of view category specific neural network parameters based on the predetermined echocardiographic image view category associated with the echocardiographic training image; and

using the echocardiographic training image as an input and the associated expert quality assessment values as a desired output, train a neural network defined by the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters to

update the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters.

13. (Currently Amended) A computer-implemented system for training neural networks to facilitate echocardiographic image analysis, the system comprising at least one processor configured to:

receive signals representing a plurality of echocardiographic training images, each of the plurality of echocardiographic training images associated with one of a plurality of predetermined echocardiographic image view categories;

receive signals representing expert quality assessment values representing view category specific quality assessments of the plurality of echocardiographic training images, each of the expert quality assessment values provided by an expert echocardiographer and associated with one of the plurality of echocardiographic training images; and

train the neural networks using the plurality of echocardiographic training images and the associated expert quality assessment values to determine sets of neural network parameters defining the neural networks, at least a portion of each of said neural networks associated with one of the plurality of predetermined echocardiographic image view categories;[[.]]

wherein the at least one processor is further configured to, once the neural networks are trained:

receive signals representing a first at least one echocardiographic image;

associate the first at least one echocardiographic image with a first view category of a plurality of predetermined echocardiographic image view categories;

determine, based on the first at least one echocardiographic image and the first view category, a first quality assessment value representing a view category specific quality assessment of the first at least one echocardiographic image;

produce signals representing the first quality assessment value for causing the first quality assessment value to be associated with the first at least one echocardiographic image;

receive signals representing a second at least one echocardiographic image;

associate the second at least one echocardiographic image with a second view category of the plurality of predetermined echocardiographic image view categories, said second view category being different from the first view category;

determine, based on the second at least one echocardiographic image and the second view category, a second quality assessment value representing a view category specific quality assessment of the second at least one echocardiographic image; and

produce signals representing the second quality assessment value for causing the second quality assessment value to be associated with the second at least one echocardiographic image;

wherein each of the plurality of predetermined echocardiographic image view categories is associated with a respective set of assessment parameters, each of the sets of assessment parameters being a set of neural network parameters that define a neural network having a plurality of layers including an input layer configured to receive one or more echocardiographic images and an output layer configured to output one or more quality assessment values, and wherein the at least one processor is configured to determine the first quality assessment value by:

> **determining that a first set of assessment parameters of the sets of assessment parameters is associated with the first view category; and**
>
> **in response to determining that the first set of assessment parameters is associated with the first view category, inputting the first at least one echocardiographic image into the neural network defined by the first set of assessment parameters; and**

wherein the at least one processor is configured to determine the second quality assessment value by:

> **determining that a second set of assessment parameters of the sets of assessment parameters is associated with the second view category; and**
>
> **in response to determining that the second set of assessment parameters is associated with the second**

view category, inputting the second at least one echocardiographic image into the neural network defined by the second set of assessment parameters.

14. (Original) The system of claim 13 wherein each of the expert quality assessment values represents an assessment of suitability of the associated echocardiographic image for quantified clinical measurement of anatomical features.

15. (Previously presented) The system of claim 13 wherein the at least one processor is configured to derive each of the expert quality assessment values at least in part from a clinical plane assessment value representing an expert opinion whether the associated echocardiographic training image was taken in an anatomical plane suitable for a quantified clinical measurement of anatomical features.

16. (Previously presented) The system of claim 13 wherein each of the sets of neural network parameters includes:

a set of common neural network parameters, which are common to each of the sets of neural network parameters; and

a set of view category specific neural network parameters, which are unique to the set of neural network parameters; and

wherein the at least one processor is configured to, for each echocardiographic training image:

select one of the sets of view category specific neural network parameters based on the predetermined echocardiographic image view category associated with the echocardiographic training image; and

using the echocardiographic training image as an input and the associated expert quality assessment value as a desired output, train a neural network defined by the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters to update the set of common neural network parameters and the selected one of the sets of view category specific neural network parameters.

17. (Currently Amended) A computer-implemented method of facilitating echocardiographic image analysis, the method comprising:

receiving signals representing a first at least one echocardiographic image;

associating the first at least one echocardiographic image with a first view category of a plurality of predetermined echocardiographic image view categories;

determining, based on the first at least one echocardiographic image and the first view category, a first quality assessment value representing a view category specific quality assessment of the first at least one echocardiographic image;

producing signals representing the first quality assessment value for causing the first quality assessment value to be associated with the first at least one echocardiographic image;

receiving signals representing a second at least one echocardiographic image;

associating the second at least one echocardiographic image with a second view category of the plurality of predetermined echocardiographic image view categories, said second view category being different from the first view category;

determining, based on the second at least one echocardiographic image and the second view category, a second quality assessment value representing a view category specific quality assessment of the second at least one echocardiographic image; and

producing signals representing the second quality assessment value for causing the second quality assessment value to be associated with the second at least one echocardiographic image;

wherein each of the plurality of predetermined echocardiographic image view categories is associated with a respective set of assessment parameters, each of the sets of assessment parameters being a set of neural network parameters that defines a neural network having a plurality of layers including an input layer configured to receive one or more echocardiographic images and an output layer configured to output one or more quality assessment values and wherein:

determining the first quality assessment value comprises:

determining that a first set of assessment parameters of the sets of assessment parameters is associated with the first view category; and

in response to determining that the first set of assessment parameters is associated with the first view category, inputting the first at least one echocardiographic image into the neural network defined by the first set of assessment parameters applying a first function based on the first set of assessment parameters to the first at least one echocardiographic image; and

determining the second quality assessment value comprises:

determining that a second set of assessment parameters of the sets of assessment parameters is associated with the second view category; and

in response to determining that the second set of assessment parameters is associated with the second view category, inputting the second at least one echocardiographic image into the neural network defined by the second set of assessment parameters.

18. (Original) The method of claim 17 wherein the first quality assessment value represents an assessment of suitability of the first at least one echocardiographic image for quantified clinical measurement of anatomical features and wherein the second quality assessment value represents an assessment of suitability of the second at least one echocardiographic image for quantified measurement of anatomical features.

19. (Previously presented) The method of claim 17 wherein:

producing the signals representing the first quality assessment value comprises producing signals for causing a representation of the first quality assessment value to be transmitted to at least one display for causing the at least one display to display the first quality assessment value in association with the first at least one echocardiographic image, to assist one or more operators of an echocardiographic device in capturing at least one subsequent echocardiographic image; and

producing the signals representing the second quality assessment value comprises producing signals for causing a representation of the second quality assessment value to be transmitted to the at least one display for causing the at least one display to display the second quality assessment value in association with the second at least one echocardiographic image, to assist the one or more operators in capturing at least one subsequent echocardiographic image.

20. (Previously presented) The method of claim 17 wherein:

associating the first at least one echocardiographic image with the first view category comprises applying one or more view categorization functions to the first at least one echocardiographic image to determine that the first at least one echocardiographic image falls within the first view category; and

associating the second at least one echocardiographic image with the second view category comprises applying one or more view categorization functions to the second at least one echocardiographic image to determine that the second at least one echocardiographic image falls within the second view category.

21. (Previously presented) The method of claim 17 wherein the first at least one echocardiographic image comprises a plurality of echocardiographic images and wherein determining the first quality assessment value comprises determining a single quality assessment value representing a view category specific assessment of the plurality of echocardiographic images.

22. (Canceled)

23. (Currently Amended) The method of claim **17** [[22]] wherein each of the sets of assessment parameters includes:

a set of common assessment parameters, which are common to each of the sets of assessment parameters; and

a set of view category specific assessment parameters, which are unique to the set of assessment parameters.

24. (Canceled)

25-35. (Previously Canceled)

REMARKS

These remarks are responsive to the non-final Office action dated May 5, 2021. Prior to entry of this response, claims 1-24 were pending in the application. By way of this response, claims 1, 13, and 17 are amended and claims 6, 8, 22, and 24 are canceled without prejudice or disclaimer. No new subject matter has been introduced. Accordingly, claims 1 through 23 are pending and before the Examiner for consideration, with claims 1, 13, and 17 being independent. Applicant respectfully requests reconsideration of the application and allowance of the pending claims.

With respect to the remarks below, Applicant does not concede that previously pending claims are unpatentable over the cited reference. Applicant reserves the right to pursue in the future any claims that capture any subject matter supported by the present disclosure.

Support for any new claims and substantive claim amendments may be found at least in the following locations:

Claim	Support
1	Original claims 6 and 8, [0038], [0060]-[0079], [0090]-[0094], Figs. 3 & 11
13	Original claims 1, 6, and 8, [0038], [0060]-[0079], [0090]-[0094], Figs. 3 & 11
17	Original claims 22 and 24, [0009], [0038], [0060]-[0079], [0090]-[0094], Figs. 3 & 11

Claim Rejections – 35 U.S.C. § 102

All claims stand rejected under 35 U.S.C. § 102 as follows:

- Claims 1-24 as anticipated by Krishnan et al, US 2005/0251013

Applicant respectfully traverses these rejections, but nevertheless has amended independent claims 1, 13, and 17 to clarify further the claimed features over the cited art. Based on these amendments, and the remarks below, Applicant requests that all rejections be withdrawn.

Regarding anticipation under § 102, it is an established legal principle that "unless a reference discloses within the four corners of the document not only all of the limitations claimed but also all of the limitations arranged or combined in the same way as recited in

the claim, it cannot be said to prove prior invention of the thing claimed, and, thus, cannot anticipate under 35 U.S.C. §102." *Net MoneyIN, Inc. v. Verisign, Inc.*, 545 F.3d 1359, 1371 (Fed. Cir. 2008). Here, the cited reference fails to teach or suggest each of the limitations of the present claims.

Claim 1 is amended to recite, in part, the following:

> …
> wherein each of the plurality of predetermined echocardiographic image view categories is associated with a respective set of assessment parameters, each of the sets of assessment parameters being a set of neural network parameters that define a neural network having a plurality of layers including an input layer configured to receive one or more echocardiographic images and an output layer configured to output one or more quality assessment values, and wherein the at least one processor is configured to determine the first quality assessment value by:
>
> > determining that a first set of assessment parameters of the sets of assessment parameters is associated with the first view category; and
> > in response to determining that the first set of assessment parameters is associated with the first view category, inputting the first at least one echocardiographic image into the neural network defined by the first set of assessment parameters; and
>
> wherein the at least one processor is configured to determine the second quality assessment value by:
>
> > determining that a second set of assessment parameters of the sets of assessment parameters is associated with the second view category; and
> > in response to determining that the second set of assessment parameters is associated with the second view category, inputting the second at least one echocardiographic image into the neural network defined by the second set of assessment parameters.

Claim 17 is similarly amended. Claims 1 and 17 have been amended to include subject matter previously recited in now-canceled claims 6 and 8. Accordingly, amended claim 1 recites at least one processor configured to determine first and second quality assessment values of respective first and second echocardiographic images utilizing respective neural networks. Amended claim 17 recites a computer-implemented method for determining first and second quality assessment values of respective first and second echocardiographic images utilizing respective neural networks. The claims include determining that a set of assessment parameters is associated with a respective view category and, in response, inputting a corresponding echocardiographic image into a respective neural network to determine the respective quality assessment value of each image. Each neural network is defined by a respective set of assessment parameters

associated with one of a plurality of predetermined view categories that may characterize an echocardiographic image (e.g., AP2, AP3, AP4, AP5, $PSAX_A$, $PSAX_{PM}$, PLAX - see para. [0060]).

The first and second images are associated with respective first and second view categories of the plurality of predetermined view categories, and it is determined that respective first and second sets of assessment parameters are associated with those view categories. To obtain quality assessment values, the first and second images are input into neural networks defined by the first and second sets of assessment parameters, respectively. The output layer of each neural network is configured to output a corresponding quality assessment value. Accordingly, a view category specific quality assessment value is obtained for each image using a neural network defined by assessment parameters associated with a view category associated with that image.

In contrast, Krishnan teaches systems and methods for processing a medical image to automatically identify anatomy and view (or pose) from the medical image and automatically assess the diagnostic quality of the medical image [0002]. Krishnan teaches that the anatomy, view, and/or diagnostic quality may be identified and/or assessed by a classification module and/or a bank of classifiers configured to classify the images based on features extracted (see Krishnan at steps 201, 202 of Fig.2 below, steps 500, 502 of Fig. 5 below, para. [0043]).

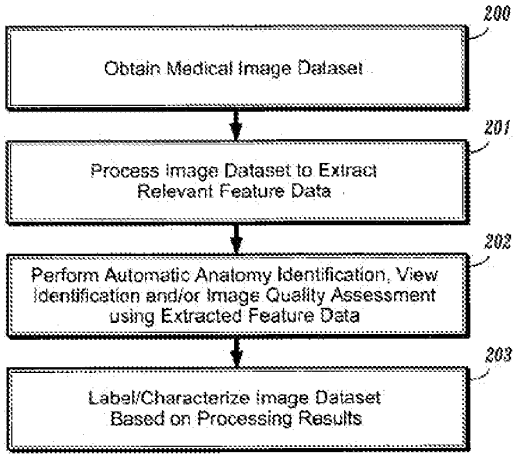


FIG. 2

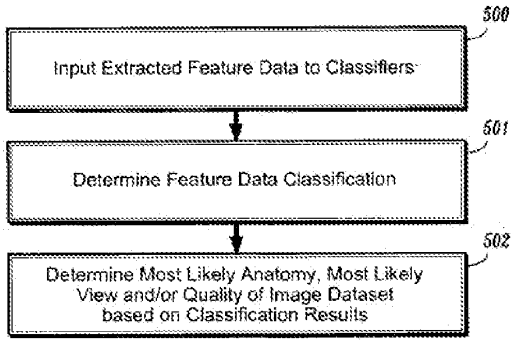


FIG. 5

The Office action at pp. 3-4 appears to interpret Krishnan's quality assessment module, which is configured to assess the diagnostic quality of the image, as reading on

the presently claimed determination of first and second quality assessment values. However, even assuming (without admitting) that this interpretation is reasonable, Krishnan fails to teach or suggest determining a quality assessment value of an image using a neural network defined by a set of assessment parameters associated with a view category associated with that image. At best, Krishnan suggests generally at para. [0020] that "the results of anatomy and/or view identification may be used for quality assessment." This is not the same as, and cannot reasonably be interpreted to be, the claimed neural network defined by a set of assessment parameters associated with a view category corresponding to the image.

Furthermore, Krishnan fails to teach or suggest determining quality assessment values for each of two images using two respective neural networks corresponding to the respective view category of each image. Accordingly, Krishnan cannot and does not teach the claimed use of a first neural network defined by a first set of assessment parameters to determine a quality assessment value for a first image, and use of a second neural network defined by a second set of assessment parameters to determine a quality assessment value for a second image, wherein the assessment parameters defining each network are associated with a view category of the associated image.

For at least these reasons, Krishnan fails to teach all of the features of claims 1 and 17. Claims 1 and 17 therefore are not anticipated by Krishnan.

Claim 13 is amended to recite, in part, the following:

> A computer-implemented system for training neural networks to facilitate echocardiographic image analysis, the system comprising at least one processor configured to:
> …
> train the neural networks using the plurality of echocardiographic training images and the associated expert quality assessment values to determine sets of neural network parameters defining the neural networks, at least a portion of each of said neural networks associated with one of the plurality of predetermined echocardiographic image view categories;
> wherein the at least one processor is further configured to, once the neural networks are trained:
> receive signals representing a first at least one echocardiographic image;
> associate the first at least one echocardiographic image with a first view category of a plurality of predetermined echocardiographic image view categories;
> determine, based on the first at least one echocardiographic image and the first view category, a first quality assessment value

representing a view category specific quality assessment of the first at least one echocardiographic image;
produce signals representing the first quality assessment value for causing the first quality assessment value to be associated with the first at least one echocardiographic image;
receive signals representing a second at least one echocardiographic image;
associate the second at least one echocardiographic image with a second view category of the plurality of predetermined echocardiographic image view categories, said second view category being different from the first view category;
determine, based on the second at least one echocardiographic image and the second view category, a second quality assessment value representing a view category specific quality assessment of the second at least one echocardiographic image; and
produce signals representing the second quality assessment value for causing the second quality assessment value to be associated with the second at least one echocardiographic image;
wherein each of the plurality of predetermined echocardiographic image view categories is associated with a respective set of assessment parameters, each of the sets of assessment parameters being a set of neural network parameters that define a neural network having a plurality of layers including an input layer configured to receive one or more echocardiographic images and an output layer configured to output one or more quality assessment values, and wherein the at least one processor is configured to determine the first quality assessment value by:

determining that a first set of assessment parameters of the sets of assessment parameters is associated with the first view category; and

in response to determining that the first set of assessment parameters is associated with the first view category, inputting the first at least one echocardiographic image into the neural network defined by the first set of assessment parameters; and

wherein the at least one processor is configured to determine the second quality assessment value by:

determining that a second set of assessment parameters of the sets of assessment parameters is associated with the second view category; and

in response to determining that the second set of assessment parameters is associated with the second view category, inputting the second at least one echocardiographic image into the neural network defined by the second set of assessment parameters.

Accordingly, amended claim 13 recites a computer-implemented system comprising at least one processor configured to both train and utilize neural networks to facilitate echocardiographic image analysis. The system includes at least one processor

configured to determine first and second quality assessment values of respective first and second echocardiographic images utilizing respective neural networks. Each neural network is defined by a respective set of assessment parameters associated with one of a plurality of predetermined view categories that may characterize an echocardiographic image.

As described above with reference to claims 1 and 17, Krishnan fails to teach or suggest the above-recited features. Furthermore, Krishnan fails to teach or suggest training neural networks using a plurality of echocardiographic training images and associated expert quality assessment values, such that at least a portion of each neural network is associated with one of a plurality of predetermined echocardiographic image view categories, as recited in amended claim 13. Amended independent claim 13 therefore is not anticipated by Krishnan.

Accordingly, amended claims 1, 13, and 17 recite features not found in Krishnan, and are therefore not anticipated by Krishnan. For at least these reasons, amended claims 1, 13, and 17 and their dependent claims are distinguishable and allowable over the cited reference, and Applicant respectfully requests the withdrawal of all rejections under 35 U.S.C. § 102.

CONCLUSION

In view of the above amendments and remarks, Applicant believes that this application is now in condition for allowance. Accordingly, Applicant respectfully requests that the Examiner issue a Notice of Allowance covering all of the claims. If the Examiner has any questions, or if a telephone interview would in any way advance prosecution of the application, please contact the undersigned practitioner of record at (503) 994-1650. The Commissioner is hereby authorized to charge or credit any deficiencies or over-payments to Deposit Account No. 602562 which may be required in connection with this filing.

CERTIFICATE OF EFS-WEB TRANSMISSION

I hereby certify that this correspondence is being transmitted via the U.S. Patent and Trademark Office electronic filing system (EFS-Web) to the USPTO on August 5, 2021.

/Lukas McNett/
Lukas MCNETT

Respectfully submitted,

/David C. Bourgeau/
David C. BOURGEAU III
Registration No. 72,711
Kolitch Romano LLP
520 SW Yamhill Street, Ste. 200
Portland, Oregon 97204
Telephone: (503) 994-1650

Electronic Acknowledgement Receipt

EFS ID:	43438575
Application Number:	16095601
International Application Number:	
Confirmation Number:	6264
Title of Invention:	ECHOCARDIOGRAPHIC IMAGE ANALYSIS
First Named Inventor/Applicant Name:	Purang ABOLMAESUMI
Customer Number:	157691
Filer:	David Charles Bourgeau III/Lukas McNett
Filer Authorized By:	David Charles Bourgeau III
Attorney Docket Number:	CRB313
Receipt Date:	05-AUG-2021
Filing Date:	22-OCT-2018
Time Stamp:	16:01:50
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		20210805_Amendment_and_Response_to_Office_Action_CRB313.pdf	258985 0a82b83220432ef32c0835fdfdac91823595ed39	yes	18

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Claims	2	11
	Applicant Arguments/Remarks Made in an Amendment	12	18
Warnings:			
Information:			
	Total Files Size (in bytes):	258985	

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.

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

NOTICE OF ALLOWANCE AND FEE(S) DUE

157691 7590 08/18/2021

KOLITCH ROMANO LLP
520 SW Yamhill Street, Suite 200
Portland, OR 97204

EXAMINER	
HUYNH, VAN D	
ART UNIT	PAPER NUMBER
2665	

DATE MAILED: 08/18/2021

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/095,601	10/22/2018	Purang ABOLMAESUMI	CRB313	6264

TITLE OF INVENTION: ECHOCARDIOGRAPHIC IMAGE ANALYSIS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$600	$0.00	$0.00	$600	11/18/2021

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: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (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)

157691 7590 08/18/2021
KOLITCH ROMANO LLP
520 SW Yamhill Street, Suite 200
Portland, OR 97204

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 transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/095,601	10/22/2018	Purang ABOLMAESUMI	CRB313	6264

TITLE OF INVENTION: ECHOCARDIOGRAPHIC IMAGE ANALYSIS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$600	$0.00	$0.00	$600	11/18/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
HUYNH, VAN D	2665	382-128000

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 03-09 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 must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). 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. Fees submitted: ❑Issue Fee ❑Publication Fee (if required) ❑Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

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.
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.
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. _____

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.
16/095,601	10/22/2018	Purang ABOLMAESUMI	CRB313	6264

157691 7590 08/18/2021

KOLITCH ROMANO LLP
520 SW Yamhill Street, Suite 200
Portland, OR 97204

EXAMINER	
HUYNH, VAN D	

ART UNIT	PAPER NUMBER
2665	

DATE MAILED: 08/18/2021

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 30 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. 16/095,601	Applicant(s) ABOLMAESUMI et al.	
	Examiner VAN D HUYNH	Art Unit 2665	AIA (FITF) Status Yes

-- 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 Amendment filed on 08/05/2021.
   ☐ 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 1-5,7,9-21 and 23 . 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 _____.

/VAN D HUYNH/
Primary Examiner, Art Unit 2665

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

REASONS FOR ALLOWANCE

2. The following is an examiner's statement of reasons for allowance: Claims 1-5, 7, 9-21, and 23 are allowed.

The prior art made of record and considered pertinent to the applicant's disclosure, taken individually or in combination, does not teach the claimed invention having the following limitations, in combination with the remaining claimed limitations.

Regarding independent claims 1, 13, and 17, the closest prior art (Park, Krishnan '903, Krishnan '013, Lu, Olivieri, Monahan) does not teach or suggest the claimed invention having "wherein the at least one processor is configured to determine the first quality assessment value by: determining that a first set of assessment parameters of the sets of assessment parameters is associated with the first view category; and in response to determining that the first set of assessment parameters is associated with the first view category, inputting the first at least one echocardiographic image into the neural network defined by the first set of assessment parameters; and wherein the at least one processor is configured to determine the second quality assessment value by: determining that a second set of assessment parameters of the sets of assessment parameters is associated with the second view category; and in response to determining that the second set of assessment parameters is associated

with the second view category, inputting the second at least one echocardiographic image into the neural network defined by the second set of assessment parameters", and a combination of other limitations thereof as recited in the claims.

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

3. Any inquiry concerning this communication or earlier communications from the examiner should be directed to VAN D HUYNH whose telephone number is (571)270-1937. The examiner can normally be reached on 8AM-6PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edward F Urban can be reached on (571) 272-7899. 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 https://ppair-my.uspto.gov/pair/PrivatePair. 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.

/VAN D HUYNH/
Primary Examiner, Art Unit 2665

Notice of References Cited	Application/Control No. 16/095,601	Applicant(s)/Patent Under Reexamination ABOLMAESUMI et al.	
	Examiner VAN D HUYNH	Art Unit 2665	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20090088640-A1	04-2009	Park; Jin Hyeong	G06K9/6257	600/453
*	B	US-20050020903-A1	01-2005	Krishnan, Sriram	G16H50/20	600/407
*	C	US-20050251013-A1	11-2005	Krishnan, Sriram	G06T7/0012	600/407
*	D	US-20090074280-A1	03-2009	Lu; Xiaoguang	A61B8/523	382/131
*	E	US-20150025666-A1	01-2015	Olivieri; Laura	G06F30/00	700/98
*	F	US-20150005629-A1	01-2015	Monahan; Kenneth J.	A61B8/481	600/431
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/095,601	ABOLMAESUMI et al.
	Examiner	Art Unit
	VAN D HUYNH	2665

CPC - Searched*		
Symbol	**Date**	**Examiner**
A61B8/0883, A61B8/463, G06N3/04, A61B8/4405, G06T7/0012, G06N3/08, G06N3/082, G06T2207/10132, G06T2207/20081, G06T2207/20084, G06T2207/30048, G06T2207/30168, G16H50/20, A61B8/5215	05/02/2021	vh
CPC search updated	08/07/2021	vh

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**
382	128	05/02/2021	vh
	class/subclass search updated	08/07/2021	vh

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

/VAN D HUYNH/ Primary Examiner, Art Unit 2665	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/095,601	ABOLMAESUMI et al.
	Examiner	Art Unit
	VAN D HUYNH	2665

Search Notes		
Search Notes	**Date**	**Examiner**
EAST (US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT ; IBM_TDB)	05/02/2021	vh
382/128 (text search- see EAST search history)	05/02/2021	vh
A61B8/0883, A61B8/463, G06N3/04, A61B8/4405, G06T7/0012, G06N3/08, G06N3/082, G06T2207/10132, G06T2207/20081, G06T2207/20084, G06T2207/30048, G06T2207/30168, G16H50/20, A61B8/5215(text search- see EAST search history)	05/02/2021	vh
Double Patenting Search (text search- see EAST search history)	05/02/2021	vh
Inventor Name/Assignee Search (text search- see EAST search history)	05/02/2021	vh
Search Plus (see EAST search history)	05/02/2021	vh
ip.com (see search history printout)	05/02/2021	vh
Google Patents/Google Scholar (see search history printout)	05/02/2021	vh
NPL Search (see search history printout)	05/02/2021	vh
Checked Global Dossier for all patents family information including foreign searches and Office Actions	05/02/2021	vh
EAST search updated	08/07/2021	vh

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
	EAST interference search using ".clm." category	08/07/2021	vh

/VAN D HUYNH/ Primary Examiner, Art Unit 2665	

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/095,601	ABOLMAESUMI et al.
	Examiner	Art Unit
	VAN D HUYNH	2665

CPC						
Symbol					Type	Version
A61B	/	8	/	0883	F	2013-01-01
A61B	/	8	/	4405	I	2013-01-01
G06T	/	7	/	0012	I	2013-01-01
G06N	/	3	/	04	I	2013-01-01
A61B	/	8	/	463	I	2013-01-01
G06N	/	3	/	08	I	2013-01-01
G06T	/	2207	/	10132	A	2013-01-01
G06T	/	2207	/	20081	A	2013-01-01
G06T	/	2207	/	20084	A	2013-01-01
G06T	/	2207	/	30048	A	2013-01-01
G06T	/	2207	/	30168	A	2013-01-01
G06N	/	3	/	082	A	2013-01-01

CPC Combination Sets							
Symbol					Type	Set	Ranking	Version
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	20	
/VAN D HUYNH/ Primary Examiner, Art Unit 2665	07 August 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	5

U.S. Patent and Trademark Office — Part of Paper No.: 20210807

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/095,601	ABOLMAESUMI et al.
	Examiner	**Art Unit**
	VAN D HUYNH	2665

INTERNATIONAL CLASSIFICATION				
CLAIMED				
G06K	/	9	/	00

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**
382	128

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/VAN D HUYNH/ Primary Examiner, Art Unit 2665	07 August 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	5

U.S. Patent and Trademark Office — Part of Paper No.: 20210807

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/095,601	ABOLMAESUMI et al.
	Examiner	**Art Unit**
	VAN D HUYNH	2665

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

CLAIMS

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

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/VAN D HUYNH/ Primary Examiner, Art Unit 2665	07 August 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	5

U.S. Patent and Trademark Office — Part of Paper No.: 20210807

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	7	"20190125298"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/22 13:37
S2	9	"20090088640"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/26 10:30
S3	5	"20050020903"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/26 10:56
S5	113	((("ABOLMAESUMI") near3 ("Purang")) OR (("ROHLING") near3 ("Robert")) OR (("ABDI") near3 ("Amir")) OR (("TSANG") near3 ("Teresa"))).INV.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 08:44
S7	1,236	((("THE") near3 ("UNIVERSITY") near3 ("OF") near3 ("BRITISH") near3 ("COLUMBIA"))).AS,AANM.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 08:48
S8	29	S5 and S7	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 08:48

S9	16,030	382/128.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 08:51
S10	220,610	(A61B8/0883 or A61B8/463 or G06N3/04 or A61B8/4405 or G06T7/0012 or G06N3/08 or G06N3/082 or G06T2207/10132 or G06T2207/20081 or G06T2207/20084 or G06T2207/30048 or G06T2207/30168 or G16H50/20 or A61B8/5215).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 08:52
S11	5,429	S9 and S10	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 08:53
S12	1	S8 and S9	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 08:53
S13	9	S8 and S10	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 08:54
S14	156	("20190125298" "5178149" "5419328" "5732707" "5749833" "5860927" "5871019" "6106466" "6149595" "6379303" "6385332" "6682485" "6711439" "8219193" "8821408" "9433792" "10653326" "20030195409" "20100049082" "20110093027" "20110093027" "20140350630" "20160325101" "20170273581" "20200100768" "20200237241" "6154750" "6171247" "6346124" "6381611" "6708055" "8073215" "8073215" "8092388" "8172756" "9011529" "9526615" "10402990" "10930379" "20030153823"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2021/04/28 08:57

		"20090074280" "20090088640" "20090219301" "20170132796" "20180286503" "20210052252" "4340287" "4465068" "4552012" "5535314").pn.				
S15	6	S9 and S14	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 08:59
S17	24	S10 and S14	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 08:59
S18	21	S14 and (echocardiograph$3 adj (image or picture or photo or photograph or frame or $4shot or clip or video))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 09:16
S19	2	S14 and (echocardiograph$3 adj (image or picture or photo or photograph or frame or $4shot or clip or video) with ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 09:29
S20	2	S14 and (echocardiograph$3 adj (image or picture or photo or photograph or frame or $4shot or clip or video) same ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 09:30
S21	9	S14 and (echocardiograph$3 adj (image or picture or photo or photograph or frame or $4shot or clip or video) and ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	ADJ	ON	2021/04/28 09:31

		neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))	DERWENT; IBM_TDB			
S22	108	("20100168578" | "20150086093" | "10242443" | "20150302638" | "20170360401" | "20090074280" | "8917917" | "20050251013" | "7680308" | "20050020903" | "20090088640" | "7912528" | "20170360403" | "20170360412" | "8891881" | "7672517" | "8712157" | "5776063" | "8744152" | "10140734" | "20170360402" | "8594398" | "9918701" | "8750375" | "10074038" | "10127659" | "20170360411" | "20180144214" | "20110082371" | "9652846" | "20050020903" | "20060147107" | "20090034808" | "20170026298" | "20170143312" | "20180153505" | "7672491").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 09:34
S23	1	S22 and (echocardiograph$3 adj (image or picture or photo or photograph or frame or $4shot or clip or video) with ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 10:21
S24	12	S22 and (echocardiograph$3 adj (image or picture or photo or photograph or frame or $4shot or clip or video))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 10:22
S25	7	S22 and (echocardiograph$3 adj (image or picture or photo or photograph or frame or $4shot or clip or video) same ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 10:23
S26	33	((echocardiograph$3 or (cardiac ultrasound)) adj (image or picture or photo or photograph or frame or $4shot or clip or video) with ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	ADJ	ON	2021/04/28 10:34

		(convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))	DERWENT; IBM_TDB			
S33	1	((echocardiograph$3 or (cardiac ultrasound)) adj (image or picture or photo or photograph or frame or $4shot or clip or video) with (view) with (qualit$3) with ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 10:45
S34	1	((echocardiograph$3 or (cardiac ultrasound)) adj (image or picture or photo or photograph or frame or $4shot or clip or video) with (view) with (qualit$3) same ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 10:45
S35	3	((echocardiograph$3 or (cardiac ultrasound)) adj (image or picture or photo or photograph or frame or $4shot or clip or video) with (view) with (qualit$3) and ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 10:46
S36	3	((echocardiograph$3 or ((cardiac or heart) adj ultrasound)) adj (image or picture or photo or photograph or frame or $4shot or clip or video) with (view) with (qualit$3) and ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 10:46
S37	3	((echocardiograph$3 or ((cardiac or heart) near3 ultrasound)) adj (image or picture or photo or photograph or frame or $4shot or clip or video) with (view) with (qualit$3) and ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 10:47

		neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))				
S38	7	(echocardiograph$3 or ((cardiac or heart) near3 ultrasound)) adj (image or picture or photo or photograph or frame or $4shot or clip or video) with (view) with (qualit$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/28 10:47
S39	3	"20050251013"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/05/01 12:12
S40	1	((echocardiograph$3 or (cardiac ultrasound)) adj (image or picture or photo or photograph or frame or $4shot or clip or video) with (view or plane or pose) with (qualit$3) with ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/05/01 14:59
S41	7	(echocardiograph$3 or (cardiac ultrasound)) adj (image or picture or photo or photograph or frame or $4shot or clip or video) with (view or plane or pose) with (qualit$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/05/01 15:00
S42	17	(image or picture or photo or photograph or frame or $4shot or clip or video) with (view or plane or pose) with (qualit$3) with (echocardiograph$3 or (cardiac ultrasound))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/05/01 15:02
S43	28	(image or picture or photo or photograph or frame or $4shot or clip or video) with (view or plane or pose) with (qualit$3) same (echocardiograph$3 or (cardiac ultrasound))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/05/01 15:02

S44	17	(image or picture or photo or photograph or frame or $4shot or clip or video) with (view or plane or pose) with (qualit$3) same (echocardiograph$3 or (cardiac ultrasound)) and ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/05/01 15:04
S46	34,815	(input$4 or train$3 or feed$3) near3 ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN) with (parameter or criterion or framework or guideline)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/08/07 13:52
S47	1	(input$4 or train$3 or feed$3) near3 (echocardiograph$3 adj (image or picture or photo or photograph or frame or $4shot or clip or video)) with ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN) with (parameter or criterion or framework or guideline)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/08/07 13:53
S48	6,709	(input$4 or train$3 or feed$3) near3 (image or picture or photo or photograph or frame or $4shot or clip or video) with ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN) with (parameter or criterion or framework or guideline)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/08/07 13:53
S49	3	(input$4 or train$3 or feed$3) near3 ((echocardiograph$3 or (cardiac ultrasound)) adj (image or picture or photo or photograph or frame or $4shot or clip or video)) with ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/08/07 13:55

		or ANN) with (parameter or criterion or framework or guideline)				
S50	13	(determin$3 or detect$3 or comput$3 or calculat$3) near3 (quality adj (value or result or number or amount)) with (parameter or criterion or framework or guideline) with (view or pose or scene)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/08/07 14:01
S51	0	(determin$3 or detect$3 or comput$3 or calculat$3) near3 (quality adj (value or result or number or amount)) with (parameter or criterion or framework or guideline) with (view or pose or scene) with((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/08/07 14:02
S52	28	(image or picture or photo or photograph or frame or $4shot or clip or video) with (view or plane or pose) with (qualit$3) same (echocardiograph$3 or (cardiac ultrasound))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/08/07 14:03
S53	0	S52 and S50	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/08/07 14:03
S54	0	S48 and S50	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/08/07 14:11
S55	0	S46 and S50	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/08/07 14:12
S56	592	(determin$3 or detect$3 or comput$3 or calculat$3) near3 (qualit$4) with	US-PGPUB; USPAT;	ADJ	ON	2021/08/07 14:12

		(parameter or criterion or framework or guideline) with (view or pose or scene)	USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			
S57	4	S48 and S56	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/08/07 14:13
S58	11	S46 and S56	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/08/07 14:13
S59	6	(determin$3 or detect$3 or comput$3 or calculat$3) near3 (qualit$4) with (parameter or criterion or framework or guideline) with (view or pose or scene) with ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/08/07 14:16
S60	7	(determin$3 or detect$3 or comput$3 or calculat$3) near3 (qualit$4) with (parameter or criterion or framework or guideline) with (view or pose or scene) same ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/08/07 14:17
S61	81	(determin$3 or detect$3 or comput$3 or calculat$3) near3 (qualit$4) with (parameter or criterion or framework or guideline) with (view or pose or scene) and ((machine learn$3) or ((learn$3 or train$3) model) or (deep learn$3) or DLN or (convolution$3 neural) or (deep neural) or (neural network) or CNN or DNN or CONvNet or (artificial neural network) or ANN)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/08/07 14:18

S62	16,031	382/128.ccls.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/08/07 14:21
S63	3	S62 and S61	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/08/07 14:21
S64	235,677	(A61B8/0883 or A61B8/463 or G06N3/04 or A61B8/4405 or G06T7/0012 or G06N3/08 or G06N3/082 or G06T2207/10132 or G06T2207/20081 or G06T2207/20084 or G06T2207/30048 or G06T2207/30168 or G16H50/20 or A61B8/5215).cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/08/07 14:21
S65	22	S64 and S61	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/08/07 14:21
S66	1	(determin$3 with (quality assessment value) with (assessment parameter) with (view category)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/08/07 14:25
S67	1	(determin$3 with (quality near3 value) with (parameter) with (view category)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/08/07 14:25
S69	1	(determin$3 with (quality near3 value) with (parameter) with (view) with (neural network)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/08/07 14:26

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S70	1	(determin$3 with (quality assessment value) with (assessment parameter) with (view category)).clm.	US-PGPUB; USPAT	ADJ	ON	2021/08/07 14:26
S71	1	(determin$3 with (quality near3 value) with (parameter) with (view category)).clm.	US-PGPUB; USPAT	ADJ	ON	2021/08/07 14:27
S72	1	(determin$3 with (quality near3 value) with (parameter) with (view) with (neural network)).clm.	US-PGPUB; USPAT	ADJ	ON	2021/08/07 14:27

8/7/2021 3:02:21 PM
C:\Users\vhuynh\Documents\EAST\Workspaces\16095601-2-echocardiography.wsp

Document Description: Issue Fee Payment (PTO-85B)

Issue Fee Transmittal Form

Application Number	Filing Date	First Named Inventor	Atty. Docket No.	Confirmation No.
16095601	22-Oct-2018	Purang ABOLMAESUMI	CRB313	6264

TITLE OF INVENTION :

ECHOCARDIOGRAPHIC IMAGE ANALYSIS

Entity Status	Application Type	Art Unit	Class - Subclass	EXAMINER
Small	U.S. National Stage under 35 USC 371	2665	128000	

Issue Fee Due	Publication Due	Total Fee(s) Due	Date Due	Prev. Paid Fee
$600	$0	$600	18-Nov-2021	$0

1.Change of Correspondence Address and/or Indication Of Fee Address (37 CFR 1.33 & 1.363)

Current Correspondence Address:	Current Indicated Fee Address :
157691 KOLITCH ROMANO LLP 520 SW Yamhill Street, Suite 200 Portland OR 97204 UNITED STATES 503-994-1650 USPTO@dockettrak.com	
☐ Change of correspondence address requested, system generated AIA/122-EFS form attached	☐ Fee Address indication requested, system generated SB/47-EFS form attached

2.Entity Status

Change in Entity Status

○ Applicant certifying micro entity status; system generated Micro Entity certification form attached. See 37 CFR 1.29.
Note: Absent a valid certification of micro entity status, issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment. If this box is checked, you will be prompted to choose a micro entity status on the gross income basis (37 CFR 1.29(a)) or the institution of higher education basis (37 CFR 1.29(d)), and make the applicable certification online.

◉ 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.

3.The Following Fee(s) Are Submitted:

☒ Issue Fee	☐ I authorize USPTO to apply my previously paid issue fee to the current fees due
☐ Publication Fee	☐ The Director is hereby authorized to apply my previously paid issue fee to the current fee due and to charge deficient fees to Deposit Account Number _____
☐ Advance Order - # of copies _____	☒ If **in addition to** the payment of the issue fee amount submitted with this form, there are any discrepancies in any amount(s) due, the Director is authorized to charge any deficiency or credit any overpayment, to Deposit Account Number 602562 . The **issue fee must be submitted** with this form. **If payment of the issue fee does not accompany this form, checking this box and providing a deposit account number will NOT be effective to satisfy full payment of the fee(s) due.**

4.Firm and/or Attorney Names To Be Printed

NOTE: If no name is listed, no name will be printed
For printing on the patent front page, list to be displayed as entered

1. Kolitch Romano LLP
2.
3.

5.Assignee Name(s) and Residence Data To Be Printed

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.

Name	City	State	Country	Category
The University of British Columbia	Vancouver		CANADA	other

6.Signature

I certify, in accordance with 37 CFR 1.4(d)(4) that I am an attorney or agent registered to practice before the Patent and Trademark Office who has filed and has been granted power of attorney in this application. I also certify that this Fee(s) Transmittal form is being transmitted to the USPTO via EFS-WEB on the date indicated below.

Signature	/David C. Bourgeau/	**Date**	08-19-2021
Name	David Charles Bourgeau III	**Registration Number**	72711

WEB IFEE 1.0

Electronic Patent Application Fee Transmittal

Application Number:	16095601
Filing Date:	22-Oct-2018
Title of Invention:	ECHOCARDIOGRAPHIC IMAGE ANALYSIS
First Named Inventor/Applicant Name:	Purang ABOLMAESUMI
Filer:	David Charles Bourgeau III/Lukas McNett
Attorney Docket Number:	CRB313

Filed as Small Entity

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

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPL ISSUE FEE	2501	1	600	600
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**600**

Electronic Acknowledgement Receipt	
EFS ID:	43555902
Application Number:	16095601
International Application Number:	
Confirmation Number:	6264
Title of Invention:	ECHOCARDIOGRAPHIC IMAGE ANALYSIS
First Named Inventor/Applicant Name:	Purang ABOLMAESUMI
Customer Number:	157691
Filer:	David Charles Bourgeau III/Lukas McNett
Filer Authorized By:	David Charles Bourgeau III
Attorney Docket Number:	CRB313
Receipt Date:	19-AUG-2021
Filing Date:	22-OCT-2018
Time Stamp:	17:49:36
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$600
RAM confirmation Number	E20218IH49321420
Deposit Account	602562
Authorized User	Lukas McNett
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.17 (Patent application and reexamination processing fees) 37 CFR 1.19 (Document supply fees)	

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

37 CFR 1.492 (National application filing, search, and examination fees)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	Web85b.pdf	62702 eeb6b48e3e8c6818749a97ece1765a31a55a2b2c	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	40431 1384c676638ef2fcfaa83b5fa2bb1ac2546355c2	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	103133		

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.

UNITED STATES PATENT AND TRADEMARK OFFICE
COMMISSIONER FOR PATENTS
P.O.BOX 1450
ALEXANDRIA VA 22313-1451

PRESORTED
FIRST-CLASS MAIL
U.S. POSTAGE PAID
POSTEDIGITAL
NNNNN

KOLITCH ROMANO LLP
520 SW Yamhill Street, Suite 200
Portland, OR 97204

Courtesy Reminder for
Application Serial No: 16/095,601

Attorney Docket No: CRB313
Customer Number: 157691
Date of Electronic Notification: 08/18/2021

This is a courtesy reminder that new correspondence is available for this application. If you have not done so already, please review the correspondence. The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

An email notification regarding the correspondence was sent to the following email address(es) associated with your customer number:

USPTO@dockettrak.com
docketing@kolitchromano.com

To view your correspondence online or update your email addresses, please visit us anytime at **https://ppair-my.uspto.gov/pair/PrivatePair.**
If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov or call 1-866-217-9197.

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.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/095,601	09/28/2021	11129591	CRB313	6264

157691 7590 09/08/2021

KOLITCH ROMANO LLP
520 SW Yamhill Street, Suite 200
Portland, OR 97204

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 500 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):

THE UNIVERSITY OF BRITISH COLUMBIA, Vancouver, CANADA;

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.

IR103 (Rev. 10/09)