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Application Number: 18127991 Document Date: 03/29/2023

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Form Revision Date: March 1, 2019

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

PTO/AIA/82A (07-13)
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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	Not Yet Assigned
Filing Date	Concurrently Herewith
First Named Inventor	Jens Filip Andreas Richter
Title	SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION
Art Unit	Not Yet Assigned
Examiner Name	Not Yet Assigned
Attorney Docket Number	2010358-0284

SIGNATURE of Applicant or Patent Practitioner

Signature	/Ronen Adato/	Date (Optional)	March 29, 2023
Name	Ronen Adato, PhD, JD	Registration Number	76,341
Title (if Applicant is a juristic entity)	Attorney for Applicant		
Applicant Name (if Applicant is a juristic entity)	EXINI Diagnostics AB		

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.

[X] *Total of 1 forms are submitted.

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

PTO/AIA/82B (07-13)
Approved for use through 03/31/2021. OMB 0651-0035
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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.)

[X] 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: 24280

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:

[X] 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):

EXINI Diagnostics AB

[ ] Inventor or Joint Inventor (title not required below)

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

[X] 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	/ Eric Green /	Date (Optional)	
Name	Eric Green		
Title	Assistant Secretary; Lantheus Holdings, Inc. (EXINI Diagnostics AB is a wholly owned subsidiary of Lantheus Holdings, Inc. The signer is authorized to act on behalf of EXINI Diagnostics AB).		

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.

[X] Total of 1 forms are submitted.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION
First Named Inventor/Applicant Name:	Jens Filip Andreas Richter
Filer:	Ronen Adato/Kimberly Chrisom
Attorney Docket Number:	2010358-0284

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	320	320
UTILITY SEARCH FEE	1111	1	700	700
UTILITY EXAMINATION FEE	1311	1	800	800
Pages:				
UTILITY APPL SIZE FEE PER 50 SHEETS >100	1081	1	420	420
Claims:				
Miscellaneous-Filing:				
Petition:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**2240**

Electronic Acknowledgement Receipt

EFS ID:	47759638
Application Number:	18127991
International Application Number:	
Confirmation Number:	4023
Title of Invention:	SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION
First Named Inventor/Applicant Name:	Jens Filip Andreas Richter
Customer Number:	24280
Filer:	Ronen Adato/Kimberly Chrisom
Filer Authorized By:	Ronen Adato
Attorney Docket Number:	2010358-0284
Receipt Date:	29-MAR-2023
Filing Date:	
Time Stamp:	15:42:10
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$2240
RAM confirmation Number	E20233SF42557617
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

MIM Ex1004

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	2023-03-24_Application_Data_Sheet_Fillable_PDF.PDF	2226150 c03044a7c76ce39eb95539f7eff470f922fd3455	no	10
Warnings:					
Information:					
2		2023-03-29_Application_for_filing.PDF	1079070 22a5e2c1454d4c2f1f6ef8193ae35e4b6a9656e2	yes	168

Multipart Description/PDF files in .zip description

Document Description	Start	End
Specification	1	134
Claims	135	167
Abstract	168	168

Warnings:					
Information:					
3	Drawings-other than black and white line drawings	2023-03-29_Figures_for_filing.PDF	11994073 1bbf5e3c6bc9cf19b8c7dd1b6fde01eb70ca15e8	no	26
Warnings:					
Information:					
4	Oath or Declaration filed	2023-03-29_Declaration_for_filing.PDF	5548775 a3da70fd1783f96f63d343228d23cc225f516fae	no	9
Warnings:					
Information:					
5	Power of Attorney	2023-03-29_POA_for_filing.PDF	467129 0fc6de81d2c51a6a10a593d058c583bea1a2dccf	no	2

Warnings:					
Information:					
6	Fee Worksheet (SB06)	fee-info.pdf	46716 cf02e81a62cffe3a3f35efc60d786385815a09ce	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	21361913	

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.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	2010358-0284
	Application Number	
Title of Invention	SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION	

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
	Jens	Filip Andreas	Richter	

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

City	Country of Residence i
Lund	SE

Mailing Address of Inventor:

Address 1	c/o EXINI Diagnostics AB
Address 2	Ideon Science Park, Scheelevägen 27, Gateway
City	Lund
State/Province	
Postal Code	SE-223 70
Country i	SE

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Kerstin	Elsa Maria	Johnsson	

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

City	Country of Residence i
Lund	SE

Mailing Address of Inventor:

Address 1	c/o EXINI Diagnostics AB
Address 2	Ideon Science Park, Scheelevägen 27, Gateway
City	Lund
State/Province	
Postal Code	SE-223 70
Country i	SE

Inventor 3 Remove

Legal Name

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	2010358-0284
	Application Number	
Title of Invention	SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION	

Prefix	Given Name	Middle Name	Family Name	Suffix
	Erik	Konrad	Gjertsson	

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

City	Lund	Country of Residence [i]	SE

Mailing Address of Inventor:

Address 1	c/o EXINI Diagnostics AB
Address 2	Ideon Science Park, Scheelevägen 27, Gateway

City	Lund	State/Province	
Postal Code	SE-223 70	**Country** [i]	SE

Inventor 4 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Aseem	Undvall	Anand	

Residence Information (Select One) ● US Residency ◯ Non US Residency Active US Military Service

City	Queens	State/Province	NY	Country of Residence [i]	US

Mailing Address of Inventor:

Address 1	c/o EXINI Diagnostics AB
Address 2	Ideon Science Park, Scheelevägen 27, Gateway

City	Lund	State/Province	
Postal Code	SE-223 70	**Country** [i]	SE

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	24280		
Email Address	patentdocket@choate.com	Add Email	Remove Email

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	2010358-0284
	Application Number	
Title of Invention	SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION	

Application Information:

Title of the Invention	SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION		
Attorney Docket Number	2010358-0284	**Small Entity Status Claimed** ☐	
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	26	**Suggested Figure for Publication (if any)**	

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

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	24280		

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	2010358-0284
	Application Number	
Title of Invention	SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION	

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	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Division of	16/734599	2020-01-06
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
16/734599	Claims benefit of provisional	62/934305	2019-11-12
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
16/734599	Claims benefit of provisional	62/907158	2019-09-27
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
16/734599	Claims benefit of provisional	62/870210	2019-07-03
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
16/734599	Claims benefit of provisional	62/863608	2019-06-19
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
16/734599	Claims benefit of provisional	62/837941	2019-04-24
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
16/734599	Claims benefit of provisional	62/789155	2019-01-07

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	2010358-0284
	Application Number	
Title of Invention	SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION	

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)[i] 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).

Remove

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. Add

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	2010358-0284
	Application Number	
Title of Invention	SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION	

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 (01-22)
Approved for use through 05/31/2024. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	2010358-0284
	Application Number	
Title of Invention	SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION	

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 — Remove

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	EXINI Diagnostics AB		
Mailing Address Information For Applicant:			
Address 1	Ideon Science Park		
Address 2	Scheelevägen 27, Gateway		
City	Lund	**State/Province**	
Country	SE	Postal Code	SE-223 70
Phone Number		Fax Number	
Email Address			

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

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.

PTO/AIA/14 (01-22)
Approved for use through 05/31/2024. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	2010358-0284
	Application Number	
Title of Invention	SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION	

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.

Remove

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. Add

Signature:

Remove

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	/Ronen Adato/			Date (YYYY-MM-DD)	2023-03-29
First Name	Ronen	Last Name	Adato	Registration Number	76,341

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

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	2010358-0284
	Application Number	
Title of Invention	SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to and benefit of U.S. Provisional Application No. 62/789,155, filed January 07, 2019, U.S. Provisional Application No. 62/837,941, filed April 24, 2019, U.S. Provisional Application No. 62/863,608, filed June 19, 2019, U.S. Provisional Application No. 62/870,210, filed July 03, 2019, U.S. Provisional Application No. 62/907,158, filed September 27, 2019, U.S. Provisional Application No. 62/934,305, filed November 12, 2019, the content of each of which are hereby incorporated by reference in their entirety.

FIELD OF THE INVENTION

[0002] This invention relates generally to methods, systems, and architectures for automated analysis of medical images. More particularly, in certain embodiments, the invention relates to automated identification of one or more particular regions of interest (e.g., corresponding to specific organs or tissue) within images of a subject.

BACKGROUND OF THE INVENTION

[0003] Targeted image analysis involves the use of radiolabeled small molecules that bind to specific receptors, enzymes and proteins in the body that are altered during the evolution of disease. After administration to a patient, these molecules circulate in the blood until they find their intended target. The bound radiopharmaceutical remains at the site of disease, while the rest of the agent clears from the body. The radioactive portion of the molecule serves as a beacon so that an image may be obtained depicting the disease location and concentration using commonly available nuclear medicine cameras, known as single-

photon emission computerized tomography (SPECT) or positron emission tomography (PET) cameras, found in most hospitals throughout the world. Physicians can then use this information to determine the presence and the extent of disease in a patient. The physician can use this information to provide a recommended course of treatment to the patient and to track the progression of disease.

[0004] There are a variety of software-based analytical techniques available for analysis and enhancement of PET and SPECT images that can be used by a radiologist or physician. There are also a number of radiopharmaceuticals available for imaging particular kinds of cancer. Imaging agents used in the art include, among others include, without limitation ^{18}F-NaF, ^{11}C-Choline, 2-deoxy-2 [18F] fluoro-d-glucose (FDG), and the like. For example, the small molecule diagnostic 1404 targets the extracellular domain of prostate specific membrane antigen (PSMA), a protein amplified on the surface of >95% of prostate cancer cells and a validated target for the detection of primary and metastatic prostate cancer. 1404 is labeled with technetium-99m, a gamma-emitter isotope that is widely available, relatively inexpensive, facilitates efficient preparation, and has spectrum characteristics attractive for nuclear medicine imaging applications.

[0005] Another example radiopharmaceutical is PyL™ (also known as [^{18}F]DCFPyL, and 18F-PyL), which is a clinical-stage, fluorinated PSMA-targeted PET imaging agent for prostate cancer. A proof-of-concept study published in the April 2016 issue of the Journal of Molecular Imaging and Biology demonstrated that PET imaging with PyL™ showed high levels of PyL™ uptake in sites of putative metastatic disease and primary tumors, suggesting the potential for high sensitivity and specificity in detecting prostate cancer.

[0006] An oncologist may use images from a targeted PET or SPECT study of a patient as input in her assessment of whether the patient has a particular disease, e.g., prostate cancer, what stage of the disease is evident, what the recommended course of treatment (if

any) would be, whether surgical intervention is indicated, and likely prognosis. The oncologist may use a radiologist report in this assessment. A radiologist report is a technical evaluation of the PET or SPECT images prepared by a radiologist for a physician who requested the imaging study and includes, for example, the type of study performed, the clinical history, a comparison between images, the technique used to perform the study, the radiologist's observations and findings, as well as overall impressions and recommendations the radiologist may have based on the imaging study results. A signed radiologist report is sent to the physician ordering the study for the physician's review, followed by a discussion between the physician and patient about the results and recommendations for treatment.

[0007] Thus, the process involves having a radiologist perform an imaging study on the patient, analyzing the images obtained, creating a radiologist report, forwarding the report to the requesting physician, having the physician formulate an assessment and treatment recommendation, and having the physician communicate the results, recommendations, and risks to the patient. The process may also involve repeating the imaging study due to inconclusive results, or ordering further tests based on initial results.

[0008] If an imaging study shows that the patient has a particular disease or condition (e.g., cancer), the physician discusses various treatment options, including surgery, as well as risks of doing nothing or adopting a watchful waiting or active surveillance approach, rather than having surgery.

[0009] There are limitations associated with this process, both from the perspective of the physician and from the perspective of the patient. While the radiologist's report is certainly helpful, the physician must ultimately rely on her experience in formulating an assessment and recommendation for her patient. Furthermore, the patient must place a great deal of trust in his physician. The physician may show the patient his PET/SPECT images and may tell the patient a numerical risk associated with various treatment options or

likelihood of a particular prognosis, but the patient may very well struggle to make sense of this information. Moreover, the patient's family will likely have questions, particularly if cancer is diagnosed but the patient opts not to have surgery. The patient and/or his family members may search online for supplemental information and may become misinformed about risks of the diagnosed condition. A difficult ordeal may become more traumatic.

[0010] Thus, there remains a need for systems and methods for improved automated analysis of medical imaging studies and communication of those results, diagnoses, prognoses, treatment recommendations, and associated risks to a patient. Of particular need is an image analysis system to consistently, efficiently, and accurately detect anatomical regions, including soft tissue organs, in the entire body.

SUMMARY OF THE INVENTION

[0011] Presented herein are systems and methods that provide for automated analysis of three-dimensional (3D) medical images of a subject in order to automatically identify specific 3D volumes within the 3D images that correspond to specific anatomical regions e.g., organs and/or tissue). Notably, the image analysis approaches described herein are not limited to a single particular organ or portion of the body. Instead, they are robust and widely applicable, providing for consistent, efficient, and accurate detection of anatomical regions, including tissue and/or organs, in the entire body. In certain embodiments, the accurate identification of one or more such volumes is used to automatically determine quantitative metrics that represent uptake of radiopharmaceuticals in particular organs and/or tissue regions. These uptake metrics can be used to assess disease state in a subject, determine a prognosis for a subject, and/or determine efficacy of a treatment modality.

[0012] The capability of the approaches described herein to handle 3D images is an important advantage over certain other image analysis that only identify 2D regions in 2D

images. For example, one approach relevant for cancer detection, EXINI Diagnostics AB's Bone Scan Index (BSI) software, detects regions of suspected bone cancer (see also U.S. Patent Application No. 8,855,387, issued October 7, 2014). However, the BSI analysis is carried out on two-dimensional scintigraphy images, as opposed to on three dimensional images.

[0013] Moreover, with the increase in the choices of imaging agents available to a physician to detect cancer, there remains a need for software with utility in analyzing images from any variety of imaging agents, using multiple detection modalities (SPECT/CT, PET/CT, and the like). Functional images such as SPECT and PET provide detailed and specific information on biological processes in the body, but their potential is only realized when combined with a detailed anatomical map so that function can be localized to individual organs and structures. Although CT and MRI provide detailed anatomical information, conventional (e.g., manual) identification of organs and structures is difficult, subjective and time consuming, making certain assessment infeasible without computer support. Accordingly, by providing platform agnostic image analysis approaches that allow for accurate and robust image segmentation applicable to a variety of imaging modalities, the systems and methods described herein facilitate image analysis of particular relevance to cancer detection, diagnosis, staging, and the like.

[0014] For example, the full body segmentation approaches described herein allow for automated analysis of combinations of anatomical and functional images in order to accurately identify and grade cancerous lesions within a subject. In particular, a PET/CT composite image can be acquired for a subject following administration of a radiopharmaceutical, such as a PSMA binding agent like PyL™. The automated, machine learning-based segmentation approaches described herein are used to identify, within the CT image of the PET/CT composite, target volumes of interest (VOIs) representing target tissue

regions where cancerous lesions may be found. For example, a skeletal VOI corresponding to a graphical representation of one or more bones of the subject may be identified. Once the skeletal VOI is identified in the anatomical, CT, image, it can be mapped to the PET image to identify a corresponding skeletal volume therein. The corresponding skeletal volume in the PET image is then analyzed to detect one or more localized regions of relatively high intensity, referred to as hotspots. These hotspots correspond, physically, to local regions of increased radiopharmaceutical accumulation and, accordingly, prospective cancerous lesions.

[0015] In certain embodiments, the ability to accurately and rapidly perform full body segmentation via the approaches described herein is leveraged to provide a useful and uniform scale on which to evaluate and/or measure radiopharmaceutical uptake levels in physical lesions corresponding to detected hotspots (e.g., to thereby grade expression levels of particular biomolecules, such as PSMA). In particular, in addition to detecting target VOIs corresponding to specific target tissue regions in which cancerous lesions may occur, additional target VOIs corresponding to reference tissue regions are also detected. These reference VOIs are also mapped to the PET image, to identify corresponding reference volumes therein. Measures of intensity, such as a mean, peak, maximum, etc., within these reference volumes are then computed and used as reference points against which to evaluate intensities of individual detected hotspots and convert them to index values on the scale.

[0016] For example, in certain embodiments, an aorta and a liver VOI, corresponding to a representation of a portion of an aorta and liver, respectively, are identified within the anatomical image and mapped to the functional image to identify corresponding reference volumes therein. Intensity levels of each of these reference volumes are determined (e.g., as a mean, median, peak, etc. of intensities of voxels within each reference volume), and assigned corresponding index levels on a scale. Then, for each particular individual hotspot, a hotspot intensity level is determined (e.g., similarly, as a mean, median, peak, etc. of voxel

intensities within the detected hotspot). A corresponding individual hotspot index value is then determined based individual hotspot intensity level, the aorta reference intensity level, and the liver reference intensity level. This approach provides a standardized scale on which to evaluate and measure uptake associated with hotspots across different images. This allows, for example, for comparison of multiple images obtained for a single subject at different time points, as well as comparison between images of different subjects.

[0017] In certain embodiments, individual hotspot indices are used to compute an overall index for the subject and/or particular target tissue region analyzed for presence of cancerous lesions. The overall index can serve as an indicator of disease severity and/or risk, for example by reflecting a total lesion volume within a particular target tissue region, with the weighting based on the hotspot index values for the individual detected hotspots to account for radiopharmaceutical uptake within the lesions. For example, a PSMA weighted total lesion volume within a skeletal volume can be computed as a weighted sum of individual detected hotspot volumes weighted by their corresponding index values. Such an index may reflect a level and/or aggressiveness of metastasis into bone.

[0018] Volumes corresponding to other tissue regions may be similarly identified and used to determine overall index values. For example, lymph node volumes may also be used to assess severity of metastases. Volumes corresponding to tissue regions where localized disease is initially found may also be identified and analyzed to detect lesions. For example, a prostate volume may be used to assess prostate cancer severity at its initial stages. Likewise, breast volumes representing breast tissue regions and lung volumes representing lung tissue regions can be used for assessment of localized breast and lung cancers, respectively.

[0019] According, by providing for full body segmentation and automated image-based analysis of cancerous lesions throughout various relevant target tissue regions

throughout a subject's body, the AI-based systems and methods described herein allow for analysis of a variety of cancers at various stages. The techniques can be used to identify and stage localized disease in relevant tissue regions such as the prostate, for example for early stage screening and monitoring, as well as to monitor regions such as bone and lymph nodes for metastasis as disease progresses. As such, the approaches described herein provide a complete set of tools for automated image-based detection of cancer, and tracking disease evolution, progression, and response to treatment.

[0020] In one aspect, the invention is directed to a method for automatically processing a 3D image to identify 3D volumes within the 3D image that correspond to particular target tissue regions, the method comprising: (a) receiving, by a processor of a computing device, a 3D anatomical image of a subject obtained using an anatomical imaging modality [e.g., x-ray computed tomography (CT); e.g., magnetic resonance imaging (MRI); e.g., ultra-sound], wherein the 3D anatomical image comprises a graphical representation of tissue (e.g., soft-tissue and/or bone) within the subject; (b) automatically identifying, by the processor, using one or more machine learning modules (e.g., wherein at least one of the one or more machine learning modules is a Convolutional Neural Network (CNN) module) for each of a plurality of target tissue regions, a corresponding target volume of interest (VOI) within the 3D anatomical image; (c) determining, by the processor, a 3D segmentation map representing a plurality of 3D segmentation masks, each 3D segmentation mask representing a particular identified target VOI (e.g., automatically, digitally stitching together the plurality of 3D segmentation masks to form the 3D segmentation map); and (d) storing and/or providing for display and/or further processing, the 3D segmentation map.

[0021] In certain embodiments, the 3D anatomical image is a full body image.

[0022] In certain embodiments, step (c) comprises digitally stitching together the plurality of 3D segmentation masks to form the 3D segmentation map {e.g., by creating an

initially empty image volume (e.g., initializing all voxel values to zero) and then inserting labels from each segmentation mask into the image volume [e.g., by mapping labeled (e.g., as representing a particular target tissue region as determined by a machine learning module) voxels of input images to one or machine learning modules to voxels of the image volume (e.g., so as to match voxels of the image volume to voxels of the input images that represent a same physical location, thereby labeling voxels of the image volume correctly)]}.

[0023] In certain embodiments, step (b) comprises, for at least one specific target tissue region: determining, using a first module (e.g., a localization module)(e.g., a first machine learning module), an initial VOI within the 3D anatomical image, the initial VOI corresponding to an anatomical region (e.g., a group of related tissue, such as a pelvic region, a chest region, a head and/or neck region, and the like) containing the specific target tissue region (e.g., wherein the initial VOI excludes more voxels of the 3D anatomical image than it includes; e.g., wherein the initial VOI includes less than 25% of the voxels of the 3D anatomical image; e.g., wherein a majority of voxels within the initial VOI represent physical volumes within the anatomical region); and identifying, using a second module (e.g., a segmentation module)(e.g., a second machine learning module), the target VOI corresponding to the specific target tissue region within the initial VOI.

[0024] In certain embodiments, the second module is a CNN module that implements a CNN.

[0025] In certain embodiments, the first module is a CNN module that implements a CNN to perform a coarse segmentation to automatically identify the initial VOI corresponding to the anatomical region containing the specific target tissue region [e.g., by automatically identifying a graphical representation of a group of related tissue within the anatomical image (e.g., and, subsequently, determining the initial VOI as a rectangular region (e.g., rectangular prism or rectangular box) entirely enclosing the identified graphical

representation of the group of related tissue)][e.g., by, for each of one or more particular tissue regions anticipated to be located within the anatomical region, automatically identifying a corresponding VOI in the anatomical image (e.g., via the coarse segmentation), e.g., and determining the initial VOI as a rectangular region entirely enclosing all of the identified VOIs corresponding to the particular tissue regions].

[0026] In certain embodiments, the first module receives a sub-sampled [e.g., by a factor of two or more (e.g., four) along one or more dimensions] version of the anatomical image as input and identifies the initial VOI using the sub-sampled version of the anatomical image [e.g., and wherein the second module receives a full resolution version of the anatomical image, cropped to the initial VOI (e.g., such that the first module operates on an lower resolution image that represents a larger physical volume than the second module, while the second module operates on a higher resolution image but representing a smaller physical volume)].

[0027] In certain embodiments, the first module is a first CNN module and the second module is a second CNN module, and wherein the first CNN module comprises additional filters in order to account for increased variability in image size with respect to the second CNN module.

[0028] In certain embodiments, the 3D anatomical image is a full body image and step (b) comprises: automatically determining, using one or more localization modules implementing machine learning technique(s) (e.g., wherein each localization module is a CNN module that implements a CNN), a plurality of initial VOIs within the 3D anatomical image, each initial VOI corresponding to a particular anatomical region (e.g., a group of related tissue, such as a pelvic region, a chest region, a head and/or neck region, a spine region, an upper body region, a lower body region, etc.) and in which an associated subset of the target VOIs are located; and for each initial VOI, automatically identifying, using one or

more segmentation modules implementing machine learning technique(s) (e.g., wherein each segmentation module is a CNN module that implements a CNN) the associated subset of target VOIs.

[0029] In certain embodiments, the plurality of initial VOIs comprises one or more members selected from the group consisting of: a pelvic region initial VOI corresponding to a pelvic region of the subject (e.g., wherein the subset of target VOIs located in the pelvic region initial VOI comprise one or more target VOIs corresponding to target tissue regions selected from the group consisting of a left and/or right ilium, a sacrum, and a coccyx); a spine region initial VOI corresponding to a spine of the subject (e.g., wherein the subset of target VOIs located in the pelvic region initial VOI comprise one or more target VOIs corresponding to target tissue regions selected from the group consisting of a thoracic vertebra, a lumber vertebra, and a sternum); a left upper body region initial VOI corresponding to a left side of the subject's upper body (e.g., wherein the subset of target VOIs located in the pelvic region initial VOI comprise one or more target VOIs corresponding to target tissue regions selected from the group consisting of one or more left rib(s), a left scapula, and a left clavicle); and a right upper body region initial VOI corresponding to a right side of the subject's upper body (e.g., wherein the subset of target VOIs located in the pelvic region initial VOI comprise one or more target VOIs corresponding to target tissue regions selected from the group consisting of one or more right rib(s), a right scapula, and a right clavicle).

[0030] In certain embodiments, the method comprises: (e) receiving, by the processor, a 3D functional image of the subject obtained using a functional imaging modality [e.g., single-photon emission computed tomography (SPECT); e.g., positron emission tomography (PET)][e.g., wherein the 3D functional image comprises a plurality of voxels, each representing a particular physical volume within the subject and having an intensity

value that represents detected radiation emitted from a the particular physical volume, wherein at least a portion of the plurality of voxels of the 3D functional image represent physical volumes within one or more of the target tissue regions of the subject]; and (f) identifying, by the processor, within the 3D functional image, one or more 3D volume(s), each corresponding to an identified target VOI, using the 3D segmentation map (e.g., by mapping 3D segmentation masks of the 3D segmentation map to the 3D functional image).

[0031] In certain embodiments, the method comprises: (g) determining, by the processor, a cancer status [(e.g., a prostate cancer status; e.g., a metastatic cancer status (e.g., metastatic cancer, including, e.g., metastatic prostate cancer, breast cancer, lung cancer, colon cancer, skin cancer, etc.)] for the subject (e.g., using intensities of voxels within the functional image and the one or more identified 3D volumes)(e.g., based on detected lesions) [e.g., a likelihood of the subject having and/or developing prostate cancer and/or a particular stage of prostate cancer (e.g., metastatic prostate cancer)][e.g., a likelihood of the subject having and/or developing a metastatic cancer (including, e.g., metastatic prostate cancer, breast cancer, lung cancer, colon cancer, skin cancer, etc.)].

[0032] In certain embodiments, the method comprises performing steps (a) – (g) repeatedly for a plurality of anatomical and corresponding functional images collected at different time points to determine, at each time point, a cancer status of the subject, thereby tracking cancer status over time (e.g., to evaluate disease progression and/or treatment efficacy).

[0033] In certain embodiments, the method comprises (e.g., prior to step (g)): (h) automatically adjusting, by the processor, intensities of voxels of the 3D functional image to correct for background uptake (e.g., of the radiopharmaceutical) in one or more background tissue regions (e.g., correcting for uptake of the radiopharmaceutical that occurs in the one or

more background tissue regions under normal circumstances, and which is not necessarily indicative of presence of cancerous lesions).

[0034] In certain embodiments, the target tissue regions comprise the one or more background tissue regions and step (h) comprises: using the 3D segmentation map to identify, within the 3D functional image, one or more 3D background tissue volume(s), each corresponding a particular background tissue region (e.g., by mapping 3D segmentation masks of the 3D segmentation map to the 3D functional image); and adjusting intensities of voxels of the 3D functional image based on intensities of voxels within the 3D background tissue volumes (e.g., by using intensities of voxels within the 3D background tissue volumes to estimate a contribution to intensities outside of the 3D background tissue volumes).

[0035] In certain embodiments, the one or more background tissue regions comprise one or more members selected from the group consisting of: a bladder (e.g., a urinary bladder), a kidney, a duodenum, a small intestine, a spleen, a liver, a pancreas, a stomach, an adrenal gland, a rectum, and testes.

[0036] In certain embodiments, the method comprises: (i) automatically detecting, by the processor, one or more hotspots within the 3D functional image determined to represent lesions based on intensities of voxels within the 3D functional image [e.g., based on a comparison of intensities within the 3D functional image with a threshold value (e.g., wherein the 3D functional image is a 3D PET image and the threshold is a particular standard uptake value (SUV) level)] (e.g., and also based on the one or more 3D volumes identified within the 3D functional image).

[0037] In certain embodiments, step (i) comprises using one or more thresholds [e.g., comparing intensities of voxels in the 3D functional image with the one or more thresholds (e.g., wherein the one or more thresholds comprises a plurality of region-specific thresholds,

each used for a specific sub-set of the one or more 3D volumes identified within the 3D functional image)].

[0038] In certain embodiments, step (i) comprises applying one or more filters to the 3D functional image [e.g., as in a blob detection technique; e.g., wherein the one or more filters comprises one or more Gaussian filters (e.g., a high pass Gaussian filter and a low pass Gaussian filter, as in a Difference of Gaussians approach); e.g., wherein the one or more filters comprises a Laplacian filter (e.g., as in a Laplacian of a Gaussian technique); e.g., wherein different filter kernels are used for different sub-sets of the one or more 3D volumes identified within the 3D functional image].

[0039] In certain embodiments, step (i) comprises using a combination of two or more techniques for identification of hotspots in different sub-sets of the one or more 3D volumes identified within the 3D functional image [e.g., using a first filtering approach (e.g., as in paragraph [0038]) for a first sub-set of the one or more 3D volumes and using a second filtering approach for a second sub-set; e.g., using thresholding approach (e.g., as paragraph [0037]) for a first sub-set of the one or more 3D volumes and using a filtering approach (e.g., as paragraph [0038]) for a second sub-set of the one or more 3D volumes].

[0040] In certain embodiments, step (i) comprises detecting an initial set of hotspots and, for at least a portion of the hotspots of the initial set, classifying each hotspot of at least a portion of the detected hotspots as either a cancerous lesion or not a cancerous lesion (e.g., as noise)[e.g., using a machine learning module; e.g., based on a shape and/or location of the hotspot (e.g., in combination with anatomical knowledge; e.g., wherein the location includes an identification of a particular target tissue region corresponding to the 3D volume in which the hotspot is located and/or a relative position of the hotspot within the particular target tissue region); e.g., and removing hotspots classified as not a cancerous lesion from the initial set, thereby obtaining a final set of hotspots determined to represent lesions].

[0041] In certain embodiments, the target tissue regions comprise one or more background tissue regions and the method comprises: using the 3D segmentation map to identify, within the 3D functional image, one or more 3D background tissue volume(s), each corresponding a particular background tissue region (e.g., a background tissue region in which significant radiopharmaceutical uptake occurs under normal circumstances and is not necessarily indicative of presence of cancerous lesions)(e.g., by mapping 3D segmentation masks of the 3D segmentation map to the 3D functional image); and excluding voxels of the 3D within the 3D background tissue from the voxels used to automatically detect the one or more hotspots at step (i).

[0042] In certain embodiments, the method comprises using the one or more detected hotspots (e.g., intensities of the one or more detected hotspots) to determine a cancer status for the subject.

[0043] In certain embodiments, the target tissue regions comprise one or more reference tissue regions and the method comprises: using the 3D segmentation map to identify, by the processor, within the 3D functional image, one or more 3D reference volume(s), each corresponding to a particular reference tissue region; determining, by the processor, one or more reference intensity values, each associated with a particular 3D reference volume of the one or more 3D reference volume(s) and corresponding to a measure of (e.g., an average/mean, a median, a maximum, etc.) intensity within the particular 3D reference volume; determining, by the processor, one or more individual hotspot intensity values, each associated with a particular hotspot of at least a portion of the detected one or more hotspots and corresponding to a measure of (e.g., an average/mean, a median, a maximum, etc.) intensity of the particular hotspot; and determining, by the processor, one or more individual hotspot index values using the one or more individual hotspot intensity values and the one or more reference intensity values [e.g., wherein each individual hotspot

index value is associated with a particular hotspot of the at least a portion of the detected one or more hotspots and determined using (e.g., based on a comparison between) (i) the individual hotspot intensity value associated with the particular hotspot and (ii) the one or more reference intensity values].

[0044] In certain embodiments, the determining the one or more individual hotspot index values comprises mapping each of the one or more reference intensity values to a corresponding reference index value on a scale and, for each individual hotspot intensity value, using the reference intensity values and corresponding reference index values to interpolate a corresponding individual hotspot index value.

[0045] In certain embodiments, the reference tissue regions comprise one or more members selected from the group consisting of: a liver, an aorta (e.g., a thoracic aorta portion; e.g., an abdominal aorta portion), and a parotid gland.

[0046] In certain embodiments, a first reference intensity value (i) is a blood reference intensity value associated with a 3D reference volume corresponding to an aorta portion, and (ii) maps to a first reference index value; a second reference intensity value (i) is a liver reference intensity value associated with a 3D reference volume corresponding to a liver, and (ii) maps to a second reference index value; and the second reference intensity value is greater than the first reference intensity value and the second reference index value is greater than the first reference index value.

[0047] In certain embodiments, the reference intensity values comprises a maximum reference intensity value that maps to a maximum reference index value, and hotspots having associated hotspot intensity values greater than the maximum reference intensity value are assigned hotspot index values equal to the maximum reference index value.

[0048] In certain embodiments, the method comprises determining, by the processor, an overall index value indicative of a cancer status of the subject using at least a portion of the one or more hotspot index values.

[0049] In certain embodiments, the overall index value is determined as a weighted sum of at least a portion [e.g., located within a 3D volume of the functional image that corresponds to a skeletal region of the subject; e.g., located within a 3D volume of the functional image that corresponds to a lymph region of the subject] of the individual hotspot index values [e.g., wherein each hotspot index value in the sum is weighted by a measure of size (e.g., 3D volume; e.g., average diameter) of the associated hotspot].

[0050] In certain embodiments, the overall index value is associated with a particular target tissue region corresponding to a particular target VOI identified within the anatomical image; and the overall index value is determined using hotspot index values of a subset of hotspots located within a particular 3D volume in the 3D functional image that corresponds to the particular identified target VOI [e.g., and wherein the overall index value is computed as a weighted sum of the hotspot index values of the subset of hotspots (e.g., wherein the weighted sum is normalized by an estimated volume of the particular target tissue region (e.g., computed as a volume of the particular 3D volume in the function image and/or a volume of the particular target VOI))].

[0051] In certain embodiments, the particular target tissue region is selected from the group consisting of: a skeletal region comprising one or more bones of the subject, a lymph region, and a prostate region.

[0052] In certain embodiments, the 3D anatomical image is an x-ray computed tomography (CT) image, and the 3D functional image is a 3D single photon emission computed tomography (SPECT) image.

[0053] In certain embodiments, the 3D anatomical image is an x-ray computed tomography (CT) image, and the 3D functional image is a 3D positron emission tomography (PET) image.

[0054] In certain embodiments, the 3D PET image of the subject is obtained following administration to the subject of a radiopharmaceutical comprising a prostate-specific membrane antigen (PSMA) binding agent.

[0055] In certain embodiments, the radiopharmaceutical comprises [18F]DCFPyL.

[0056] In certain embodiments, step (b) comprises cropping, by the processor, the 3D anatomical image to remove voxels representing air [e.g., to create a cropped anatomical image, and using the cropped anatomical image to identify the one or more target VOIs (e.g., using the cropped anatomical image is used as input to one or more machine learning modules, as opposed to the original size 3D anatomical image)].

[0057] In certain embodiments, the target tissue regions comprise one or more members selected from the group consisting of: a left hip bone, a right hip bone, a sacrum and coccyx region, a left clavicle, a right clavicle, a left rib, a right rib, a left scapula, a right scapula, a sternum, a lumbar vertebra, a thoracic vertebra, a skull, a cervical vertebra, a left femur, a right femur, a left humerus, a right humerus, a prostate, a urinary bladder, a rectum, a left gluteus maximus, a right gluteus maximus, an aorta (e.g., a thoracic aorta portion; e.g., an abdominal aorta portion), a left kidney, a right kidney, a liver, a left lung, a right lung, a spleen, a ventricle, a left adrenal gland, a right adrenal gland, a gallbladder, a brain, a pancreas, a heart, a mandible, a left bronchi, a right bronchi, a trachea, a left common iliac artery, a right common iliac artery, and a parotid gland.

[0058] In certain embodiments, one or more of the target tissue regions comprise one or more specific bones selected from the group consisting of: a left clavicle, a right clavicle, a left femur, a right femur, a left fibula, a right fibula, a left hip bone, a right hip bone, a left

humerus, a right humerus, a mandible, a left patella, a right patella, left radius, a right radius, a left tibia, a right tibia, a left ulna, a right ulna, a left rib (e.g., a first left rib, a second left rib, a third left rib, a fourth left rib, a fifth left rib, a sixth left rib, a seventh left rib, an eighth left rib, a ninth left rib, a tenth left rib, an eleventh left rib, a twelfth left rib), a right rib (e.g., a first right rib, a second right rib, a third right rib, a fourth right rib, a fifth right rib, a sixth right rib, a seventh right rib, an eighth right rib, a ninth right rib, a tenth right rib, an eleventh right rib, a twelfth right rib), a sacrum and coccyx (e.g., a combined sacrum and coccyx region; e.g., a sacrum and a coccyx individually, so as to distinguish between the two), a left scapula, a right scapula, a skull, sternum, a vertebrae region [e.g., a cervical vertebrae region, comprising one or more (e.g., up to all) cervical vertebrae; e.g., a lumber vertebrae region, comprising one or more (e.g., up to all) lumbar vertebrae; e.g., a thoracic vertebrae region, comprising one or more (e.g., up to all) thoracic vertebrae], and an individual vertebra [e.g., e.g., an individual cervical vertebra (e.g., a first cervical vertebra, a second cervical vertebra, a third cervical vertebra, a fourth cervical vertebra, a fifth cervical vertebra, a sixth cervical vertebra, a seventh cervical vertebra); e.g., an individual lumbar vertebra (e.g., a first lumbar vertebra, a second lumbar vertebra, a third lumbar vertebra, a fourth lumbar vertebra, a fifth lumbar vertebra, a sixth lumbar vertebra); e.g., an individual thoracic vertebra (e.g., a first thoracic vertebra, a second thoracic vertebra, a third thoracic vertebra, a fourth, thoracic vertebra, a fifth thoracic vertebra, a sixth thoracic vertebra, a seventh thoracic vertebra, an eighth thoracic vertebra, a ninth thoracic vertebra, a tenth thoracic vertebra, an eleventh thoracic vertebra, an twelfth thoracic vertebra)].

[0059] In certain embodiments, one or more of the target tissue regions comprise one or more specific bones selected from the group consisting of: a left clavicle, a right clavicle, a left hip bone, a right hip bone, a left rib (e.g., a first left rib, a second left rib, a third left rib, a fourth left rib, a fifth left rib, a sixth left rib, a seventh left rib, an eighth left rib, a ninth left

rib, a tenth left rib, an eleventh left rib, a twelfth left rib), a right rib (e.g., a first right rib, a second right rib, a third right rib, a fourth right rib, a fifth right rib, a sixth right rib, a seventh right rib, an eighth right rib, a ninth right rib, a tenth right rib, an eleventh right rib, a twelfth right rib), a sacrum and coccyx (e.g., a combined sacrum and coccyx region; e.g., a sacrum and a coccyx individually, so as to distinguish between the two), a left scapula, a right scapula, a sternum, a vertebrae region [e.g., a cervical vertebrae region, comprising one or more (e.g., up to all) cervical vertebrae; e.g., a lumber vertebrae region, comprising one or more (e.g., up to all) lumbar vertebrae; e.g., a thoracic vertebrae region, comprising one or more (e.g., up to all) thoracic vertebrae], and an individual vertebra [e.g., an individual lumbar vertebra (e.g., a first lumbar vertebra, a second lumbar vertebra, a third lumbar vertebra, a fourth lumbar vertebra, a fifth lumbar vertebra); e.g., an individual thoracic vertebra (e.g., a first thoracic vertebra, a second thoracic vertebra, a third thoracic vertebra, a fourth, thoracic vertebra, a fifth thoracic vertebra, a sixth thoracic vertebra, a seventh thoracic vertebra, an eighth thoracic vertebra, a ninth thoracic vertebra, a tenth thoracic vertebra, an eleventh thoracic vertebra, an twelfth thoracic vertebra)].

[0060] In certain embodiments, one or more of the target tissue regions comprise one or more soft-tissue regions (e.g., organs) selected from the group consisting of: a left adrenal gland, a right adrenal gland, an aorta (e.g., a thoracic aorta portion; e.g., an abdominal aorta portion), a brain, a left bronchi, a right bronchi, a gallbladder, a left gluteus maximus, a right gluteus maximus, a heart, a left common iliac artery, a right common iliac artery, a left kidney, a right kidney, a liver, a left lung, a right lung, a pancreas, a prostate, a rectum, a spleen , a trachea, a urinary bladder, a ventricle, and a parotid gland.

[0061] In certain embodiments, the one or more target tissue regions comprise one or more soft-tissue regions (e.g., organs) selected from the group consisting of: a gallbladder, a left kidney, a right kidney, a liver, a left lung, a right lung, a prostate, and a urinary bladder.

[0062] In certain embodiments, the target tissue regions comprise one or more bone regions, each corresponding to a specific bone [e.g., where the target tissue regions comprise at least a portion of (e.g., up to all) the bones listed in paragraph [0058] or [0059]] and one or more soft tissue regions, each corresponding to a specific soft-tissue region [e.g., where the target tissue regions comprise at least a portion of (e.g., up to all) the soft-tissue regions listed in paragraph [0060] or [0061]].

[0063] In another aspect, the invention is directed to a method for automatically processing 3D images to automatically identify cancerous lesions within a subject, the method comprising: (a) receiving, by a processor of a computing device, a 3D anatomical image of a subject obtained using an anatomical imaging modality [e.g., x-ray computed tomography (CT); e.g., magnetic resonance imaging (MRI); e.g., ultra-sound], wherein the 3D anatomical image comprises a graphical representation of tissue (e.g., soft-tissue and/or bone) within the subject; (b) automatically identifying, by the processor, using one or more machine learning modules (e.g., wherein at least one of the one or more machine learning modules is a Convolutional Neural Network (CNN) module), for each of a plurality of target tissue regions, a corresponding target volume of interest (VOI) within the 3D anatomical image; (c) determining, by the processor, a 3D segmentation map representing a plurality of 3D segmentation masks, each 3D segmentation mask representing a particular identified target VOI (e.g., automatically, digitally stitching together the plurality of 3D segmentation masks to form the 3D segmentation map); (d) receiving, by the processor, a 3D functional image of the subject obtained using a functional imaging modality [e.g., single-photon emission computed tomography (SPECT); e.g., positron emission tomography (PET)][e.g., wherein the 3D functional image comprises a plurality of voxels, each representing a particular physical volume within the subject and having an intensity value that represents detected radiation emitted from a the particular physical volume, wherein at least a portion of

the plurality of voxels of the 3D functional image represent physical volumes within one or more of the target tissue regions of the subject]; (e) identifying, within the 3D functional image, one or more 3D volume(s), each corresponding to an identified target VOI, using the 3D segmentation map (e.g., by mapping 3D segmentation masks of the 3D segmentation map to the 3D functional image); and (f) automatically detecting, by the processor, within at least a portion of the one or more 3D volumes identified within the 3D functional image, one or more hotspots determined to represent lesions based on intensities of voxels within the 3D functional image [e.g., based on a comparison of intensities within the 3D functional image with a threshold value (e.g., wherein the 3D functional image is a 3D PET image and the threshold is a particular standard uptake value (SUV) level)].

[0064] In certain embodiments, the method comprises using, by the processor, the one or more detected hotspots (e.g., intensities of the one or more detected hotspots) to determine a cancer status for the subject.

[0065] In certain embodiments, the target tissue regions comprise one or more reference tissue regions and wherein the method comprises: using the 3D segmentation map to identify, by the processor, within the 3D functional image, one or more 3D reference volume(s), each corresponding to a particular reference tissue region; determining one or more reference intensity values, each associated with a particular 3D reference volume of the one or more 3D reference volume(s) and corresponding to a measure of (e.g., an average/mean, a median, a maximum, etc.) intensity within the particular 3D reference volume; determining, by the processor, one or more individual hotspot intensity values, each associated with a particular hotspot of at least a portion of the detected one or more hotspots and corresponding to a measure of (e.g., an average/mean, a median, a maximum, etc.) intensity of the particular hotspot; and determining, by the processor, one or more individual hotspot index values using the one or more individual hotspot intensity values and the one or

more reference intensity values [e.g., wherein each individual hotspot index value is associated with a particular hotspot of the at least a portion of the detected one or more hotspots and determined using (e.g., based on a comparison between) (i) the individual hotspot intensity value associated with the particular hotspot and (ii) the one or more reference intensity values].

[0066] In certain embodiments, the reference tissue regions comprise one or more members selected from the group consisting of: a liver, an aorta (e.g., a thoracic aorta portion; e.g., an abdominal aorta portion), and a parotid gland.

[0067] In certain embodiments, the method comprises determining, by the processor, an overall index value indicative of a cancer status of the subject using at least a portion of the one or more hotspot index values.

[0068] In certain embodiments, the overall index value is determined as a weighted sum of at least a portion [e.g., located within a 3D volume of the functional image that corresponds to a skeletal region of the subject; e.g., located within a 3D volume of the functional image that corresponds to a lymph region of the subject] of the individual hotspot index values [e.g., wherein each hotspot index value in the sum is weighted by a measure of size (e.g., 3D volume; e.g., average diameter) of the associated hotspot].

[0069] In certain embodiments, the 3D anatomical image is an x-ray computed tomography (CT) image, and the 3D functional image is a 3D positron emission tomography (PET) image.

[0070] In certain embodiments, the 3D PET image of the subject is obtained following administration to the subject of a radiopharmaceutical comprising a prostate-specific membrane antigen (PSMA) binding agent.

[0071] In certain embodiments, the radiopharmaceutical comprises [18F]DCFPyL.

[0072] In another aspect, the invention is directed to a method for automatically processing 3D images to identify, and measure uptake of radiopharmaceutical in, cancerous lesions (e.g., metastases) within a subject having or at risk for a cancer (e.g., prostate cancer, breast cancer, lung cancer; e.g., a metastatic cancer, such as metastatic prostate cancer, metastatic breast cancer, metastatic lung cancer) , the method comprising: (a) receiving, by a processor of a computing device, a 3D anatomical image of a subject obtained using an anatomical imaging modality [e.g., x-ray computed tomography (CT); e.g., magnetic resonance imaging (MRI); e.g., ultra-sound], wherein the 3D anatomical image comprises a graphical representation of tissue (e.g., soft-tissue and/or bone) within the subject; (b) automatically identifying, by the processor, using one or more machine learning modules (e.g., wherein at least one of the machine learning modules is a Convolutional Neural Network (CNN) module), within the 3D anatomical image: a first skeletal volume comprising a graphical representation of one or more bones of the subject; a first aorta volume comprising a graphical representation of at least a portion of an aorta of the subject; and a first liver volume comprising a graphical representation of a liver of the subject; (c) determining, by the processor, a 3D segmentation map representing a plurality of 3D segmentation masks, including a skeletal mask representing the identified first skeletal volume, an aorta mask representing the identified first aorta volume, and a liver mask representing the identified first liver volume; (d) receiving, by the processor, a 3D functional image of the subject obtained using a functional imaging modality [e.g., single-photon emission computed tomography (SPECT); e.g., positron emission tomography (PET)][e.g., wherein the 3D functional image comprises a plurality of voxels, each representing a particular physical volume within the subject and having an intensity value that represents detected radiation emitted from a the particular physical volume, wherein at least a portion of the plurality of voxels of the 3D functional image represent physical volumes within one or

more bones, an aorta portion, and/or a liver of the subject]; (e) automatically identifying, within the 3D functional image, using the 3D segmentation map (e.g., by mapping the 3D segmentation masks of the 3D segmentation map to the 3D functional image): a second skeletal volume corresponding to the first identified skeletal volume, within the 3D anatomical image; a second aorta volume corresponding to the first aorta volume, identified within the 3D anatomical image; and a second liver volume corresponding to the first liver volume, identified within the 3D anatomical image; (f) automatically detecting, by the processor, within the second skeletal volume, one or more hotspots determined to represent lesions based on intensities of voxels within the second skeletal volume (e.g., the one or more hotspots corresponding to localized regions of relatively high intensity, e.g., identified based on a comparison of intensities of voxels located within the second skeletal volume with a threshold value); and (g) determining, by the processor, for each of the one or more detected hotspots, an individual hotspot index (e.g., indicative of a measure of radiopharmaceutical uptake in the lesions represented by the detected hotspot) value by: determining an aorta reference intensity level based on a measure (e.g., a mean, a maximum, a median, etc.) of intensity of voxels within the second aorta volume; determining a liver reference intensity level based on a measure (e.g., a mean, a maximum, a median, etc.) of intensity of voxels within the second liver volume; and for each individual detected hotspot: determining a corresponding individual hotspot intensity level based on a measure (e.g., a mean, a maximum, a median, etc.) of intensity of voxels of the detected hotspot; and determining a corresponding individual hotspot index level from the individual hotspot intensity level, the aorta reference intensity level, and the liver reference intensity level.

[0073] In certain embodiments, the method comprises determining, by the processor, an overall index value indicative of a cancer status of the subject based on the individual hotspot index values of at least a portion of the one or more detected hotspots.

[0074] In certain embodiments, the subject has or is at risk for prostate cancer.

[0075] In certain embodiments, step (b) comprises automatically identifying, within the 3D anatomical image, a first prostate volume comprising a graphical representation of a prostate of the subject, the 3D segmentation map determined at step (c) further includes a prostate mask representing the identified first prostate volume, step (e) comprises automatically identifying, within the 3D functional image, a second prostate volume corresponding to the first identified prostate volume, within the 3D anatomical image, step (f) comprises automatically detecting one or more hotspots in the second prostate volume, and the method further comprises: determining, by the processor, (i) an overall bone index value indicative of a lesion content (e.g., and severity) in the one or more bones of the subject based on the individual hotspot index values of at least a portion of the one or more detected hotspots located in the second skeletal volume and (ii) an overall prostate index value indicative of a lesion content (e.g., and severity) in the prostate of the subject based on the individual hotspot index values of at least a portion of the one or more detected hotspots located in the second prostate volume.

[0076] In certain embodiments, the subject has or is at risk for metastatic cancer (e.g., metastatic prostate cancer, metastatic breast cancer, metastatic lung cancer, and other metastatic bone cancers).

[0077] In another aspect, the invention is directed to a method for automatically processing a set of full body 3D anatomical images of varying sizes to automatically identify, within each 3D anatomical image, a plurality of 3D volumes that correspond to particular target tissue regions, the method comprising: (a) receiving, by a processor of a computing device, the set of 3D anatomical images of one or more subject(s) obtained using an anatomical imaging modality [e.g., x-ray computed tomography (CT); e.g., magnetic resonance imaging (MRI); e.g., ultra-sound], wherein the 3D anatomical image comprises a

graphical representation of tissue (e.g., soft-tissue and/or bone) within each of the one or more subject(s), wherein the set of 3D anatomical images has a mean x-dimension, a mean y-dimension, and a mean z-dimension, at least one of which (the mean x-, mean y-, or mean z-dimension) having a standard deviation at least 3% of the corresponding mean [e.g., at least one of which (the mean x-, mean y-, or mean z-dimension) having a relative standard deviation of at least 3 %, at least 5%, at least 10%, at least 15%, or at least 20%]; and (b) automatically determining, by the processor, using a localization module that implements a CNN, within each image of the set of 3D anatomical images, at least one initial VOI corresponding to a particular anatomical region (e.g., a group of related tissue, such as a pelvic region and a spin region) that comprises one or more particular associated target tissue regions (e.g., one or more specific bones, e.g., one or more specific organs), thereby identifying at least one initial VOI for the corresponding 3D anatomical image; and (c) for each initial VOI, automatically identifying, by the processor, using one or more segmentation modules each implementing a CNN, for each of the one or more particular target tissue regions associated with the particular anatomical region to which the initial VOI corresponds, a corresponding target VOI (e.g., a graphical representation of the particular target tissue region).

[0078] In another aspect, the invention is directed to a system for automatically processing a 3D image to identify 3D volumes within the 3D image that correspond to particular target tissue regions, the system comprising: a processor of a computing device; and a memory having instructions stored thereon, wherein the instructions, when executed by the processor, cause the processor to: (a) receive a 3D anatomical image of a subject obtained using an anatomical imaging modality [e.g., x-ray computed tomography (CT); e.g., magnetic resonance imaging (MRI); e.g., ultra-sound], wherein the 3D anatomical image comprises a graphical representation of tissue (e.g., soft-tissue and/or bone) within the subject; (b)

automatically identify, using one or more machine learning modules (e.g., wherein at least one of the one or more machine learning modules is a Convolutional Neural Network (CNN) module), for each of a plurality of target tissue regions, a corresponding target volume of interest (VOI) within the 3D anatomical image; (c) determine 3D segmentation map representing a plurality of 3D segmentation masks, each 3D segmentation mask representing a particular identified target VOI (e.g., automatically, digitally stitching together the plurality of 3D segmentation masks to form the 3D segmentation map); and (d) store and/or provide the 3D segmentation map for display and/or further processing.

[0079] In certain embodiments, the 3D anatomical image is a full body image.

[0080] In certain embodiments, at step (c) the instructions cause the processor to digitally stitch together the plurality of 3D segmentation masks to form the 3D segmentation map {e.g., by creating an initially empty image volume (e.g., initializing all voxel values to zero) and then inserting labels from each segmentation mask into the image volume [e.g., by mapping labeled (e.g., as representing a particular target tissue region as determined by a machine learning module) voxels of input images to one or machine learning modules to voxels of the image volume (e.g., so as to match voxels of the image volume to voxels of the input images that represent a same physical location, thereby labeling voxels of the image volume correctly)]}.

[0081] In certain embodiments, at step (b), the instructions cause the processor to, for at least one specific target tissue region: determine, using a first module (e.g., a localization module)(e.g., a first machine learning module), an initial VOI within the 3D anatomical image, the initial VOI corresponding to an anatomical region (e.g., a group of related tissue, such as a pelvic region, a chest region, a head and/or neck region, and the like) containing the specific target tissue region (e.g., wherein the initial VOI excludes more voxels of the 3D anatomical image than it includes; e.g., wherein the initial VOI includes less than 25% of the

voxels of the 3D anatomical image; e.g., wherein a majority of voxels within the initial VOI represent physical volumes within the anatomical region); and identify, using a second module (e.g., a segmentation module)(e.g., a second machine learning module), the target VOI corresponding to the specific target tissue region within the initial VOI.

[0082] In certain embodiments, the second module is a CNN module that implements a CNN.

[0083] In certain embodiments, the first module is a CNN module that implements a CNN to perform a coarse segmentation to automatically identify the initial VOI corresponding to the anatomical region containing the specific target tissue region [e.g., by automatically identifying a graphical representation of a group of related tissue within the anatomical image (e.g., and, subsequently, determining the initial VOI as a rectangular region (e.g., rectangular prism or rectangular box) entirely enclosing the identified graphical representation of the group of related tissue)][e.g., by, for each of one or more particular tissue regions anticipated to be located within the anatomical region, automatically identifying a corresponding VOI in the anatomical image (e.g., via the coarse segmentation), e.g., and determining the initial VOI as a rectangular region entirely enclosing all of the identified VOIs corresponding to the particular tissue regions].

[0084] In certain embodiments, the first module receives a sub-sampled [e.g., by a factor of two or more (e.g., four) along one or more dimensions] version of the anatomical image as input and identifies the initial VOI using the sub-sampled version of the anatomical image [e.g., and wherein the second module receives a full resolution version of the anatomical image, cropped to the initial VOI (e.g., such that the first module operates on an lower resolution image that represents a larger physical volume than the second module, while the second module operates on a higher resolution image but representing a smaller physical volume)].

[0085] In certain embodiments, the first module is a first CNN module and the second module is a second CNN module, and wherein the first CNN module comprises additional filters in order to account for increased variability in image size with respect to the second CNN module.

[0086] In certain embodiments, the 3D anatomical image is a full body image and wherein, at step (b), the instructions cause the processor to: automatically determine, using one or more localization modules implementing machine learning technique(s) (e.g., wherein each localization module is a CNN module that implements a CNN), a plurality of initial VOIs within the 3D anatomical image, each initial VOI corresponding to a particular anatomical region (e.g., a group of related tissue, such as a pelvic region, a chest region, a head and/or neck region, a spine region, an upper body region, a lower body region, etc.) and in which an associated subset of the target VOIs are located; and for each initial VOI, automatically identify, using one or more segmentation modules implementing machine learning technique(s) (e.g., wherein each segmentation module is a CNN module that implements a CNN) the associated subset of target VOIs.

[0087] In certain embodiments, the plurality of initial VOIs comprises one or more members selected from the group consisting of: a pelvic region initial VOI corresponding to a pelvic region of the subject (e.g., wherein the subset of target VOIs located in the pelvic region initial VOI comprise one or more target VOIs corresponding to target tissue regions selected from the group consisting of a left and/or right ilium, a sacrum, and a coccyx); a spine region initial VOI corresponding to a spine of the subject (e.g., wherein the subset of target VOIs located in the pelvic region initial VOI comprise one or more target VOIs corresponding to target tissue regions selected from the group consisting of a thoracic vertebra, a lumber vertebra, and a sternum); a left upper body region initial VOI corresponding to a left side of the subject's upper body (e.g., wherein the subset of target

VOIs located in the pelvic region initial VOI comprise one or more target VOIs corresponding to target tissue regions selected from the group consisting of one or more left rib(s), a left scapula, and a left clavicle); and a right upper body region initial VOI corresponding to a right side of the subject's upper body (e.g., wherein the subset of target VOIs located in the pelvic region initial VOI comprise one or more target VOIs corresponding to target tissue regions selected from the group consisting of one or more right rib(s), a right scapula, and a right clavicle).

[0088] In certain embodiments, the instructions cause the processor to: (e) receive a 3D functional image of the subject obtained using a functional imaging modality [e.g., single-photon emission computed tomography (SPECT); e.g., positron emission tomography (PET)][e.g., wherein the 3D functional image comprises a plurality of voxels, each representing a particular physical volume within the subject and having an intensity value that represents detected radiation emitted from a the particular physical volume, wherein at least a portion of the plurality of voxels of the 3D functional image represent physical volumes within one or more of the target tissue regions of the subject]; and (f) identify, within the 3D functional image, one or more 3D volume(s), each corresponding to an identified target VOI, using the 3D segmentation map (e.g., by mapping 3D segmentation masks of the 3D segmentation map to the 3D functional image).

[0089] In certain embodiments, the instructions cause the processor to: (g) determine a cancer status [(e.g., a prostate cancer status; e.g., a metastatic cancer status (e.g., metastatic cancer, including, e.g., metastatic prostate cancer, breast cancer, lung cancer, colon cancer, skin cancer, etc.)] for the subject (e.g., using intensities of voxels within the functional image and the one or more identified 3D volumes)(e.g., based on detected lesions) [e.g., a likelihood of the subject having and/or developing prostate cancer and/or a particular stage of prostate cancer (e.g., metastatic prostate cancer)][e.g., a likelihood of the subject having and/or

developing a metastatic cancer (including, e.g., metastatic prostate cancer, breast cancer, lung cancer, colon cancer, skin cancer, etc.)].

[0090] In certain embodiments, the instructions cause the processor to perform steps (a) – (g) repeatedly for a plurality of anatomical and corresponding functional images collected at different time points to determine, at each time point, a cancer status of the subject, thereby tracking cancer status over time (e.g., to evaluate disease progression and/or treatment efficacy).

[0091] In certain embodiments, the instructions cause the processor to (e.g., prior to step (g)): (h) automatically adjust intensities of voxels of the 3D functional image to correct for background uptake (e.g., of the radiopharmaceutical) in one or more background tissue regions (e.g., correcting for uptake of the radiopharmaceutical that occurs in the one or more background tissue regions under normal circumstances, and which is not necessarily indicative of presence of cancerous lesions).

[0092] In certain embodiments, the target tissue regions comprise the one or more background tissue regions and wherein, at step (h), the instructions cause the processor to: use the 3D segmentation map to identify, within the 3D functional image, one or more 3D background tissue volume(s), each corresponding a particular background tissue region (e.g., by mapping 3D segmentation masks of the 3D segmentation map to the 3D functional image); and adjust intensities of voxels of the 3D functional image based on intensities of voxels within the 3D background tissue volumes (e.g., by using intensities of voxels within the 3D background tissue volumes to estimate a contribution to intensities outside of the 3D background tissue volumes).

[0093] In certain embodiments, the one or more background tissue regions comprise one or more members selected from the group consisting of: a bladder (e.g., a urinary

bladder), a kidney, a duodenum, a small intestine, a spleen, a liver, a pancreas, a stomach, an adrenal gland, a rectum, and testes.

[0094] In certain embodiments, the instructions cause the processor to: (i) automatically detect one or more hotspots within the 3D functional image determined to represent lesions based on intensities of voxels within the 3D functional image [e.g., based on a comparison of intensities within the 3D functional image with a threshold value (e.g., wherein the 3D functional image is a 3D PET image and the threshold is a particular standard uptake value (SUV) level)] (e.g., and also based on the one or more 3D volumes identified within the 3D functional image).

[0095] In certain embodiments, at step (i), the instructions cause the processor to use one or more thresholds [e.g., comparing intensities of voxels in the 3D functional image with the one or more thresholds (e.g., wherein the one or more thresholds comprises a plurality of region-specific thresholds, each used for a specific sub-set of the one or more 3D volumes identified within the 3D functional image)].

[0096] In certain embodiments, at step (i), the instructions cause the processor to apply one or more filters to the 3D functional image [e.g., as in a blob detection technique; e.g., wherein the one or more filters comprises one or more Gaussian filters (e.g., a high pass Gaussian filter and a low pass Gaussian filter, as in a Difference of Gaussians approach); e.g., wherein the one or more filters comprises a Laplacian filter (e.g., as in a Laplacian of a Gaussian technique); e.g., wherein different filter kernels are used for different sub-sets of the one or more 3D volumes identified within the 3D functional image].

[0097] In certain embodiments, at step (i), the instructions cause the processor to use a combination of two or more techniques for identification of hotspots in different sub-sets of the one or more 3D volumes identified within the 3D functional image [e.g., using a first filtering approach (e.g., as in paragraph [0096]) for a first sub-set of the one or more 3D

volumes and using a second filtering approach for a second sub-set; e.g., using thresholding approach (e.g., as in paragraph [0095]) for a first sub-set of the one or more 3D volumes and using a filtering approach (e.g., as in paragraph [0096]) for a second sub-set of the one or more 3D volumes].

[0098] In certain embodiments, at step (i), the instructions cause the processor to detect an initial set of hotspots and, for at least a portion of the hotspots of the initial set, classify each hotspot of at least a portion of the detected hotspots as either a cancerous lesion or not a cancerous lesion (e.g., as noise)[e.g., using a machine learning module; e.g., based on a shape and/or location of the hotspot (e.g., in combination with anatomical knowledge; e.g., wherein the location includes an identification of a particular target tissue region corresponding to the 3D volume in which the hotspot is located and/or a relative position of the hotspot within the particular target tissue region); e.g., and removing hotspots classified as not a cancerous lesion from the initial set, thereby obtaining a final set of hotspots determined to represent lesions].

[0099] In certain embodiments, the target tissue regions comprise one or more background tissue regions and the instructions cause the processor to: use the 3D segmentation map to identify, within the 3D functional image, one or more 3D background tissue volume(s), each corresponding a particular background tissue region (e.g., a background tissue region in which significant radiopharmaceutical uptake occurs under normal circumstances and is not necessarily indicative of presence of cancerous lesions)(e.g., by mapping 3D segmentation masks of the 3D segmentation map to the 3D functional image); and exclude voxels of the 3D within the 3D background tissue from the voxels used to automatically detect the one or more hotspots at step (i).

[0100] In certain embodiments, the instructions cause the processor to use the one or more detected hotspots (e.g., intensities of the one or more detected hotspots) to determine a cancer status for the subject.

[0101] In certain embodiments, the target tissue regions comprise one or more reference tissue regions and the instructions cause the processor to: use the 3D segmentation map to identify, within the 3D functional image, one or more 3D reference volume(s), each corresponding to a particular reference tissue region; determine one or more reference intensity values, each associated with a particular 3D reference volume of the one or more 3D reference volume(s) and corresponding to a measure of (e.g., an average/mean, a median, a maximum, etc.) intensity within the particular 3D reference volume; determine one or more individual hotspot intensity values, each associated with a particular hotspot of at least a portion of the detected one or more hotspots and corresponding to a measure of (e.g., an average/mean, a median, a maximum, etc.) intensity of the particular hotspot; and determine one or more individual hotspot index values using the one or more individual hotspot intensity values and the one or more reference intensity values [e.g., wherein each individual hotspot index value is associated with a particular hotspot of the at least a portion of the detected one or more hotspots and determined using (e.g., based on a comparison between) (i) the individual hotspot intensity value associated with the particular hotspot and (ii) the one or more reference intensity values].

[0102] In certain embodiments, the instructions cause the processor to determine the one or more individual hotspot index values by mapping each of the one or more reference intensity values to a corresponding reference index value on a scale and, for each individual hotspot intensity value, using the reference intensity values and corresponding reference index values to interpolate a corresponding individual hotspot index value.

[0103] In certain embodiments, the reference tissue regions comprise one or more members selected from the group consisting of: a liver, an aorta (e.g., a thoracic aorta portion; e.g., an abdominal aorta portion), and a parotid gland.

[0104] In certain embodiments, a first reference intensity value (i) is a blood reference intensity value associated with a 3D reference volume corresponding to an aorta portion, and (ii) maps to a first reference index value; a second reference intensity value (i) is a liver reference intensity value associated with a 3D reference volume corresponding to a liver, and (ii) maps to a second reference index value; and the second reference intensity value is greater than the first reference intensity value and the second reference index value is greater than the first reference index value.

[0105] In certain embodiments, the reference intensity values comprises a maximum reference intensity value that maps to a maximum reference index value, and wherein hotspots having associated hotspot intensity values greater than the maximum reference intensity value are assigned hotspot index values equal to the maximum reference index value.

[0106] In certain embodiments, the instructions cause the processor to determine an overall index value indicative of a cancer status of the subject using at least a portion of the one or more hotspot index values.

[0107] In certain embodiments, the overall index value is determined as a weighted sum of at least a portion [e.g., located within a 3D volume of the functional image that corresponds to a skeletal region of the subject; e.g., located within a 3D volume of the functional image that corresponds to a lymph region of the subject] of the individual hotspot index values [e.g., wherein each hotspot index value in the sum is weighted by a measure of size (e.g., 3D volume; e.g., average diameter) of the associated hotspot].

[0108] In certain embodiments, the overall index value is associated with a particular target tissue region corresponding to a particular target VOI identified within the anatomical image; and the overall index value is determined using hotspot index values of a subset of hotspots located within a particular 3D volume in the 3D functional image that corresponds to the particular identified target VOI [e.g., and wherein the overall index value is computed as a weighted sum of the hotspot index values of the subset of hotspots (e.g., wherein the weighted sum is normalized by an estimated volume of the particular target tissue region (e.g., computed as a volume of the particular 3D volume in the function image and/or a volume of the particular target VOI))].

[0109] In certain embodiments, the particular target tissue region is selected from the group consisting of: a skeletal region comprising one or more bones of the subject, a lymph region, and a prostate region.

[0110] In certain embodiments, the 3D anatomical image is an x-ray computed tomography (CT) image, and the 3D functional image is a 3D single photon emission computed tomography (SPECT) image.

[0111] In certain embodiments, the 3D anatomical image is an x-ray computed tomography (CT) image, and the 3D functional image is a 3D positron emission tomography (PET) image.

[0112] In certain embodiments, the 3D PET image of the subject is obtained following administration to the subject of a radiopharmaceutical comprising a prostate-specific membrane antigen (PSMA) binding agent.

[0113] In certain embodiments, the radiopharmaceutical comprises [18F]DCFPyL.

[0114] In certain embodiments, at step (b), the instructions cause the processor to crop the 3D anatomical image to remove voxels representing air [e.g., to create a cropped anatomical image, and using the cropped anatomical image to identify the one or more target

VOIs (e.g., using the cropped anatomical image is used as input to one or more machine learning modules, as opposed to the original size 3D anatomical image)].

[0115] In certain embodiments, the target tissue regions comprise one or more members selected from the group consisting of: a left hip bone, a right hip bone, a sacrum and coccyx region, a left clavicle, a right clavicle, a left rib, a right rib, a left scapula, a right scapula, a sternum, a lumbar vertebra, a thoracic vertebra, a skull, a cervical vertebra, a left femur, a right femur, a left humerus, a right humerus, a prostate, a urinary bladder, a rectum, a left gluteus maximus, a right gluteus maximus, an aorta (e.g., a thoracic aorta portion; e.g., an abdominal aorta portion), a left kidney, a right kidney, a liver, a left lung, a right lung, a spleen, a ventricle, a left adrenal gland, a right adrenal gland, a gallbladder, a brain, a pancreas, a heart, a mandible, a left bronchi, a right bronchi, a trachea, a left common iliac artery, a right common iliac artery, and a parotid gland.

[0116] In certain embodiments, one or more of the target tissue regions comprise one or more specific bones selected from the group consisting of: a left clavicle, a right clavicle, a left femur, a right femur, a left fibula, a right fibula, a left hip bone, a right hip bone, a left humerus, a right humerus, a mandible, a left patella, a right patella, left radius, a right radius, a left tibia, a right tibia, a left ulna, a right ulna, a left rib (e.g., a first left rib, a second left rib, a third left rib, a fourth left rib, a fifth left rib, a sixth left rib, a seventh left rib, an eighth left rib, a ninth left rib, a tenth left rib, an eleventh left rib, a twelfth left rib), a right rib (e.g., a first right rib, a second right rib, a third right rib, a fourth right rib, a fifth right rib, a sixth right rib, a seventh right rib, an eighth right rib, a ninth right rib, a tenth right rib, an eleventh right rib, a twelfth right rib), a sacrum and coccyx (e.g., a combined sacrum and coccyx region; e.g., a sacrum and a coccyx individually, so as to distinguish between the two), a left scapula, a right scapula, a skull, sternum, a vertebrae region [e.g., a cervical vertebrae region, comprising one or more (e.g., up to all) cervical vertebrae; e.g., a lumber vertebrae region,

comprising one or more (e.g., up to all) lumbar vertebrae; e.g., a thoracic vertebrae region, comprising one or more (e.g., up to all) thoracic vertebrae], and an individual vertebra [e.g., e.g., an individual cervical vertebra (e.g., a first cervical vertebra, a second cervical vertebra, a third cervical vertebra, a fourth cervical vertebra, a fifth cervical vertebra, a sixth cervical vertebra, a seventh cervical vertebra); e.g., an individual lumbar vertebra (e.g., a first lumbar vertebra, a second lumbar vertebra, a third lumbar vertebra, a fourth lumbar vertebra, a fifth lumbar vertebra, a sixth lumbar vertebra); e.g., an individual thoracic vertebra (e.g., a first thoracic vertebra, a second thoracic vertebra, a third thoracic vertebra, a fourth, thoracic vertebra, a fifth thoracic vertebra, a sixth thoracic vertebra, a seventh thoracic vertebra, an eighth thoracic vertebra, a ninth thoracic vertebra, a tenth thoracic vertebra, an eleventh thoracic vertebra, an twelfth thoracic vertebra)].

[0117] In certain embodiments, one or more of the target tissue regions comprise one or more specific bones selected from the group consisting of: a left clavicle, a right clavicle, a left hip bone, a right hip bone, a left rib (e.g., a first left rib, a second left rib, a third left rib, a fourth left rib, a fifth left rib, a sixth left rib, a seventh left rib, an eighth left rib, a ninth left rib, a tenth left rib, an eleventh left rib, a twelfth left rib), a right rib (e.g., a first right rib, a second right rib, a third right rib, a fourth right rib, a fifth right rib, a sixth right rib, a seventh right rib, an eighth right rib, a ninth right rib, a tenth right rib, an eleventh right rib, a twelfth right rib), a sacrum and coccyx (e.g., a combined sacrum and coccyx region; e.g., a sacrum and a coccyx individually, so as to distinguish between the two), a left scapula, a right scapula, a sternum, a vertebrae region [e.g., a cervical vertebrae region, comprising one or more (e.g., up to all) cervical vertebrae; e.g., a lumber vertebrae region, comprising one or more (e.g., up to all) lumbar vertebrae; e.g., a thoracic vertebrae region, comprising one or more (e.g., up to all) thoracic vertebrae], and an individual vertebra [e.g., an individual lumbar vertebra (e.g., a first lumbar vertebra, a second lumbar vertebra, a third lumbar

vertebra, a fourth lumbar vertebra, a fifth lumbar vertebra); e.g., an individual thoracic vertebra (e.g., a first thoracic vertebra, a second thoracic vertebra, a third thoracic vertebra, a fourth, thoracic vertebra, a fifth thoracic vertebra, a sixth thoracic vertebra, a seventh thoracic vertebra, an eighth thoracic vertebra, a ninth thoracic vertebra, a tenth thoracic vertebra, an eleventh thoracic vertebra, an twelfth thoracic vertebra)].

[0118] In certain embodiments, one or more of the target tissue regions comprise one or more soft-tissue regions (e.g., organs) selected from the group consisting of: a left adrenal gland, a right adrenal gland, an aorta (e.g., a thoracic aorta portion; e.g., an abdominal aorta portion), a brain, a left bronchi, a right bronchi, a gallbladder, a left gluteus maximus, a right gluteus maximus, a heart, a left common iliac artery, a right common iliac artery, a left kidney, a right kidney, a liver, a left lung, a right lung, a pancreas, a prostate, a rectum, a spleen , a trachea, a urinary bladder, a ventricle, and a parotid gland.

[0119] In certain embodiments, the one or more target tissue regions comprise one or more soft-tissue regions (e.g., organs) selected from the group consisting of: a gallbladder, a left kidney, a right kidney, a liver, a left lung, a right lung, a prostate, and a urinary bladder.

[0120] In certain embodiments, the target tissue regions comprise one or more bone regions, each corresponding to a specific bone [e.g., where the target tissue regions comprise at least a portion of (e.g., up to all) the bones listed in paragraph [0116] or [0117]] and one or more soft tissue regions, each corresponding to a specific soft-tissue region [e.g., where the target tissue regions comprise at least a portion of (e.g., up to all) the soft-tissue regions listed in paragraph [0118] or [0119]].

[0121] In another aspect, the invention is directed to a system for automatically processing 3D images to automatically identify cancerous lesions within a subject, the system comprising: a processor of a computing device; and a memory having instructions stored thereon, wherein the instructions, when executed by the processor, cause the processor to: (a)

receive a 3D anatomical image of a subject obtained using an anatomical imaging modality [e.g., x-ray computed tomography (CT); e.g., magnetic resonance imaging (MRI); e.g., ultra-sound], wherein the 3D anatomical image comprises a graphical representation of tissue (e.g., soft-tissue and/or bone) within the subject; (b) automatically identify, using one or more machine learning modules (e.g., wherein at least one of the one or more machine learning modules is a Convolutional Neural Network (CNN) module), for each of a plurality of target tissue regions, a corresponding target volume of interest (VOI) within the 3D anatomical image; (c) determine a 3D segmentation map representing a plurality of 3D segmentation masks, each 3D segmentation mask representing a particular identified target VOI (e.g., automatically, digitally stitching together the plurality of 3D segmentation masks to form the 3D segmentation map); (d) receive a 3D functional image of the subject obtained using a functional imaging modality [e.g., single-photon emission computed tomography (SPECT); e.g., positron emission tomography (PET)][e.g., wherein the 3D functional image comprises a plurality of voxels, each representing a particular physical volume within the subject and having an intensity value that represents detected radiation emitted from a the particular physical volume, wherein at least a portion of the plurality of voxels of the 3D functional image represent physical volumes within one or more of the target tissue regions of the subject]; (e) identify, within the 3D functional image, one or more 3D volume(s), each corresponding to an identified target VOI, using the 3D segmentation map (e.g., by mapping 3D segmentation masks of the 3D segmentation map to the 3D functional image); and (f) automatically detect, within at least a portion of the one or more 3D volumes identified within the 3D functional image, one or more hotspots determined to represent lesions based on intensities of voxels within the 3D functional image [e.g., based on a comparison of intensities within the 3D functional image with a threshold value (e.g., wherein the 3D

functional image is a 3D PET image and the threshold is a particular standard uptake value (SUV) level)].

[0122] In certain embodiments, the instructions cause the processor to use the one or more detected hotspots (e.g., intensities of the one or more detected hotspots) to determine a cancer status for the subject.

[0123] In certain embodiments, the target tissue regions comprise one or more reference tissue regions and wherein the instructions cause the processor to: use the 3D segmentation map to identify, within the 3D functional image, one or more 3D reference volume(s), each corresponding to a particular reference tissue region; determine one or more reference intensity values, each associated with a particular 3D reference volume of the one or more 3D reference volume(s) and corresponding to a measure of (e.g., an average/mean, a median, a maximum, etc.) intensity within the particular 3D reference volume; determine one or more individual hotspot intensity values, each associated with a particular hotspot of at least a portion of the detected one or more hotspots and corresponding to a measure of (e.g., an average/mean, a median, a maximum, etc.) intensity of the particular hotspot; and determine one or more individual hotspot index values using the one or more individual hotspot intensity values and the one or more reference intensity values [e.g., wherein each individual hotspot index value is associated with a particular hotspot of the at least a portion of the detected one or more hotspots and determined using (e.g., based on a comparison between) (i) the individual hotspot intensity value associated with the particular hotspot and (ii) the one or more reference intensity values].

[0124] In certain embodiments, the reference tissue regions comprise one or more members selected from the group consisting of: a liver, an aorta (e.g., a thoracic aorta portion; e.g., an abdominal aorta portion), and a parotid gland.

[0125] In certain embodiments, the instructions cause the processor to determine an overall index value indicative of a cancer status of the subject using at least a portion of the one or more hotspot index values.

[0126] In certain embodiments, the overall index value is determined as a weighted sum of at least a portion [e.g., located within a 3D volume of the functional image that corresponds to a skeletal region of the subject; e.g., located within a 3D volume of the functional image that corresponds to a lymph region of the subject] of the individual hotspot index values [e.g., wherein each hotspot index value in the sum is weighted by a measure of size (e.g., 3D volume; e.g., average diameter) of the associated hotspot].

[0127] In certain embodiments, the 3D anatomical image is an x-ray computed tomography (CT) image, and the 3D functional image is a 3D positron emission tomography (PET) image.

[0128] In certain embodiments, the 3D PET image of the subject is obtained following administration to the subject of a radiopharmaceutical comprising a prostate-specific membrane antigen (PSMA) binding agent.

[0129] In certain embodiments, the radiopharmaceutical comprises [18F]DCFPyL.

[0130] In another aspect, the invention is directed to a system for automatically processing 3D images to identify, and measure uptake of radiopharmaceutical in, cancerous lesions (e.g., metastases) within a subject having or at risk for a cancer (e.g., prostate cancer, breast cancer, lung cancer; e.g., a metastatic cancer, such as metastatic prostate cancer, metastatic breast cancer, metastatic lung cancer) , the system comprising: a processor of a computing device; and a memory having instructions stored thereon, wherein the instructions, when executed by the processor, cause the processor to: (a) receive a 3D anatomical image of a subject obtained using an anatomical imaging modality [e.g., x-ray computed tomography (CT); e.g., magnetic resonance imaging (MRI); e.g., ultra-sound], wherein the 3D anatomical

image comprises a graphical representation of tissue (e.g., soft-tissue and/or bone) within the subject; (b) automatically identify using one or more machine learning modules (e.g., wherein at least one of the machine learning modules is a Convolutional Neural Network (CNN) module), within the 3D anatomical image: a first skeletal volume comprising a graphical representation of one or more bones of the subject; a first aorta volume comprising a graphical representation of at least a portion of an aorta of the subject; and a first liver volume comprising a graphical representation of a liver of the subject; (c) determine a 3D segmentation map representing a plurality of 3D segmentation masks, including a skeletal mask representing the identified first skeletal volume, an aorta mask representing the identified first aorta volume, and a liver mask representing the identified first liver volume; (d) receive a 3D functional image of the subject obtained using a functional imaging modality [e.g., single-photon emission computed tomography (SPECT); e.g., positron emission tomography (PET)][e.g., wherein the 3D functional image comprises a plurality of voxels, each representing a particular physical volume within the subject and having an intensity value that represents detected radiation emitted from a the particular physical volume, wherein at least a portion of the plurality of voxels of the 3D functional image represent physical volumes within one or more bones, an aorta portion, and/or a liver of the subject]; (e) automatically identify, within the 3D functional image, using the 3D segmentation map (e.g., by mapping the 3D segmentation masks of the 3D segmentation map to the 3D functional image): a second skeletal volume corresponding to the first identified skeletal volume, within the 3D anatomical image; a second aorta volume corresponding to the first aorta volume, identified within the 3D anatomical image; and a second liver volume corresponding to the first liver volume, identified within the 3D anatomical image; (f) automatically detect, within the second skeletal volume, one or more hotspots determined to represent lesions based on intensities of voxels within the second skeletal volume (e.g., the

one or more hotspots corresponding to localized regions of relatively high intensity, e.g., identified based on a comparison of intensities of voxels located within the second skeletal volume with a threshold value); and (g) determine, for each of the one or more detected hotspots, an individual hotspot index (e.g., indicative of a measure of radiopharmaceutical uptake in the lesions represented by the detected hotspot) value by: determining an aorta reference intensity level based on a measure (e.g., a mean, a maximum, a median, etc.) of intensity of voxels within the second aorta volume; determining a liver reference intensity level based on a measure (e.g., a mean, a maximum, a median, etc.) of intensity of voxels within the second liver volume; and for each individual detected hotspot: determining a corresponding individual hotspot intensity level based on a measure (e.g., a mean, a maximum, a median, etc.) of intensity of voxels of the detected hotspot; and determining a corresponding individual hotspot index level from the individual hotspot intensity level, the aorta reference intensity level, and the liver reference intensity level.

[0131] In certain embodiments, the instructions cause the processor to determine an overall index value indicative of a cancer status of the subject based on the individual hotspot index values of at least a portion of the one or more detected hotspots.

[0132] In certain embodiments, the subject has or is at risk for prostate cancer.

[0133] In certain embodiments, the instructions cause the processor to: at step (b), automatically identify, within the 3D anatomical image, a first prostate volume comprising a graphical representation of a prostate of the subject; at step (c), include a prostate mask representing the identified first prostate volume in the determined 3D segmentation map; at step (e), automatically identify, within the 3D functional image, a second prostate volume corresponding to the first identified prostate volume, within the 3D anatomical image, at step (f), automatically detect one or more hotspots in the second prostate volume; and determine (i) an overall bone index value indicative of a lesion content (e.g., and severity) in the one or

more bones of the subject based on the individual hotspot index values of at least a portion of the one or more detected hotspots located in the second skeletal volume and (ii) an overall prostate index value indicative of a lesion content (e.g., and severity) in the prostate of the subject based on the individual hotspot index values of at least a portion of the one or more detected hotspots located in the second prostate volume.

[0134] In certain embodiments, the subject has or is at risk for metastatic cancer (e.g., metastatic prostate cancer, metastatic breast cancer, metastatic lung cancer, and other metastatic bone cancers).

[0135] In another aspect, the invention is directed to a system for automatically processing a set of full body 3D anatomical images of varying sizes to automatically identify, within each 3D anatomical image, a plurality of 3D volumes that correspond to particular target tissue regions, the system comprising: a processor of a computing device; and a memory having instructions stored thereon, wherein the instructions, when executed by the processor, cause the processor to: (a) receive the set of 3D anatomical images of one or more subject(s) obtained using an anatomical imaging modality [e.g., x-ray computed tomography (CT); e.g., magnetic resonance imaging (MRI); e.g., ultra-sound], wherein the 3D anatomical image comprises a graphical representation of tissue (e.g., soft-tissue and/or bone) within each of the one or more subject(s), wherein the set of 3D anatomical images has a mean x-dimension, a mean y-dimension, and a mean z-dimension, at least one of which (the mean x-, mean y-, or mean z-dimension) having a standard deviation at least 3% of the corresponding mean [e.g., at least one of which (the mean x-, mean y-, or mean z-dimension) having a relative standard deviation of at least 3 %, at least 5%, at least 10%, at least 15%, or at least 20%]; and (b) automatically determine, using a localization module that implements a CNN, within each image of the set of 3D anatomical images, at least one initial VOI corresponding to a particular anatomical region (e.g., a group of related tissue, such as a pelvic region and a

spin region) that comprises one or more particular associated target tissue regions (e.g., one or more specific bones, e.g., one or more specific organs), thereby identifying at least one initial VOI for the corresponding 3D anatomical image; and (c) for each initial VOI, automatically identify, using one or more segmentation modules each implementing a CNN, for each of the one or more particular target tissue regions associated with the particular anatomical region to which the initial VOI corresponds, a corresponding target VOI (e.g., a graphical representation of the particular target tissue region).

[0136] Features of embodiments described with respect to one aspect of the invention may be applied with respect to another aspect of the invention.

BRIEF DESCRIPTION OF THE FIGURES

[0137] The foregoing and other objects, aspects, features, and advantages of the present disclosure will become more apparent and better understood by referring to the following description taken in conjunction with the accompanying drawings, in which:

[0138] FIG. 1 is a diagram showing integration of various imaging modalities with an artificial intelligence (AI) platform, according to an illustrative embodiment.

[0139] FIG. 2 is an image showing a skeleton of a subject with various specific bones identified, according to an illustrative embodiment.

[0140] FIG. 3 is a block diagram showing use of full body segmentation in various functional imaging modalities, for various applications, according to an illustrative embodiment.

[0141] FIG. 4 is a diagram showing processing flow of different informational datasets by an AI module to classify, locate, and quantify cancerous lesions, according to an illustrative embodiment.

[0142] FIG. 5A is a block flow diagram of a process for automatically processing 3D images to identify 3D volumes within the 3D images that correspond to particular target tissue regions, according to an illustrative embodiment.

[0143] FIG. 5B is a block flow diagram of a process for automatically processing 3D images to identify 3D volumes and use the 3D volumes to detect hotspots representing cancerous lesions, according to an illustrative embodiment.

[0144] FIG. 6A is a block flow diagram of a process for automatically processing CT images for whole-body segmentation, according to an illustrative embodiment.

[0145] FIG. 6B is a set of CT images showing processing results of various steps of the process shown in FIG. 6A.

[0146] FIG. 7 is a set of three images used as training data for machine learning modules used to segment CT images, according to an illustrative embodiment.

[0147] FIG. 8 is a set of two images with identified volumes of interest overlaid.

[0148] FIG. 9A is a set of 2D views of a 3D PET/CT image obtained from a subject following administration of PyL™.

[0149] FIG. 9B is the same set of 2D views shown in FIG. 9A, following background correction.

[0150] FIG. 9C is a set of 2D views of a 3D PET/CT image obtained from a subject following administration of PyL™.

[0151] FIG. 9D is the same set of 2D views shown in FIG. 9C, following background correction.

[0152] FIG. 10A is a block flow diagram showing an example process for analyzing PyL™-PET images, according to an illustrative embodiment.

[0153] FIG. 10B is a PET/CT image obtained following administration of PyL™ to a subject.

[0154] FIG. 10C is a set of two CT images showing volumes of interest identified via the machine learning approaches described herein.

[0155] FIG. 10D is a set of 3 images illustrating background correction in PET images, according to an illustrative embodiment.

[0156] FIG. 11A is a view of a 3D CT image with volumes of interest corresponding to specific bones labeled in color, according to an illustrative embodiment.

[0157] FIG. 11B is another view of the 3D CT image with labeled volumes of interest shown in FIG. 11A.

[0158] FIG. 12 is a CT image with an overlaid PET image showing identified background tissue regions.

[0159] FIG. 13A is view a CT image with an overlaid PET image showing a detected lesion.

[0160] FIG. 13B is another view of the CT image with overlaid PET image of FIG. 13A, showing the detected lesion.

[0161] FIG. 13C is another view of the CT image with overlaid PET image of FIG. 13A, showing the detected lesion.

[0162] FIG. 13D is another view of the CT image with overlaid PET image of FIG. 13A, showing the detected lesion.

[0163] FIG. 14A is a set of two views of a CT image with an overlaid PET image obtained for a subject following administration of PyL™.

[0164] FIG. 14B shows the same views as FIG. 14A, but following processing via the machine learning approaches described herein to provide for background correction and detection of lesions.

[0165] FIG. 15A is a set of two views of a CT image with an overlaid PET image obtained for a subject following administration of PyL™.

[0166] FIG. 15B shows the same views as FIG. 15A, but following processing via the machine learning approaches described herein to provide for background correction and detection of lesions.

[0167] FIG. 16A is a view of a 3D CT image with identified volumes of interest overlaid.

[0168] FIG. 16B is another view of the 3D CT image with identified volumes of interest overlaid shown in FIG. 16A.

[0169] FIG. 17 is a block diagram of an exemplary cloud computing environment, used in certain embodiments.

[0170] FIG. 18 is a block diagram of an example computing device and an example mobile computing device used in certain embodiments.

[0171] FIG. 19 is a set of three graph, each graphs showing overall index values quantifying PyL™-PSMA uptake in lesions identified in a particular tissue region based on PET/CT image analysis for six different cancer indications, according to an illustrative embodiment.

[0172] FIG. 20 is a graph showing individual lesion PSMA index (LPI) values determined for lesions detected in three different tissue regions (bone, lymph, and prostate) via PET/CT image analysis, according to an illustrative embodiment.

[0173] FIG. 21 is a set of two graphs comparing reference values determined via manual and automated image analysis for a blood pool reference value and a liver reference value according to an illustrative embodiment.

[0174] The features and advantages of the present disclosure will become more apparent from the detailed description set forth below when taken in conjunction with the drawings, in which like reference characters identify corresponding elements throughout. In

the drawings, like reference numbers generally indicate identical, functionally similar, and/or structurally similar elements.

DETAILED DESCRIPTION

[0175] It is contemplated that systems, architectures, devices, methods, and processes of the claimed invention encompass variations and adaptations developed using information from the embodiments described herein. Adaptation and/or modification of the systems, architectures, devices, methods, and processes described herein may be performed, as contemplated by this description.

[0176] Throughout the description, where articles, devices, systems, and architectures are described as having, including, or comprising specific components, or where processes and methods are described as having, including, or comprising specific steps, it is contemplated that, additionally, there are articles, devices, systems, and architectures of the present invention that consist essentially of, or consist of, the recited components, and that there are processes and methods according to the present invention that consist essentially of, or consist of, the recited processing steps.

[0177] It should be understood that the order of steps or order for performing certain action is immaterial so long as the invention remains operable. Moreover, two or more steps or actions may be conducted simultaneously.

[0178] The mention herein of any publication, for example, in the Background section, is not an admission that the publication serves as prior art with respect to any of the claims presented herein. The Background section is presented for purposes of clarity and is not meant as a description of prior art with respect to any claim.

[0179] Documents are incorporated herein by reference as noted. Where there is any discrepancy in the meaning of a particular term, the meaning provided in the Definition section above is controlling.

[0180] Headers are provided for the convenience of the reader – the presence and/or placement of a header is not intended to limit the scope of the subject matter described herein.

i. Definitions

[0181] As used herein, "radionuclide" refers to a moiety comprising a radioactive isotope of at least one element. Exemplary suitable radionuclides include but are not limited to those described herein. In some embodiments, a radionuclide is one used in positron emission tomography (PET). In some embodiments, a radionuclide is one used in single-photon emission computed tomography (SPECT). In some embodiments, a non-limiting list of radionuclides includes ^{99m}Tc, ^{111}In, ^{64}Cu, ^{67}Ga, ^{68}Ga, ^{186}Re, ^{188}Re, ^{153}Sm, ^{177}Lu, ^{67}Cu, ^{123}I, ^{124}I, ^{125}I, ^{126}I, ^{131}I , ^{11}C, ^{13}N, ^{15}O, ^{18}F , ^{153}Sm, ^{166}Ho, ^{177}Lu, ^{149}Pm, ^{90}Y, ^{213}Bi, ^{103}Pd, ^{109}Pd, ^{159}Gd, ^{140}La, ^{198}Au, ^{199}Au, ^{169}Yb, ^{175}Yb, ^{165}Dy, ^{166}Dy, ^{105}Rh, ^{111}Ag, ^{89}Zr, ^{225}Ac, ^{82}Rb, ^{75}Br, ^{76}Br, ^{77}Br, ^{80}Br, ^{80m}Br, ^{82}Br, ^{83}Br, ^{211}At and ^{192}Ir.

[0182] As used herein, the term "radiopharmaceutical" refers to a compound comprising a radionuclide. In certain embodiments, radiopharmaceuticals are used for diagnostic and/or therapeutic purposes. In certain embodiments, radiopharmaceuticals include small molecules that are labeled with one or more radionuclide(s), antibodies that are labeled with one or more radionuclide(s), and antigen-binding portions of antibodies that are labeled with one or more radionuclide(s).

[0183] As used herein, "3D" or "three dimensional" with reference to an "image" means conveying information about three dimensions. A 3D image may be rendered as a

dataset in three dimensions and/or may be displayed as a set of two-dimensional representations, or as a three-dimensional representation.

[0184] As used herein, an "image" – for example, a 3-D image of a subject – includes any visual representation, such as a photo, a video frame, streaming video, as well as any electronic, digital or mathematical analogue of a photo, video frame, or streaming video. Any apparatus described herein, in certain embodiments, includes a display for displaying an image or any other result produced by the processor. Any method described herein, in certain embodiments, includes a step of displaying an image or any other result produced via the method.

[0185] As used herein, a "subject" means a human or other mammal (e.g., rodent (mouse, rat, hamster), pig, cat, dog, horse, primate, rabbit, and the like).

[0186] As used herein, "administering" an agent means introducing a substance (e.g., an imaging agent) into a subject. In general, any route of administration may be utilized including, for example, parenteral (e.g., intravenous), oral, topical, subcutaneous, peritoneal, intraarterial, inhalation, vaginal, rectal, nasal, introduction into the cerebrospinal fluid, or instillation into body compartments.

[0187] As used herein, the terms "filter", and "filtering", as in a "filtering function" or a "filter", refer to a function that operates on localized portions of an input array (e.g., a multi-dimensional array) of data (e.g., image data, e.g., values computed by a layer of a CNN), referred to herein as "subpatches", computing, for a given subpatch, a response value. In general, a filter is applied in a sliding window fashion across the array to compute a plurality of response values for the array. In particular, for a given multidimensional array, a subpatch of the array can be a rectangular region of the array having a specific size (e.g., having the same number of dimensions as the array). For example, for a 6 x 3 x 3 array, a given 3 x 3 x 3 subpatch refers to a given 3 x 3 x 3 set of adjacent values (e.g., a

neighborhood) of the array, such that there are five distinct 3 x 3 x 3 subpatches in the 6 x 3 x 3 array (each patch shifted one position over along the first dimension).

[0188] For example, a filtering function can compute, for a given subpatch of an array, a response value using the values of the subpatch. A filtering function can be applied in a sliding window fashion across an array, computing, for each of a plurality of subpatches of the array, a response value. The computed response values can be stored in an output array such that the positional correspondence between response values and the subpatches of the input array is maintained.

[0189] For example, at a first step, beginning with a subpatch in a corner of an input array, a filter can compute a first response value, and store the first response value in a corresponding corner of an output array. In certain embodiments, at a second step, the filter then computes a second response value for a second subpatch, shifted one position over along a specific dimension of the input array. The second response value can be stored in a corresponding position of the output array – that is, shifted one position over along a same dimension of the output array. The step of shifting position of the subpatch, computing a response value, and storing the response value in a corresponding position of the output array can be repeated for the full input array, along each dimension of the input array. In certain embodiments (e.g., a strided filtering approach), the subpatch for which the filter computes a response value is shifted more than one position at a time along a given dimension, such that response values are not computed for every possible subpatch of the input array.

[0190] As used herein, the term "convolutional neural network (CNN)" refers to a type of artificial neural network where at least one layer performs one or more filtering functions. As used herein, the term "convolution layer" refers to a layer of a CNN that receives as input an input array and computes an output array, wherein values of the output array are computed by applying one or more filters to the input array. In particular, in certain

embodiments, a convolution layer receives as input an input array having $n + 1$ dimensions and produces an output array also having $n + 1$ dimensions. The first n dimensions of input and output arrays operated on by filtering layers of a CNN are referred to herein as "spatial dimensions". The $(n + 1)^{th}$ dimension of the input is referred to herein as the "input channel" dimension. The size of the input channel dimension is referred to herein as the "number of input channels". The $(n + 1)^{th}$ dimension of the output is referred to herein as the "output channel" dimension. The size of the input channel dimension is referred to herein as the "number of output channels".

[0191] In certain embodiments, a convolution layer computes response values by applying a filter that operates on subpatches that are smaller than the input array along the spatial dimensions, but extend across the full output channel dimension. For example, an N x M x L x K_0 size input array, has three spatial dimensions and K_0 output channels. Filters of a convolution layer may operate on subpatches having sizes of N_f x M_f x L_f x K_0, where $N_f \leq N$, $M_f \leq M$ and $L_f \leq L$. Often, a filter of a convolutional layer operates on subpatches having sizes where $N_f < N$, $M_f < M$ and/or $L_f < L$. For example, in certain embodiments, $N_f << N$, $M_f << M$ and/or $L_f << L$.

[0192] Accordingly, for each of one or more filters applied by a convolution layer, response values computed by a given filter are stored in a corresponding output channel. Accordingly, a convolution layer that receives an input array having $n + 1$ dimensions computes an output array also having $n + 1$ dimensions, wherein the $(n + 1)^{th}$ dimension represents the output channels corresponding to the one or more filters applied by the convolution layer. In this manner, an output array computed by a given convolution layer can be received as input by a subsequent convolution layer.

[0193] As used herein, the term "size" in reference to a filter of a convolution layer refers to a size along spatial dimensions of subpatches on which the filter operates (e.g., the

subpatch size along the output channel dimension is taken as the full number of output channels). As used herein, the term "size", in reference to a convolution layer, as in "size of a convolution layer" refers to a size of filters of the convolution layer (e.g., each filter of the convolution layer having a same size). In certain embodiments, a filter of a convolution layer has a number of variable parameters that are determined via a machine learning training process. In certain embodiments, the number of parameters of a given filter equals the number of values in a subpatch that the given filter operates on. For example, a size N_f *x* M_f *x* L_f filter that operates on an input array with K_0 output channels has N_f x M_f x L_f x K_0 parameters. In certain embodiments, a filter is implemented as an array, and the response value determined by the filter for a given subpatch is computed as a dot product between the filter and the given subpatch.

[0194] As used herein, the term "fully convolutional neural network (FCNN)" refers to a CNN wherein each layer of the CNN is a convolution layer.

[0195] As used herein, the term "volume", as used in reference to an input or output of a layer of a CNN refers to an input array received or an output array computed by a CNN layer.

[0196] As used herein, the term "CNN module" refers to a computer implemented process that implements a specific CNN in order to determine, for a given input, such as an image (e.g., a 2D image; e.g., a 3D image) one or more output values. For example, a CNN module may receive as input a 3D image of a subject (e.g., a CT image; e.g., an MRI), and for each voxel of the image, determine a value that represents a likelihood that the voxel lies within a region of the 3D image that corresponds to a representation of a particular organ or tissue of the subject. A CNN module may be software and/or hardware. For example, a CNN module may be implemented entirely as software, or certain functions of a CNN

module may be carried out via specialized hardware (e.g., via an application specific integrated circuit (ASIC)).

[0197] As used herein, the term "tissue" refers to bone (osseous tissue) as well as soft-tissue.

[0198] In certain embodiments, the approaches described herein can be used to segment and identify target tissue regions within a full body image of a subject. As used herein, the terms "full body" and "whole body" used (interchangeably) in the context of segmentation refer to approaches that evaluate a majority (e.g., greater than 50%) of a graphical representation of a subject's body in a 3D anatomical image to identify target tissue regions of interest. In certain embodiments, full body and whole body segmentation refers to identification of target tissue regions within at least an entire torso of a subject. In certain embodiments, portions of limbs are also included, along with a head of the subject.

A. Detecting and Assessing Cancer Status via Nuclear Medicine Imaging and Automated Image Segmentation

[0199] Described herein are systems and methods that provide artificial intelligence (AI) – based segmentation technology that provides a basis for detecting, evaluating, and making predictions about cancer status of subjects. In particular, the AI-based segmentation techniques described herein allow for 3D representations of various tissue regions in medical images to be accurately and rapidly identified. The AI-based segmentation technologies described herein utilize machine learning techniques, such as Convolutional Neural Networks (CNNs) to automatically to identify a plurality of target 3D volumes of interest (VOIs) each corresponding to a specific target tissue region, such as one or more organs, portions of organs, particular bone(s), a skeletal region etc. Each identified 3D VOI may be represented via a segmentation mask. The multiple segmentation masks, identifying multiple target tissue

regions across a patient's body, can be stitched together to form a segmentation map. The segmentation map, and/or various segmentation masks that it comprises, may be used compute various quantities from medical images, such as useful indices that serve as measures and/or predictions of cancer status, progression, and response to treatment. Segmentation maps and masks may also be displayed, for example as a graphical representation overlaid on a medical image to guide physicians and other medical practitioners.

[0200] In certain embodiments, AI-based segmentation is performed using an anatomical image that provides detailed structural information about locations and extent of tissue within a subject's body. Examples of anatomical images include, without limitation, x-ray computed tomography (CT) images, magnetic resonance images (MRI), and ultra-sound. Image contrast in anatomical images is a function of physical properties of underlying tissue, such as density, water and fat content. As described in further detail herein, the AI-based segmentation techniques of the present disclosure analyze contrast variations and patterns in anatomical image to identify target 3D VOIs that correspond to different specific target tissue regions.

[0201] In certain embodiments, structural information and identified target VOIs from anatomical images are combined with and/or used to analyze images obtained via functional imaging modalities. Functional images reflect physiological properties and activity in a subject. They are often acquired using probes and have intensity variations that reflect a spatial distribution of the probes within an imaged portion of a subject. For example, nuclear medicine images (e.g., PET scans; e.g., SPECT scans; e.g., whole-body scans; e.g. composite PET-CT images; e.g., composite SPECT-CT images) detect radiation emitted from the radionuclides of radiopharmaceuticals to form an image. The distribution of a particular radiopharmaceutical within a patient may be determined by biological

mechanisms such as blood flow or perfusion, as well as by specific enzymatic or receptor binding interactions. Different radiopharmaceuticals may be designed to take advantage of different biological mechanisms and/or particular specific enzymatic or receptor binding interactions and thus, when administered to a patient, selectively concentrate within particular types of tissue and/or regions within the patient. Greater amounts of radiation are emitted from regions within the patient that have higher concentrations of radiopharmaceutical than other regions, such that these regions appear brighter in nuclear medicine images. Accordingly, intensity variations within a nuclear medicine image can be used to map the distribution of radiopharmaceutical within the patient. This mapped distribution of radiopharmaceutical within the patient can be used to, for example, infer the presence of cancerous tissue within various regions of the patient's body..

[0202] Transferring a segmentation map to a functional image (e.g., a nuclear medicine image, such as a PET image or a SPECT image) provides valuable context for evaluating and deriving meaning from intensity fluctuations in the functional image. In particular, it allows for regions of the functional image to be identified as corresponding to particular tissue regions of the subject. In this manner, intensity values and fluctuations in and across voxels within a particular region can thus be understood as originating from underlying accumulation of a radiopharmaceutical in a specific tissue region (e.g., organ or bone) of the subject.

[0203] As described in further detail herein, this anatomical context serves a variety of uses. For example, it allows for measures of radiopharmaceutical uptake in various specific target organs and tissue regions, such as prostate, lymph nodes, and bone, to be assessed, and used as an indicator of presence of cancerous tissue therein. Identifying a what particular region intensities of a functional image are associated with also allows them to be evaluated in proper context. For example intensities of a certain value, if associated with a

prostate region, may be more likely to be indicative of cancer than intensities of the same value, when found within another organ, such as a bladder or kidney. In certain embodiments, reference regions are identified and used to compute normalization values and levels on a scale to which intensities in other regions are compared to evaluate a cancer status. Background regions, to either be excluded from the image or used to correct for artifacts may also be identified.

[0204] Accordingly, the AI-based segmentation approaches described herein can serve as a platform on which a variety of tools and techniques for detecting, evaluating, and predicting cancer status for patients can be built. Moreover, since the AI-based segmentation tools described herein can identify a variety of important tissue regions across an entire body of a patient, and then transfer those identifications (e.g., segmentation maps) from anatomical images to various functional images, they can be used as a building block for analysis techniques based on a variety of different imaging methods that obtain contrast via a variety of different radiopharmaceuticals.

[0205] FIGs. 1 – 3 illustrate this concept. In particular, FIG. 1 is a schematic illustrating how various anatomical and functional imaging modalities can be integrated in the context of a platform agnostic AI-based segmentation technology. As illustrated in FIG. 1, the AI-segmentation platform described herein can be used as a basis for analysis of a variety of images, such as anatomical CT image themselves, 18NaF images, C-11 images, Ga-68 images, FDG image, and PyL™ images. FIG. 2 shows results of an example segmentation performed on a skeleton of a subject, with different specific bones identified by different colors. The segmentation shown in FIG. 2, performed using a CT image, can be transferred to a functional image in order to identify 3D volumes in the functional image that correspond to the target VOIs identified within the CT image. Other VOIs, such as soft-tissue, may also be identified and used to identify corresponding 3D volumes in a functional

image. For example, FIG. 3 is a block flow diagram illustrating how segmentation of various soft-tissue and bone regions based on an anatomical image (e.g., a CT image) can be used and mapped to images obtained via various functional imaging modalities using various probes (e.g., ^{99m}Tc-MIP-1404, ^{18}F-PyL, ^{68}Ga-PSMA-11, ^{18}F-NaF, ^{11}C-Choline, [18F]FDG, [18F]FACBC, etc.) to perform image based diagnosis and assessment of disease progression, state, and the like. As shown in FIG. 3, the full body segmentation techniques described herein can serve as a platform that a variety of application specific image analysis techniques that utilize different functional imaging modalities and probes can leverage and be built upon.

[0206] FIG. 4 is a diagram showing how artificial intelligence-based image analysis 400 can be performed to classify and locate lesions, as well as quantify positive lesions, e.g., for assessing cancer state in a subject. As shown in FIG. 4, a machine learning module 402, such as a convolutional neural network (CNN), receives contextual anatomical information (e.g., a CT image or other anatomical imaging modality) 404 along with functional information (e.g., a functional image, such as a SPECT, PET, or other functional image obtained using a particular imaging probe) 406. The machine learning module 402 then uses the functional 406 and anatomical 404 information to identify, classify, and/or quantify cancerous lesions in a subject 410. The machine learning module 402 may also leverage additional information 408, such as subject demographic data (e.g., age, weight, etc.) and other diagnostic test results (e.g., a biopsy, Gleason score, genetic testing results, a prostate specific antigen (PSA) test result), clinical treatment(s) (e.g., external beam radiation, brachytherapy, prostatectomy, antiandrogens, immunotherapy (e.g., Provenge), chemotherapy, etc.) as input and base the classification, identification, and/or quantification of cancerous lesions on this additional information as well.

[0207] FIG. 5 is a block flow diagram showing an example process 500 for performing segmentation to identify a plurality of target tissue regions. As shown in FIG. 5,

a machine learning module receives a 3D anatomical image (e.g., a full body image) as input 502, and identifies, for each of a plurality of target tissue region, a target volume comprising a graphical representation of the target tissue region within the 3D anatomical image 504. The target volumes are stitched together 506 to form a segmentation map 510 that comprises a plurality of segmentation masks 512, with each segmentation mask representing an identified target volume. The segmentation map 510 can be stored and/or provided for display and/or further processing 508.

i. Image Segmentation using Convolutional Neural Networks (CNNs)

[0208] In certain embodiments, the AI-based image segmentation approaches described herein utilize machine learning techniques, such as CNNs to perform segmentation. As described herein, one or more machine learning modules may be used to perform intermediate analysis and processing of images, and ultimately identify target VOIs.

[0209] In certain embodiments, the AI-based image segmentation described herein utilizes a two-step approach to identify one or more of the 3D target VOIs representing target tissue regions of interest in an anatomical image. In this two-step approach, an initial volume of interest (VOI) that comprises one or more of the target VOIs is first identified. The initial VOI may be identified using a first module, referred to as a localization module. The localization module may be a first machine learning module, such as a first Convolutional Neural Network (CNN) module. Once the initial VOI is identified, a second module, referred to as a segmentation module [e.g., that implements a second machine learning network (e.g., a second CNN) to perform fine segmentation], is used to identify one or more target VOIs within the initial VOI. This approach is advantageous as allows the segmentation module to operate on a standardized input, of manageable size, without regard to variations in dimensions and boundaries of the original anatomical image received. This two-step

approach is especially useful for performing accurate, finely resolved segmentation of tissue regions within a large image, such as a full body scan. The localization module may perform a rough analysis, such as by performing a coarse segmentation, to identify the initial VOI. Freed from having to accommodate varying image sizes, and analyze an entire image, the segmentation module can devote resources to performing fine segmentation to accurately identify the target VOIs within the initial VOI.

[0210] Moreover, as described in further detail herein, for example in Example 1, to identify a set of target VOIs spread out across an entire body of a subject, multiple initial VOIs can be identified in order to partition a whole body image into multiple manageable initial VOIs, each comprising a subset of the desired target VOIs to be identified. The partitioning of a whole body image into multiple initial VOIs can be performed using a single localization module, such as a machine learning module that performs a coarse segmentation to identify general anatomical regions such as an upper body, a lower body, a spine, and a pelvic region. In certain embodiments, multiple localization modules (e.g., each tasked with identifying one or more initial VOIs) may be used. For each identified initial VOI, one or more segmentation modules may then be used to perform fine segmentation and identify the one or more desired target VOIs within the initial VOI.

[0211] Various localization and segmentation modules may be combined and implemented as a single module and/or a single software application, or may be implemented separately, e.g., as separate software applications.

[0212] A number of different approaches may be used by a localization module to identify a particular initial VOI. For example, in one approach, the localization module may implement a CNN that receives a grayscale CT image (e.g., a single input channel) as input and outputs coordinates of opposite corners of a rectangular VOI (e.g., a bounding box). In another approach, the localization module may implement a CNN that receives two input

channels: (*i*) a grayscale CT image, and (*ii*) a pre-processed version of the CT image. The pre-processed version of the CT image may be a thresholded version of the CT image, wherein the thresholding provides a rough identification of the initial VOI to be identified. The CNN is trained to analyze both these input channels in order to output coordinates representing opposite corners of a rectangular initial VOI (e.g., a bounding box).

[0213] In a third approach, in order to identify a particular initial VOI comprising one or more specific target VOIs, the localization module performs a coarse segmentation to roughly identify the specific target VOIs. In this way, the localization module is essentially a rough version of the segmentation modules used to identify the specific target VOIs within the particular initial VOI. A rectangular initial VOI is then generated using the coarsely identified specific target VOIs (e.g., by drawing the smallest box that fits them, or maybe adding some buffer distance). A distinction here is that the output of the localization module in this case is not merely coordinates of cuboid vertices. In this approach, likelihood values are automatically determined for each voxel of the image that give the likelihood as to how the voxel is classified – e.g., whether the voxel is a particular initial VOI, or background, for example.

[0214] In certain embodiments, voxel classifications performed by the machine learning modules may be refined via an iterative process in order to mitigate noise in the classification process. In particular, in certain embodiments, a machine learning module such as a CNN module receives an entire image, or portion thereof as input, and outputs, for each particular voxel, a label classifying the particular voxel as (i) one of a set of pre-defined classes corresponding to anatomical regions or target tissue regions, or (ii) background. For example, a localization module trained to identify initial VOIs corresponding to a spine, a pelvic region, and a left and right upper body may label each voxel as 1, 2, 3, or 4 for spine, pelvic region, left upper body, and right upper body, respectively, or 0 for background.

[0215] A segmentation module that identifies one or more target tissue regions within a particular initial VOI may receive the particular initial VOI as input, and output an integer label for each voxel, with the integer label identifying that voxel as corresponding to one of the particular target tissue regions, or background. For example, a segmentation module that identifies different vertebrae may receive as input an initial VOI corresponding to the spine, and label each voxel in the initial VOI with an integer corresponding to a particular vertebra (e.g., 1 for a first lumbar vertebra, 2 for a second lumbar vertebra, 3 for a third lumbar vertebra, etc. with other integer labels for other bones).

[0216] The classification performed by machine learning modules as described above, may produce noisy results, with certain isolated voxels having different labels than their surroundings. For example, a CNN module may produce an output wherein a majority of voxels within a large volume are assigned a first label, with isolated voxels and/or small groups of voxels assigned different, e.g., second or third labels, identifying them as corresponding to different anatomical regions than their neighbors. Often such isolated voxels and/or islands appear on the edges of a large uniformly labeled region.

[0217] These small non-uniformities correspond to noise in the classification process, and can be removed via an iterative procedure as follows. First, for each label representing (i) a particular anatomical region or target tissue region, or (ii) background, an associated largest connected component of labeled voxels is identified. Second, for each particular label, differently labeled isolated voxels and/or voxel islands that are immediately adjacent to voxels of the largest connected component associated with the particular label are identified and re-assigned the particular label. In certain embodiments, in a third step, any remaining isolated differently labeled voxel islands can then be removed. In a fourth step, holes in segmentation regions – voxels that are labeled as background but are completely encapsulated by non-background labeled voxels are filled (e.g., by assigning voxels of the

holes a label of the non-background region that encapsulates them). The second through fourth steps, in which isolated voxels and/or voxel islands are relabeled based on their surroundings are repeated until convergence – i.e., no change from on iteration to the next. This approach reduces and/or eliminates isolated voxels of a different label from their surrounding thereby mitigating noise in the classification process.

[0218] These various approaches for identifying initial VOIs may be used alone or in combination to identify multiple initial VOIs within an anatomical image of a subject. Once one or more initial VOIs are identified, one or more target VOIs within each initial VOI may be identified. For example, PCT Publication WO2019/136349, the content of which is hereby incorporated by reference in its entirety, provides further detail on how a single initial VOI corresponding to a pelvic region may be identified within a CT image, and how fine segmentation may be performed to identify target VOIs corresponding to organs such as a prostate, bladder, gluteal muscles, as well as various pelvic bones, such as a sacrum, coccyx, and left and right hip bones, may be identified. The approaches described herein, and in particular in Examples 1 – 4, show how multiple initial VOIs can be identified and used to identify a plurality of target VOIs across a subject's body, thereby providing for accurate whole-body image segmentation that can serve as a basis for detection and assessment of cancer status, progression, and response to treatment at localized stages in various organs and tissue regions, as well as metastatic stages where it is present in multiple regions in a patient's body.

ii. Providing Anatomical Context to 3D Functional Images

[0219] Segmentation maps generated by automated AI-based analysis of anatomical images can be transferred to 3D functional images in order to identify, within the 3D functional image, 3D volumes corresponding to the target VOIs identified in the anatomical

image. In particular, in certain embodiments, the individual segmentation masks (of the segmentation map) are mapped from the 3D anatomical image to the 3D functional image. The 3D volumes identified within the 3D functional image can be used for a variety of purposes in analyzing images for assessment of cancer status.

[0220] Certain identified 3D volumes and corresponding target VOIs correspond to tissue regions where cancer is suspected and/or may occur. Such regions may include, for example, a prostate, breast tissue, lung(s), brain, lymph nodes, and bone. Other regions may also be evaluated. Certain regions, such as prostate, breast, and lungs, are relevant for detecting cancer at earlier, localized stages, while others, such as lymph nodes and bone are relevant for assessing metastatic cancer. Since intensities of functional images, such as PET and SPECT images map spatial distribution of radiopharmaceutical accumulation in a patient's body, by accurately identifying specific 3D volumes in functional images that correspond to specific tissue regions intensities of voxels within those 3D volumes can be used determine a measure of uptake of radiopharmaceutical probes within the specific tissue regions to which they correspond. Since radiopharmaceutical probes can be designed to selectively accumulate in cancerous tissue (e.g., via enhanced affinity to biomolecules that are overexpressed in cancerous tissue, such as prostate specific membrane antigen (PSMA)), detecting and quantifying uptake of particular probes in certain target tissue regions and organs is of interest is indicative of and/or can be used to determining a cancer status for the subject. For example, as described in PCT Publication WO2019/136349, the content of which is hereby incorporated by reference in its entirety, assessing 1404 uptake in a prostate volume can be used to determine a prostate cancer status for a subject. Other probes may be used to assess metastatic cancer, present in a wide variety of other tissue regions, including bones. For example, Examples 2 to 6 describe segmentation used to identify accumulation of PyL™ in cancerous lesions throughout a patient's body.

[0221] Accordingly, in certain embodiments, segmentation performed on an anatomical image, such as CT image, is transferred (e.g., mapped) to a co-registered functional image, such as a PET or SPECT image, allowing for specific tissue volumes of interest within the functional image that correspond to particular tissue regions of interest to be identified. Accumulation of radiopharmaceutical within those particular tissue regions can then be quantified based on intensities of functional image voxels that lie within the specific tissue volumes of interest.

[0222] A variety of approaches can be used to analyze voxel intensities in functional images. For example, an average, a median, a total, a maximum, etc. intensity within a specific volume may be computed and used for quantification. This computed value may then be compared with other values, e.g., computed for other tissue regions (e.g., for normalization), and used to assign a cancer status to a patient (e.g., based on comparison with one or more predetermined threshold values). In certain embodiments, localized regions of high intensity – referred to as hotspots, are identified within particular 3D volumes. As described in further detail in section B, below, these localized hotspots can be identified as representing cancerous lesions, and used to determine cancer status of a subject. In certain embodiments, machine learning approaches can be used. For example, intensities of functional image voxels lying within one or more specific tissue volumes of interest can be used as inputs to machine learning modules that compute a risk index that can, in itself be used to quantify a risk of cancer, metastasis, or recurrence of cancer, etc. and/or compared with reference values, such as thresholds, to assign a particular cancer status.

[0223] In certain embodiments, in addition to identifying specific tissue regions in which cancerous tissue is may be present, e.g., in order to determine the presence and/or the state of cancer therein, other additional tissue regions may be identified. Such additional tissue regions may correspond to background regions in which a particular

radiopharmaceutical probe accumulates under normal circumstances, without lesions necessarily being present.

[0224] In certain embodiments, identified background regions are used to normalize voxel intensities so as to standardize intensity values from image to image. For example, as described in PCT Publication WO2019/136349, the content of which is hereby incorporated by reference in its entirety, gluteal muscles can be identified and uptake in them can be used to normalize intensities in SPECT images obtained following administration of 1404.

[0225] Identification of certain background regions can also be used to account for high probe accumulation levels in these regions. In certain embodiments, certain background regions are identified and excluded from analysis. For example, as described in Example 3, certain probes, such as PyL™ may accumulate in certain background regions under normal circumstances, absent any cancerous lesions or tissue within those regions. Accordingly, these regions may be identified and excluded from, e.g., hotspot detection analysis. Examples of such regions include kidneys, duodenum, small intestines, spleen, liver, pancreas, stomach, adrenal gland, rectum, and testes.

[0226] In certain embodiments, identifying 3D volumes in a functional image that correspond to background regions can be used to correct for intensity bleed effects, where high accumulation of radiopharmaceutical in a particular region may produce high intensities in the functional image not only in the 3D volume that corresponds to the particular region, but also in its neighborhood. Such intensity bleed into other regions of functional images can mask useful signal. For example, radiopharmaceutical typically accumulates in high amounts in a patient's bladder. When imaged via a functional imaging modality, this high accumulation in the bladder may, via scattering effects, contribute to intensities in 3D volumes corresponding to tissue regions outside the bladder, such as a prostate. . Accordingly, accounting for this intensity bleed or "cross-talk" can improve the accuracy

with which intensities in a 3D functional image are used to measure underlying radiopharmaceutical uptake.

[0227] In certain embodiments, the 3D volume corresponding to the particular background region producing the intensity bleed is dilated. The dilated background region may be excluded from analysis, so as to avoid using intensities of regions directly adjacent to the background region to determine uptake metrics or identification of hotspots.

[0228] In certain embodiments, a suppression method which models the profile of the functional intensities may also be used to adjust the intensity levels in neighboring regions to correct for the intensity bleed. In this approach, for a particular background region that produces intensity bleed, an amount of suppression, that is, intensity bleed, to remove from a particular voxel of the functional image is dependent on a distance from that voxel to a high intensity core region within a particular 3D background volume corresponding to the particular background region. The high intensity core region may be determined as a region comprising voxels having intensities above a predetermined value, or within a specific fraction of a maximum intensity in a specific region of the functional image.

[0229] In certain embodiments, this suppression is utilized if a maximum functional image intensity within a 3D volume identified as corresponding to the particular background region is more than a specific multiplier value times a determined background intensity value. Background intensity values may be determined based on intensities of voxels of the 3D functional image corresponding to specific reference volumes corresponding to specific tissue regions, such as gluteal muscles. The suppression approach may be applied to a sub-region of the 3D functional image in the vicinity of the particular background region producing intensity bleed. For example, it may be applied to a rectangular sub-region encompassing the particular region, plus a predetermined margin.

[0230] In certain embodiments, one or more intensity bleed functions are determined to perform suppression and thereby correct intensities of voxels of the 3D functional image for bleed (e.g., cross-talk). For example, the 3D functional image may be cropped to the aforementioned rectangular sub-region encompassing the particular region plus the predetermined margin. A determined background intensity value can be subtracted from intensities of voxels within the cropped image region. Sample intensities can then be collected to determine how intensity originating from radiopharmaceutical uptake within the particular background region decreases as one moves away from the particular background 3D volume corresponding to the particular background region. Samples beginning at an extreme top, right, left, and bottom, and then moving outwards up, right, left, and down, respectively, may be used. Other directions are also possible. The sampled intensities provide curves (e.g., sets of sampled intensity data points) showing intensity decrease from the high intensity core. Template functions, such as n-th degree polynomials can be fit to these sampled curves and used to compute intensity values to be used as correction factors in the vicinity of the particular 3D background volume.

[0231] For example, PCT Publication WO2019/136349, the content of which is hereby incorporated by reference in its entirety describes how identification of a bladder region can be used to adjust prostate voxel intensities for intensity bleed through due to high accumulation in the bladder in 1404-SPECT images. In certain embodiments, similar approaches can be used for other images obtained with other probes, which may accumulate in the bladder, and/or other regions (e.g., the liver, the kidneys, etc.).

[0232] In certain embodiments, the segmentation approaches described herein assume that the 3D anatomical image includes certain anatomical regions. For example, an embodiment of the systems and methods described herein may assume that its input anatomical images always include a pelvic region, and automatically attempts to segment the

pelvic region. The systems and methods described herein may also, for other anatomical regions, only segment such regions if they are included in the anatomical image input, for example first performing a determination as to whether they are present.

[0233] Approaches for performing whole body segmentation to identify target tissue regions corresponding to bone and/or soft-tissue (e.g., organs) are described in further detail in Examples 1, 2, 3, and 4 below. Also described are approaches for using such whole body segmentation for assessment of disease state, in particular, cancer in a patient.

B. Hotspot and Lesion Detection

[0234] In certain embodiments, instead of, or in addition to, quantifying overall uptake in a particular volume within the functional image, localized hotspots (localized regions of relatively high intensity) are detected. In certain embodiments, hotspots are detected via a thresholding approach – by comparing intensities of voxels within the functional image to one or more thresholds values. Groupings of voxels with intensities above a threshold may be detected as hotspots. A single, global, threshold value may be used, or, in certain embodiments, multiple region specific thresholds may also be used. For example, segmentation of the co-registered anatomical image can be used to set different thresholds for different tissue regions used for hotspot detection. Segmentation of the co-registered image can also be used, as described herein, to remove effects of background signal, thereby facilitating hotspot detection (e.g., if a global threshold and/or multiple regional thresholds are used).

[0235] In certain embodiments, hotspots can additionally be detected using blob detection techniques. One approach is to use the Difference of Gaussians approach, where a PET image is filtered through a combination of high and low-pass filters approximated by Gaussian kernels. The filters reduce background noise and are invariant to changes in

background levels in the different regions of the image (e.g. the thorax might have significantly higher background levels due to significant uptake in liver and kidneys compared to the pelvic region). This cascaded high/low-pass filter approach would allow for hotspot extraction without the utilization of fixed thresholds, but could instead identify local changes in the PET intensities. Another approach is to employ a Laplacian of a Gaussian blob detection method. The Laplacian of a Gaussian approach is a method for detecting edges in images using Laplacian and Gaussian filter kernels. By using different sizes of kernels, edges of structures of different sizes are detected. Choosing appropriate kernel sizes allows the method to detect structures that have properties common to lesions. The described approaches may be used in a stand-alone fashion where only one of the techniques is used for all regions of interest, or they may be used simultaneously, where different methods can be employed for different tissue regions as identified by the semantic segmentation of the co-registered anatomical image in conjunction with either a single global threshold or multiple local thresholds.

[0236] FIG. 5B shows an example process 520 for using the segmentation approaches described herein to detect hotspots representing cancerous lesions. In a first step, a 3D anatomical image is received 522. A one or more target VOIs corresponding to particular target tissue regions are identified within the 3D anatomical image 524 and the identifications of the target VOIs are stitched together 526 to create a segmentation map 534 comprising a plurality of segmentation masks 536. Each segmentation mask of the segmentation map represents a particular target VOI. Next, a 3D functional image (e.g., a PET image) is received 528 and the segmentation map is transferred to the 3D functional image to identify, for each target VOI, a corresponding 3D volume in the 3D functional image 530. The identified 3D volumes are then used to detect 532, within the 3D functional image, one or more hotspots corresponding to localized regions of high intensity relative to their

surroundings. In particular, one or more specific 3D volumes may correspond to specific tissue regions where cancerous lesions may form, and be analyzed to detect hotspots therein. Other 3D volumes may be used to perform background correction, or intentionally be excluded from the hotspot detection process. As described in further detail herein, still other volumes may be relevant in that they are used as reference volumes for computing useful indices that can be assigned to hotspots in order to score them, e.g., to indicate risk / severity of the underlying lesions they represent.

[0237] Hotspots may also be classified following their initial detection, e.g., as cancerous or not, and/or assigned likelihood values representing their likelihood of being a metastases. Hotspot classification may be performed by extracting hotspot features (e.g., metrics that describe characteristics of a particular hotspot) and using the extracted hotspot features as a basis for classification, e.g., via a machine learning module.

[0238] In certain embodiments, hotspot classification can also be performed without the use of machine learning. In such embodiments, anatomical knowledge can be combined with information relating to the shape and location of a detected hotspot to classify the hotspot as either a cancerous lesion or noise. For example, if a detected hotspot is located on the edge of a rib facing the liver and the detected peak is not the global maximum in the area surrounding the hotspot, it is possible to estimate whether the hotspot is a tumor or not based on the given anatomical and spatial information. The segmentation of the co-registered anatomical image can additionally be used to create intensity models of background tissue regions known to not contain cancerous cells, but where exceptionally high functional image voxel intensities are common. Such background regions may cause intensity bleed outside of the boundaries of the background region itself and impact the neighboring regions where cancerous lesions might exist. Profiles of the intensity levels can be estimated and used to

subtract the estimated additional intensity levels present in neighboring tissue regions harboring cancerous lesions to allow a more robust hotspot detection.

[0239] Hotspots representing lesions may be used to determine risk indices that provide an indication of disease presence and/or state (e.g., a cancer status, similar to a Gleason score) for a patient. For example, metrics such as number of hotspots, a total summed intensity of identified hotspots, area fraction of a particular body part or region (e.g., skeleton) occupied by hotspots, and the like, may be used themselves as, and/or in calculation of, such risk indices. In certain embodiments, regions identified via the segmentation approaches described herein may be used in computation of risk indices, for example in computing metrics such as area fractions. Examples of approaches for using identified hotspots to compute risk indices is provided herein, in Examples 5 and 7.

C. Example CNN-Based Whole Body Segmentation and Lesion Detection Approaches

[0240] The following examples demonstrate use of the AI-based segmentation and hotspot detection approaches described herein for whole-body segmentation, detecting cancerous lesions, and determining useful metrics for evaluating a cancer status of a subject.

i. Example 1 – CNN Based Whole Body Segmentation

[0241] Example 1 describes an example approach for whole body segmentation. The implementation in this example uses five neural networks to segment bones within an entire torso. A first neural network is used to roughly localize different regions of the body. The results are used to divide the body into four regions. In each of these regions, a corresponding neural network is then used to perform segmentation into distinct bones. The

results from all four regions are then combined into a finished result (e.g., a final segmentation map).

[0242] This approach is related to the two-step 'bounding box' approach described herein, wherein a first machine learning module (e.g., a localization module) is used to roughly localize an initial volume of interest (VOI) corresponding to an anatomical region that comprises one or more particular target tissue regions (e.g., a prostate). A second machine learning module (e.g., a segmentation module) then performs a fine segmentation within the initial VOI to identify target volume(s) corresponding to the target tissue region(s) within the initial VOI. In this case, for whole body segmentation, the first machine learning module (localization module) identifies multiple initial VOIs, each corresponding to a different anatomical region. Then, for each anatomical region, a corresponding secondary machine learning module (segmentation module) identifies one or more target volumes, each representing a particular target tissue region. The machine learning modules (e.g., neural networks) may be implemented as separate modules, or certain machine learning networks may be combined. For example, each secondary, segmentation network may be implemented as a separate module, or within a single module.

[0243] Accordingly, in this example, the first module (localization) is used for identifying the anatomical regions within the CT; that is, to find volumes of interest where networks of the second module can be applied to generate the segmentation map that is used for further analysis. The networks in the second module work with a full-resolution CT image, while the localization network works in low resolution, using a sub-sampled version of the CT image.

[0244] Three example versions of CNN networks used in software implementing whole-body segmentation in accordance with the approaches. Versions 1 and 2 segment 49 bones, and version 2 segments 49 bones and 8 soft-tissue regions.

CNN-Based Segmentation Platform Example Version 1

[0245] In a first example version of a CNN network used for whole body segmentation , the first machine learning module (localization module) in this example is referred to as "coarse-seg", and was trained to identify 49 bones in sub-sampled CT images (a sub-sampling factor of 4 along each dimension). The localization module was used to differentiate regions of the body in to a pelvic region, a spine, a left upper body, and a right upper body. The four fine segmentation networks were as follows:

- "fine-seg-pelvic": Trained to identify the left and right ilium and the sacrum and coccyx;
- "fine-seg-spine": Trained to identify 12 thoracic vertebrae, 5 lumbar vertebrae, and the sternum;
- "fine-seg-left-upper-body": Trained to identify 12 ribs on the left side of the body, the left scapula, and left clavicle; and
- "fine-seg-right-upper-body": Trained to identify 12 ribs on the right side of the body, the right scapula, and right clavicle.

[0246] The input image sizes for each network were as follows:

Table 1: Input image sizes for five neural networks.

Network Name	Input image size (no. slices, no. rows, no. columns)
coarse-seg	(81, 70, 104)
fine-seg-pelvic	(93, 146, 253)
fine-seg-spine	(194, 204, 94)
fine-seg-left-upper-body	(158, 187, 144)
fine-seg-right-upper-body	(158, 191, 146)

[0247] While the coarse-seg network of the localization module received, as an input image, an 3D anatomical image representing a large physical volume and comprising a majority of the subject's body, the actual number of voxels in its input image was lower than

for the other networks due to the factor of 4 sub-sampling. The number of voxels and size of the input image to the localization module was also reduced by cropping (removing) regions of the image that did not include graphical representations of tissue, but instead represent air. Removing these voxels as a pre-processing step further reduced the size of the image input to the localization module (see e.g., first two columns of Table 4 below). Reducing the size of the image input to the localization module via sub-sampling allows the coarse-seg network to trade resolution of the image on which it operates for additional filters, which allow it to e.g., account for variability in images it receives and perform more accurate and robust coarse segmentation to identify the different initial volumes of interest.

[0248] The number of filters and parameters used in each neural network are listed in Tables 2 – 4, below:

Table 2: Number of convolutional filters in five neural networks.

Network Name	Total Number of Filters	Number of Filters in First Layer
coarse-seg	4096 + 49 (49 classes)	32
fine-seg-pelvic	4096 + 3	32
fine-seg-spine	2048 + 18	16
fine-seg-left-upper-body	2048 + 14	16
fine-seg-right-upper-body	2048 + 14	16

Table 3: Number of parameters in five neural networks

Network Name	Total params.	No. trainable params.	No. non-trainable params.
coarse-seg	5,881,978	5,878,678	3,300
fine-seg-pelvic	5,880,276	5,877,068	3,208
fine-seg-spine	1,472,815	1,471,177	1,638
fine-seg-left-upper-body	1,472,731	1,471,101	1,630

fine-seg-right-upper-body	1,472,731	1,471,101	1,630

[0249] Table 4 below also shows a variability in input image size for the raw data and five neural networks used in this example. As shown in the table, variability in input image size for the four secondary, fine segmentation networks is less than that for the first, localization network since the identification of the initial VOIs produces a more standardized input for the secondary machine learning modules.

Table 4: Input image size for raw data and five neural networks.

	Raw data	Coarse-seg (cropped by air)	Fine-seg-pelvic (cropped by coarse)	Fine-seg-spine (cropped by coarse)	Fine-seg-left-upper-body (cropped by coarse)	Fine-seg-right-upper-body (cropped by coarse)
rows mean px	512	390	121	151	126	129
rows std px	0	39	7	19	20	21
rows min px	512	255	97	107	72	88
rows max px	512	399	136	189	170	188
rows min mm	700	308	133	146	98	120
rows max mm	700	546	186	258	232	242
columns mean px	512	399	207	67	112	113
columns std px	0	61	14	10	13	15
columns min px	512	311	155	45	84	72
columns max px	512	512	236	130	164	215
columns min mm	700	425	212	62	115	98
columns max mm	700	700	322	178	224	294
slices mean px	342	340	74	158	110	111

slices std px	99	95	6	12	11	12
slices min px	274	274	48	125	85	85
slices max px	624	624	92	208	136	140
slices min mm	822	822	144	375	255	255
slices max mm	1872	1872	276	624	408	420

CNN-Based Segmentation Platform Example Version 2

[0250] An updated, second, example version of the CNN whole-body segmentation system as described above in this example included adjustments to input image sizes, number of convolutional filters, and parameters used in the neural networks used to perform the segmentation. Tables 5, 6, and 7, as seen below, show updated values for the various parameters used in the five neural networks. Table 5 shows updated values for the input image sizes shown in Table 1, Table 6 shows updated values for the number of convolutional filters for the neural networks shown in Table 2, and Table 7 shows updated values for the number of parameters used by the neural networks shown in Table 3.

Table 5: Updated values for input image sizes for five neural networks.

Network Name	Input image size (no. slices, no. rows, no. columns)
coarse-seg	(81, 77, 99)
fine-seg-pelvic	(92, 144, 251)
fine-seg-spine	(192, 183, 115)
fine-seg-left-upper-body	(154, 171, 140)
fine-seg-right-upper-body	(154, 170, 140)

Table 6: Updated values for number of convolutional filters in five neural networks.

Network Name	Total Number of Filters	Number of Filters in First Layer
coarse-seg	4096 + 49 (49 classes)	32
fine-seg-pelvic	3328 + 3	26
fine-seg-spine	2048 + 18	16

fine-seg-left-upper-body	2048 + 14	16
fine-seg-right-upper-body	2048 + 14	16

Table 7: Updated values for number of parameters in five neural networks

Network Name	Total params.	No. trainable params.	No. non-trainable params.
coarse-seg	5,882,423	5,879,132	3,300
fine-seg-pelvic	3,881,200	3,883,812	2,612
fine-seg-spine	1,472,815	1,471,177	1,638
fine-seg-left-upper-body	1,472,731	1,471,101	1,630
fine-seg-right-upper-body	1,472,731	1,471,101	1,630

CNN-Based Segmentation Platform Example Version 3

[0251] Another, 3rd, example version of the CNN whole body segmentation approach was used to segment soft-tissue regions as well as bones. As described herein, this 3rd version included two coarse segmentation modules, which were used in parallel, referred to herein as "coarse-seg-02" and "coarse-seg-03".

[0252] The "coarse-seg-02" module was trained to identify 49 bones in sub-sampled CT images. The "coarse-seg-03" module was trained to identify 49 bones and the liver, in sub-sampled CT images. The "coarse-seg-02" module outperformed the "coarse-seg-03" module for localization of bones and, to take advantage of the benefits of each module, both were used in parallel, to identify initial volumes of interest (e.g., "bounding boxes") for different fine segmentation networks. In particular, in the 3rd version, seven fine segmentation networks were used. Six out of the seven fine segmentation networks used "coarse-seg-02" for initial volume of interest identification and a seventh, "fine-seg-abdomen", used "coarse-seg-03" for the initial volume of interest identification.

[0253] The seven fine segmentation networks for this 3rd example version of the CNN whole-body segmentation system are as follows:

- "fine-seg-abdomen": Trained to identify the liver, left and right kidney, and gallbladder;
- "fine-seg-left-lung": Trained to identify the left lung;
- "fine-seg-right-lung": Trained to identify the right lung
- "fine-seg-pelvic-region-mixed": Trained to identify the left and right ilium, the prostate, the urinary bladder, and the sacrum and coccyx;
- "fine-seg-spine-bone": Trained to identify 12 thoracic vertebrae, 5 lumbar vertebrae, and the sternum;
- "fine-seg-left-upper-body-bone": Trained to identify 12 ribs on the left side of the body, the left scapula, and left clavicle; and
- "fine-seg-right-upper-body-bone": Trained to identify 12 ribs on the right side of the body, the right scapula, and right clavicle.

Tables 8, 9, and 10, below, show values for the various parameters used in seven neural networks in the 3rd version of the CNN-based segmentation system.

Table 8: Input image sizes for the seven neural networks and two localization networks.

Network Name	Input image size (Input image size (no. slices, no. rows, no. columns)
coarse-seg-02	(81, 77, 99)
coarse-seg-03	(81, 77, 99)
fine-seg-abdomen	(92, 176, 259)
fine-seg-left-lung	(154, 171, 140)
fine-seg-right-lung	(154, 171, 141)
fine-seg-left-upper-body-bone	(154, 171, 140)
fine-seg-right-upper-body-bone	(154, 170, 140)

fine-seg-pelvic-region-mixed	(92, 144, 251)
fine-seg-spine-bone	(192, 183, 115)

Table 9: Number of convolutional filters in the seven neural networks and two localization networks.

Network Name	Total Number of Filters	Number of Filters in First Layer
coarse-seg-02	2278 + 49 (49 classes)	32
coarse-seg-03	2278 + 50	32
fine-seg-abdomen	1142 + 16 (not all output classes are included in the complete segmentation platform)	16
fine-seg-left-lung	1142 + 15	16
fine-seg-right-lung	1142 + 15	16
fine-seg-left-upper-body	1142 + 14	16
fine-seg-right-upper-body	1142 + 14	16
fine-seg-pelvic-region-mixed	1852 + 5	26
fine-seg-spine-bone	1142 + 18	16

Table 10: Number of parameters in seven neural networks and two localization networks.

Network Name	Total Params	No. trainable params	No. non-trainable params
coarse-seg-02	5,882,432	5,879,132	3,300
coarse-seg-03	5,882,469	5,879,167	3,302
fine-seg-abdomen	1,473,003	1,471,369	1,634
fine-seg-left-lung	1,472,752	1,471,120	1,632
fine-seg-right-lung	1,472,752	1,471,120	1,632
fine-seg-left-upper-body	1,472,731	1,471,101	1,630

fine-seg-right-upper-body	1,472,731	1,471,101	1,630
fine-seg-pelvic-region-mixed	3,883,812	3,881,200	2,612
fine-seg-spine-bone	1,472,815	1,471,177	1,638

[0254] Accordingly, this example demonstrates how segmentation approaches described herein can be used to perform efficient whole body segmentation.

ii. Example 2: Automated Segmentation of the Skeleton in Low-Dose CT and Quantification of Metastatic Prostate Cancer in [^{18}F]DCFPyL PET

[0255] PSMA-PET/CT hybrid imaging is a promising diagnostic platform for prostate cancer patients. While manual delineation of organs in three dimensional CT images is often needed for accurate diagnostics and treatment planning, such manual delineation is a time consuming process. To address this challenge, this example demonstrates automating the process of accurate bone segmentation in whole body CT images using deep learning approaches in accordance with the whole body segmentation technology described herein. As described in this example, the anatomical information gained via such skeletal segmentation can be used to create a fully automated lesion detection algorithm in [^{18}F]DCFPyL (PyL^{TM}-PSMA) PET/CT images.

[0256] A deep learning algorithm based on cascaded deep learning convolutional neural networks for semantic segmentation of 12 skeletal regions was developed. In particular, the 12 skeletal regions were the thoracic and lumbar vertebrae, sinister (left) / dexter (right) ribs, sternum, sinister (left) / dexter (right) clavicle, sinister (left) / dexter (right) scapula, sinister (left) / dexter (right) ilium, and the sacrum. A training set ($N = 90$) and validation set ($N = 22$) of pairs of low-dose CT images and manually crafted segmentation maps were used to develop the deep learning algorithm. The algorithm's performance was assessed on a test set ($N = 10$) of low-dose CT images obtained from a PyL^{TM} –PSMA study.

In the test set of images, five representatively body parts: sinister (left) ilium, lumbar vertebrae, sinister (left) ribs, dexter (right) scapula, and sternum were manually segmented. These manual segmentations were used as ground truth for evaluation of the automated segmentation procedure.

[0257] The automated segmentation can be used for automated lesion detection. For example, automated lesion detection approach using a hard threshold of standard uptake value (SUV) based on PET image voxel intensities can be performed..

[0258] Sorensen-Dice scores were used to evaluate accuracy of the automated segmentation. The segmentation approach achieved a Sorensen-Dice score mean and standard deviation of 0.95 and 0.024, respectively, on the training set and a mean and standard deviation of 0.93 and 0.036, respectively, on the validation set. For the test set, mean values (with standard deviation values shown in parentheses) for each of the five regions are as follows: 0.94 (0.016) for dexter (right) clavicle, 0.90 (0.023) for sinister (left) ribs, 0.92 (0.019) for sternum, 0.94 (0.033) for lumbar vertebrae, and 0.97 (0.0033) for sinister (left) ilium. The overall mean (over all body parts) was 0.93, with a standard deviation of 0.030.

[0259] Accordingly, this example demonstrates the accuracy of a fully automated segmentation approach for 12 skeletal regions in whole body low-dose CT images and use of an automated lesion detection approach for PyL™-PSMA/CT hybrid imaging.

iii. Example 3: Automated Whole Body Segmentation for PyL™-PET Image Analysis and Lesion Detection

[0260] This example demonstrates automated segmentation of 49 bones and 27 soft-tissue regions in whole body CT images using deep learning approaches in accordance with the whole body segmentation technology described herein. This example also demonstrates

how the anatomical information gained via such segmentation can be used to create a fully automated lesion detection algorithm in [^{18}F]DCFPyL (PyL™-PSMA) PET/CT images. This example also shows how the segmentation can be used to remove background signal from PET images to facilitate observation and detection of lesions in which PyL™ has accumulated.

[0261] FIG. 6A shows a block flow diagram illustrating an embodiment of the segmentation processes described herein that is used in the PyL™-PET/CT image analysis described in this example. As in process 500, shown in FIG. 5, in process 600 an anatomical image is received. In particular, in process 600, a CT image is received 610a. In this example, process 600 is used to identify and segment the CT image into target volumes of interest corresponding to 49 specific bones and 8 soft tissue regions (in this example, example version 3 of the CNN-based segmentation approach described in Example 1 is used). In order to identify the target volumes, a coarse segmentation is performed 620a to localize a set of initial volumes of interest, or sub-regions, e.g., as described in Example 1. A fine segmentation is then performed within each of the sub-regions to identify the specific target volumes of interest that correspond to the target 49 bone and 8 soft-tissue regions 630a. Segmentation masks representing the identified target volumes can be created, and merged 640a, for example to create a 3D whole body segmentation map.

[0262] As noted in Example 1 (CNN Network Version 3), the specific regions segmented are as follows:

49 Bones:

clavicle_left
clavicle_right
hip_bone_left
hip_bone_right
rib_left_1
rib_left_10

rib_left_11
rib_left_12
rib_left_2
rib_left_3
rib_left_4
rib_left_5
rib_left_6
rib_left_7
rib_left_8
rib_left_9
rib_right_1
rib_right_10
rib_right_11
rib_right_12
rib_right_2
rib_right_3
rib_right_4
rib_right_5
rib_right_6
rib_right_7
rib_right_8
rib_right_9
sacrum_and_coccyx
scapula_left
scapula_right
sternum
vertebra_lumbar_1
vertebra_lumbar_2
vertebra_lumbar_3
vertebra_lumbar_4
vertebra_lumbar_5
vertebra_thoracic_1
vertebra_thoracic_10
vertebra_thoracic_11
vertebra_thoracic_12

vertebra_thoracic_2
vertebra_thoracic_3
vertebra_thoracic_4
vertebra_thoracic_5
vertebra_thoracic_6
vertebra_thoracic_7
vertebra_thoracic_8
vertebra_thoracic_9

8 Soft-Tissue Regions:

gallbladder
kidney_left
kidney_right
liver
lung_left
lung_right
prostate
urinary_bladder

[0263] FIG. 6B shows a series of CT images overlaid with annotations illustrating the steps in the whole-body segmentation process 600 described in this example. An example raw CT image that is received at step 610a is shown in 610b. Image 620b shows results of a coarse segmentation (different regions identified are shown as colored regions) used to identify the initial volumes of interest in the CT image. Image 630b shows "bounding boxes" identifying initial volumes of interest in which fine segmentation is performed to identify the target volumes of interest corresponding to the 49 bones and 8 soft tissue regions. Image 640 illustrates the final, merged whole body segmentation.

[0264] Turning to FIG. 7, in order to train the machine learning modules used to perform the segmentations, numerous pre-labeled sample images, such as the three images (710, 720, 730) shown in FIG. 7, were used as a training data set. The machine learning

modules were fine-tuned using 1000's of manually annotated labels along with 100's of models trained on dozens of GPUs over 1000's of hours before optimal configurations for the many components of the segmentation platform were discovered. Once trained, however, segmentation can be performed rapidly, with results such as those shown in FIG. 8 (810 and 820 are two example images) and FIG. 16A and 16B obtained in a matter of seconds - typically under 180 seconds.

[0265] The anatomical context obtained by segmenting the CT image can be used to detect lesions in PET images that are co-registered with the CT image, for example, as in a typical PET/CT imaging modality in which CT and PET images are obtained for a subject in quick succession, with the subject remaining in a substantially same position as the images are recorded. In particular, as demonstrated in this example, segmentation of the CT image can be transferred to the PET image in order to identify regions of interest such as the prostate gland or the skeleton, where the entire functional image except for regions expected to carry either primary or secondary prostate cancer tumors can be excluded from the lesion detection algorithm. Without wishing to be bound to any particular theory, exclusion of regions from the lesion detection algorithm can be especially important for background regions where accumulation leads to high intensity in PET image voxels within and around the background tissue regions. The high intensities in background tissue regions may, if not excluded from the prostatic lesion detection process, lead to erroneous classification of background noise as cancerous lesions. In the regions that remain after the background exclusion process, a simple threshold (e.g., a SUV of 3) in conjunction with a lesion classification algorithm can be employed to find hotspots within the relevant tissue regions. The classification algorithm may be used as a simple check to confirm the hotspots position and to compare the intensity in the hotspot's neighborhood. If the hotspot is part of a larger hotspot and is located on the edge of a body part (e.g. a rib close to the liver), the lesion may

be classified as noise and excluded. FIGs. 9A – D illustrate the need for, and benefits obtained by, this background subtraction approach and lesion detection algorithm, where only regions of interest are included in the detection procedure, and portions of the image contains high intensity background voxels. FIGs. 9A and 9C show PET images as white-to-red-to-blue false color overlaid on CT images. Blue color indicates low PET image intensity, transitioning from red to white as intensity increases. FIGs. 9B and 9D show the same PET images as in 9A and 9C, but with all background uptake removed from the PET image. In FIG. 9B and 9D, a few localized hotspots, corresponding to cancerous lesions are visible. In the PET images without background removal, these hotspots were overwhelmed and masked by the large background signal.

[0266] FIG. 10A shows an example process 1000 for using the anatomical context provided by whole body CT segmentation for detecting lesions and determining useful risk indices that quantify a cancer status (e.g., prostate cancer status) of a subject using PET/CT images obtained following administration of PyL™ as a radiopharmaceutical. As shown in FIG. 10A, PET/CT images are obtained 1010, anatomical context is determined 1012 via segmentation of bones and soft tissue and used to obtain measurements (e.g., of lesions and/or risk indices) from the PET image 1014. FIG. 10B shows an example PET/CT image 1016 and FIG. 10C shows example segmentations of bones and soft tissue 1018a and 1018b. As shown in FIG. 10D, segmentation of bone and soft-tissue (e.g., shown in image 1020a) can be used to remove background signal (e.g., from background tissue regions, such as those shown in image 1020b), leaving only desired signal from hotspots indicative of cancerous lesions 1020c.

[0267] FIGs. 11 – 13 illustrate this process, showing how segmentation of a CT image can be transferred to a PET image, and are used to provide anatomical context for background removal and lesion detection. In particular, FIG. 11A and FIG. 11B show

different views of a CT image, in which segmentation of bones has been performed. The various segmented bones are labeled with different colors in the views shown in FIG. 11A and FIG. 11B. Notably, by virtue of the "bounding box" approach described herein, even such a complex and large scale segmentation can be performed extremely rapidly. The segmentation shown in FIGs. 11A and 11B was performed in less than 180 seconds.

[0268] As shown in FIG. 12, segmentation of bones and soft tissue can be used to account for normal uptake in certain background tissue regions, which may occur under normal circumstances and mask useful hotspot signals that indicate presence of cancerous lesions. In PET/CT imaging performed with PyL™, normal uptake can occur in kidneys, duodenum, small intestines, spleen, liver, pancreas, stomach, adrenal gland, rectum, and testes. FIG. 12 shows the aforementioned regions identified in red. As shown in FIG. 13A, once background intensities due to normal PyL™ accumulation in these regions is subtracted out, lesions become readily observable and can be detected. One such lesion 1302 is visible in FIGs. 13A - D. Lesions such as lesion 1302 can be detected, for example via a thresholding approach, and classified as PyL™ positive (i.e., indicative of cancer) e.g., as described above. As with segmentation, lesion detection is also rapid. Lesion 1302 was detected in less than 5 seconds.

[0269] FIG. 14A and FIG. 14B show results of the PET image processing and lesion detection approach described above performed on PET/CT images obtained for a 65 year old male with metastatic castration resistant prostate cancer. The patient's prostate specific antigen (PSA) score was 6.8 ng/ml. The PET images were obtained following administration of PyL™ as the radiopharmaceutical. FIG. 14A shows the initial, raw, PET/CT image. FIG. 14B shows the image following the processing described herein. The background intensity is removed, and several small lesions are readily observable. The segmentation of the 49 bones and 8 soft-tissue regions (e.g., organs) was performed in less than 180 seconds.

[0270] FIG. 15A and FIG. 15B show results of the PET image processing and lesion detection approach performed on PET/CT images obtained for a 54 year old male with metastatic castration resistant prostate cancer. The patient's PSA score was 33.55 ng/ml. The PET images were obtained following administration of PyL™ as the radiopharmaceutical. FIG. 15A shows the initial, raw, PET/CT image. FIG. 15B shows the image following the processing described herein. The background intensity is removed, and several small lesions are readily observable. The segmentation of the 49 bones and 8 soft-tissue regions (e.g., organs) was again performed in less than or about 180 seconds.

[0271] Accordingly, this example demonstrates how the whole-body segmentation approach described herein contextualizing the PyL™ images, with automated segmentation of 27 soft-tissue organs and 49 bones, to detect, quantify and track PyL™ avid lesions. The approach would allow the clinicians/physicians to ask clinically relevant questions for better management of prostate cancer patients. Advantages such as increased diagnostic accuracy, precision, speed, and reproducibility, were demonstrated (statistically) in the context of artificial intelligence assisted 1404-SPECT image analysis (see, e.g., PCT Publication WO2019/136349, the content of which is hereby incorporated by reference in its entirety), may also be obtained for PyL™-PET images.

iv. Example 4: Example Bone and Soft-Tissue Segmentation Regions

[0272] This example provides a listing of a set of example bone and soft-tissue regions that a system developed using the approaches and embodiments described herein can identify via segmentation of CT images. In particular, listed below are 67 bones and 22 soft-tissue regions for that have been manually labeled (e.g., identified by one or more human experts) in a set of CT images. These manually labeled CT images can be used as training data for the machine learning approaches described herein. For example, while Examples 1 –

3 describe current versions of software implementing whole body segmentation approaches that segment 49 bones and 8 soft-tissue regions, their functionality can readily be updated to segment any number of the 67 bone and 22 soft-tissue regions listed in this example. Accordingly, this example shows that embodiments of the systems and methods described herein may be developed to identify similar regions, including, but not necessarily limited to the specific regions described in this example. Certain systems and methods may identify tissue regions not necessarily listed in this example. In certain embodiments, both bone and soft-tissue regions are identified. In certain embodiments, some systems and methods may identify only bones, or only soft-tissue.

[0273] As indicated in the listing below, certain left and right hand side bones are identified as separate tissue regions (e.g., a left clavicle and a right clavicle) and, in certain cases, individual members of large groups of bones are identified separately. For example, the example listing below shows that individual ribs and vertebrae are identified via the segmentation approach of this example (specific ribs and vertebrae are numbered in the listing). This example also should make clear that the approaches described herein can be used to segment a variety of regions throughout the body, including, but not necessarily limited to the regions listed herein.

Segmentation regions:

Bones (67)

clavicle_left
clavicle_right
femur_left
femur_right
fibula_left
fibula_right
hip_bone_left
hip_bone_right

humerus_left
humerus_right
mandible
patella_left
patella_right
radius_left
radius_right
rib_left_1
rib_left_2
rib_left_3
rib_left_4
rib_left_5
rib_left_6
rib_left_7
rib_left_8
rib_left_9
rib_left_10
rib_left_11
rib_left_12
rib_right_1
rib_right_2
rib_right_3
rib_right_4
rib_right_5
rib_right_6
rib_right_7
rib_right_8
rib_right_9
rib_right_10
rib_right_11
rib_right_12
sacrum_and_coccyx
scapula_left
scapula_right
skull

sternum
tibia_left
tibia_right
ulna_left
ulna_right
vertebra_cervical_all
vertebra_lumbar_1
vertebra_lumbar_2
vertebra_lumbar_3
vertebra_lumbar_4
vertebra_lumbar_5
vertebra_lumbar_6
vertebra_thoracic_1
vertebra_thoracic_2
vertebra_thoracic_3
vertebra_thoracic_4
vertebra_thoracic_5
vertebra_thoracic_6
vertebra_thoracic_7
vertebra_thoracic_8
vertebra_thoracic_9
vertebra_thoracic_10
vertebra_thoracic_11
vertebra_thoracic_12

Soft tissue (22):

adrenal_gland_left
adrenal_gland_right
aorta_abdominal_part
aorta_thoracic_part
brain
bronchi_left
bronchi_right
gallbladder

gluteus_maximus_left
gluteus_maximus_right
heart
kidney_left
kidney_right
liver
lung_left
lung_right
pancreas
prostate
rectum
spleen
urinary_bladder
ventricle

v. Example 5: Computing Hotspot Indices for Radiopharmaceutical Uptake Quantification and Clinical Endpoint Assessment

[0274] Example 5 is an example approach that uses the segmentation and hotspot detection methods described herein to compute, for a particular detected hotspot, a hotpot index value that can be used to infer and/or quantify uptake of radiopharmaceutical within the lesion that the detected hotspot represents. The computed hotspot index can be related to clinical endpoints, including survival rate of a patient and to determine treatment strategy. When computed for multiple images, collected at different time points, the computed index values can be compared with each other for a particular patient, and the change in index used to evaluate efficacy of a treatment and to make a prognosis of how the index will change in the near future. In certain embodiments, the computed index can predict sensitivity towards treatment targeting the imaging-ligand. In certain embodiments, the computed index can also be included in nomograms for effective patient stratification.

[0275] The approach in this example uses a CT-PET image set obtained for a particular patient following administration of a radiopharmaceutical comprising a PSMA binding agent, for example, PyL™. However, the approaches described herein are agnostic to the particular radiopharmaceutical used for imaging, and can be utilized with a variety of different radiopharmaceuticals, e.g., ^{99m}Tc-MIP-1404, ^{18}F-PyL, ^{68}Ga-PSMA-11, ^{18}F-NaF, ^{11}C-Choline, [18F]FDG, [18F]FACBC, etc.

[0276] A machine learning-based approach in accordance with the systems and methods described herein is used to identify various target VOIs within the CT image. As described herein, the target VOIs are volumes in the CT image identified, automatically, by the segmentation approach, to correspond particular target tissue regions. In this example approach, target VOIs corresponding to a liver, an aorta portion, and a parotid gland are identified. As described herein, these particular tissue regions – the liver, aorta portion, and parotid gland – serve as reference regions for computation of the hotspot index. Other target VOIs corresponding to other target tissue regions, in addition to the reference regions, may also be identified. Segmentation masks representing the identified target VOIs are mapped to the PET image to identify corresponding 3D volumes within the PET image. In this manner, 3D reference volumes corresponding to the liver, aorta portion, and parotid gland are identified in the PET image. Once identified, each particular 3D reference volume is used to compute a corresponding reference intensity value that provides a measure of the intensities of voxels within the particular 3D reference volume. In this example, a mean intensity inside each volume is used, though other measures (e.g., a median, a maximum, a mode, etc.) are possible.

[0277] To compute an index value for a particular identified hotspot, a hotspot intensity value is computed for that particular hotspot and compared with the reference intensity values. Similar to the reference values, the hotspot intensity value provides a

measure of intensity of voxels of the hotspot. In this example, a maximum value is computed, although, as with the reference values, other measures can be used. As this example shows, the particular measure used to compute the hotspot intensity value need not be the same as that used to compute the reference intensity values. To compute the hotspot index value, the reference intensity values can be mapped to reference index values on a scale, and the hotspot index value can then be computed based on whether the hotspot intensity value lies above, below, or in between the reference values.

[0278] For example, typically the reference intensity value computed from the reference volume corresponding to the aorta portion (this – aorta – region is used to provide a measure of uptake in the blood pool, and may also be referred to as a blood or blood pool reference value) is lowest in value, followed by the liver and then the parotid region. Accordingly, a hotspot whose hotspot intensity value is equal to the blood reference value will be assigned a hotspot index value equal to 100; a hotspot whose hotspot intensity value is equal to the liver reference value will be assigned a hotspot index value equal to 200; and a hotspot whose hotspot intensity value is equal to the parotid gland reference value will be assigned a hotspot index value equal to 300. Hotspot index values for hotspot intensity values lying in between two reference intensity values can be determined via interpolation (e.g., linear interpolation).

[0279] In this manner, a detected hotspot can be assigned an index value that quantifies, in a standardized fashion (e.g., so as to be comparable between different images) a level of radiopharmaceutical uptake in the particular lesion that the hotspot represents. As described herein, these indices can be related to survival, which, in turn, makes them useful for treatment management. For example, depending on the expected outcome of the patient, a more or less aggressive treatment may be considered. Price of treatments can also be included as a factor. The index is especially useful when measured over time. When

comparing indices across time and multiple imaging examinations for a patient, the change in index can be used to evaluate the efficacy of a treatment, and to make a prognosis how the index will change in the near future.

[0280] Notably, a significant advantage of the approach described in this example over previous approaches is the ability to compute reference intensity values (as well as hotspot intensity values) from automatically identified 3D volumes provided by the artificial intelligence based segmentation approaches described herein. Previous approaches that attempted to quantify regions of images representing lesions relied on hand marking – e.g., via placement of a circular marker – of regions in 2D slices to identify 2D regions of interest lying within a reference tissue region. In contrast to such small 2D regions, the 3D volume that are identified via the approaches used herein capture intensities throughout entire organs, and thereby offer increased accuracy and repeatability. Moreover, by using accurate automated segmentation, further increases in accuracy and repeatability are provided.

[0281] In addition, rather than classifying a detected lesion using one of a small number of values, the approach of this example uses a continuously varying index computed via interpolation. This approach provides more detailed information that can be utilized to manage treatment strategy and track disease progression and/or treatment efficacy over time in a finely grained and accurate fashion.

vi. Example 6: Automated Hotspot Detection and Uptake Quantification in Bone and Local Lymph

[0282] PyL™-PSMA PET/CT hybrid imaging (*e.g.*, images PET/CT images acquired for a patient after administering PyL™ to the patient) is a promising tool for detection of metastatic prostate cancer. Image segmentation, hotspot detection, and quantification technologies of the present disclosure can be used as a basis for providing automated

quantitative assessment of abnormal PyL™-PSMA uptake in bone and local lymph (*i.e.*, lymph nodes localized within and/or in substantial proximity to a pelvic region of a patient). In particular, as shown in this example, image segmentation and hotspot detection techniques in accordance with the systems and methods described herein can be used to automatically analyze in PET images to detect hotspots that a physician might identify as malignant lesions.

[0283] In this example, PET/CT scans were evaluated to automatically identify, within the PET images of the scans, hotspots corresponding to potential bone and local lymph node lesions. For each scan, a semantic segmentation of the CT image was performed using the deep learning approaches described herein in order to identify a set of specific bone and soft-tissue regions (*e.g.*, organs). Once obtained, the CT image segmentation was transferred (*e.g.*, mapped) to the PET image of the PET/CT scan to identify corresponding 3D volumes in the PET image. In each PET image, intensities corresponding to background uptake were removed by suppressing intensities in identified volumes corresponding to a urinary bladder, a liver, and a kidney. The segmentation was also used to define relevant volumes in which to detect hotspots. Blob detection algorithms were then applied to identify abnormal hotspots representing either possible bone lesions or possible malignant local lymph nodes. Reference volumes corresponding to a liver and a thoracic part of an aorta were used to compute reference SUV values.

[0284] Accuracy of the hotspot detection approach in this example was validated by comparing detection of hotspots in PET images using the automated approach described herein with manual annotations identifying bone lesions and lymph node lesions from teams of physicians. A set of 157 PET/CT scans that were annotated for bone lesions (114 of the images did not have any lesions and 11 of the images had greater than three lesions) were used to evaluate accuracy in detecting hotspots corresponding to bone lesions and a set of 66 scans that were annotated for local lymph node lesions (40 images without lesions and six

with greater than three lesions). The bone detection algorithm identified 97% of all annotated bone lesions, with on average 109 hotspots per image. The local lymph detection algorithm found 96% of all annotated malignant local lymph nodes, with on average 32 hotspots per scan.

[0285] Accuracy of the deep learning segmentation was also evaluated in this example. The segmentation algorithm was trained to segment a set of 52 bones and 7 soft tissue regions (*e.g.*, organs) used either for defining the hotspot search region or as reference regions. Training and validation was performed and evaluated for each particular region (bone or soft tissue region) using a manual identification of that region in a CT image. For example, 140 manually identified livers were used to train the algorithm for liver segmentation, and 37 manually identified livers were used for validation. Similarly, 61 and 14 manually identified aortas were used for training and validation of the aorta region segmentation, respectively. For liver segmentation, Dice scores of 0.99 and 0.96 were obtained for the training and validation sets, respectively. For aorta segmentation, Dice scores of 0.96 and 0.89 were obtained for training and validation, respectively. Finally, a set of ten additional images that were not used development of the algorithm were used to assess generalization. For these ten images, Dice scores characterizing segmentation accuracy of the liver and aorta were 0.97±0.01 and 0.91 ±0.5, respectively.

[0286] A full listing of the specific 52 bone (the sacrum and coccyx are listed on a single line as "sacrum_and_coccyx", but correspond to two segmented regions) and 7 soft-tissue regions used in this particular example is below.

Bone Regions:

capula_left
clavicle_left
clavicle_left
clavicle_right
hip_bone_left

hip_bone_right
rib_left_1
rib_left_10
rib_left_11
rib_left_12
rib_left_2
rib_left_3
rib_left_4
rib_left_5
rib_left_6
rib_left_7
rib_left_8
rib_left_9
rib_right_1
rib_right_10
rib_right_11
rib_right_12
rib_right_2
rib_right_3
rib_right_4
rib_right_5
rib_right_6
rib_right_7
rib_right_8
rib_right_9
sacrum_and_coccyx
scapula_left
scapula_right
sternum
vertebra_lumbar_1
vertebra_lumbar_2
vertebra_lumbar_3
vertebra_lumbar_4
vertebra_lumbar_5
vertebra_thoracic_1
vertebra_thoracic_10
vertebra_thoracic_11
vertebra_thoracic_12
vertebra_thoracic_2
vertebra_thoracic_3
vertebra_thoracic_4
vertebra_thoracic_5
vertebra_thoracic_6
vertebra_thoracic_7

vertebra_thoracic_8
vertebra_thoracic_9

Soft Tissue Regions:

aorta_abdominal_part
aorta_thoracic_part
kidney_left
kidney_right
liver
prostate
urinary_bladder

[0287] Accordingly, this example demonstrates use of deep learning based semantic segmentation for automated identification of hotspots and for computation of SUV reference values in [18^F] DCFPyL (PyL^{TM}-PSMA) PET/CT images.

vii. Example 7: Lesion PSMA Score and PSMA Weighted Lesion Involvement

[0288] This example provides an approach for assigning detected hotspots hotspot indices, based on a comparison of individual hotspot intensities with reference levels, and then using the assigned individual hotspot indices to determine overall indices representing a weighted sum of measures of lesion size. The indices used in this example are used to assess cancer status for patients imaged using a PSMA binding agent and PET-CT imaging.

[0289] In particular, individual hotspot indices are determined via interpolation from our reference levels similar to the approach described in Example 5. In this example, reference VOIs corresponding to an aorta portion and a liver portion are segmented and mapped to corresponding 3D volumes in a PET image. The aorta portion volume is used to determine a blood reference intensity, and the liver volume is used to determine a liver reference intensity. In this example, each reference intensity is determined from its

corresponding volume by taking an average intensity (SUV) in the corresponding volume, but other measures, such as a maximum, peak, or median value could also be used. Reference levels on a scale, referred to as a Lesion PSMA Score (LPS), are assigned to intensity values based on the blood and liver reference intensities (SUVs) as follows: a LPS of 0 is assigned to a 0 SUV level, an LPS of 1 is assigned to the blood reference intensity, an LPS of 2 is assigned to the liver reference intensity, and a maximum LPS of 3 is assigned to a reference intensity calculated as twice the liver reference intensity.

[0290] Individual hotspots are assigned LPS scores based on their individual intensities. For individual hotspots having intensities ranging from 0 to the maximum reference intensity (twice the liver reference intensity), the LPS score corresponding to the individual hotspot intensity is interpolated from the reference scale. Hotspots having intensities greater than the maximum reference intensity are assigned the maximum LPS of 3.

[0291] Two example overall risk indices that can be computed using detected hotspots and the individual hotspot indices (LPS scores) are calculated as weighted sums of hotspot sizes in particular volumes corresponding to tissue regions where cancerous lesions may occur. A first example index is a PSMA-weighted total bone/lymph/prostate lesion volume or ratio (PTLV or PTLR). This index is a weighted sum of lesion volumes, the weight being the lesion PSMA score. The sum is computed separately for 3D volumes corresponding to bone (e.g., a skeletal region), lymph nodes, and prostate as the weighted sum of hotspot volumes for hotspots found in each particular region. In particular, the weighted sum is computed as follows:

$$\sum(lesion\ volume\ \times lesion\ psma\ score)$$

[0292] In certain case, a ratio may be preferable and can be computed by dividing the weighted sum by the total 3D volume of the particular region (e.g., in the PET image). Weighting summed hotspot volumes by LPS, as opposed to, for example SUV or normalized

SUV is advantageous since it PSMA expression in the form of (normalized) SUV values may not relate to aggressiveness of the disease in a linear fashion. That is, for example, it is not a given that a hotspot with an intensity of 100 represents a lesion is five times worse than one represented by a hotpot having an intensity of 20. Calculating the LPS score and weighting hotspots by the LPS score provides a scale to compare different hotspots.

[0293] Another example index is a PSMA-weighted bone/lymph aggregated diameter (PLAD). This index is also a sum of a measure of lesion size, weighted by LPS score, but instead of volume this index uses an average diameter (e.g., averaged of *x*, *y*, and *z*-diameters) of each hotspot. Since volume is a three-dimensional quantity, a minor change in volume for a large lesion can dominate (e.g., cause large fluctuations in the sum) over changes in size of smaller lesions. Using the average diameter instead mitigates this effect. This index is calculated as follows:

$$\sum(lesion\ average\ diameter\ \times lesion\ psma\ score)$$

[0294] The weighed aggregated diameter can be calculated for the bone and lymph.

vii. Example 8: Improved Performance in AI-Assisted Image Analysis for Patients with Low or Intermediate Risk Prostate Cancer

[0295] 99mTc MIP-1404 (1404) is a PSMA targeted imaging agent for the detection and staging of clinically significant prostate cancer. Manual assessment of tracer uptake in SPECT/CT images introduces inherent limitations in inter- and intra-reader standardization. This example describes a study that evaluated the performance of PSMA-AI assisted reads, wherein automated segmentation of prostate volumes and other target tissue regions are performed in accordance with the embodiments described herein, over manual assessment and known clinical predictors.

[0296] The study analyzed 464 evaluable patients with very low-, low-, or intermediate- risk prostate cancer, whose diagnostic biopsy indicated a Gleason grade of ≤ 3+4 and/or who were candidates for active surveillance (1404-3301). All subjects received an IV injection of 1404 and SPECT/CT imaging was performed 3-6 hours postdose. Three independent readers evaluated the images. All subjects underwent either voluntary RP (low- and intermediate-risk) or prostate biopsy (very low-risk) post dosing. Clinically significant disease was declared in subjects with Gleason grade 7 or higher. The PSMA-AI was developed and locked prior to the analysis. Three different independent readers used PSMA-AI to obtain quantitative expression of 1404 in the prostate against the background (PSMA-Index). PSMA-Index for all readers and subjects were compared to the histopathological reference, yielding 6 receiver operating characteristic (ROC) curves (3 manual reads + 3 PSMA-AI assisted reads). The clinical performance of the 1404 PSMA-AI assisted read was also evaluated by comparing the Area Under the ROC Curve (AUC), of a multivariate model (PSA, clinical staging and diagnostic Gleason score) with and without PSMA-Index.

[0297] The manual reads demonstrated AUCs of 0.62, 0.62 and 0.63. The reads with PSMA-AI demonstrated AUCs of 0.65, 0.66 and 0.66. The PSMA-AI performance in terms of AUC was higher than manual in all 3*3=9 pairwise comparisons between the two reader groups, with statistically significant improvement observed in five cases (nominal $p<0.05$), not accounting for multiple comparisons. The predictive ability of the baseline multivariate model, without PSMA-Index, was at AUC 0.74. Upon adding of PSMA-Index, the model predictive ability increased to AUC 0.77. The logistic regression model indicated that PSMA-Index (p=0.004), pre-surgery PSA (0.018) and % positive cores (p=<0.001) were significantly associated with clinically significant disease. When measuring reproducibility, log (PSMA-Index) correlation coefficients for pairs of PSMAAI readers were 0.94, 0.97 and 0.98.

[0298] Accordingly, the study described in this example demonstrated that PSMA-AI provides a standardized platform to generate reproducible quantitative assessment of 1404. The PSMA-AI assisted read demonstrated an additive improvement over known predictors for identifying men with clinically significant disease.

ix. Example 9: Automated Calculation of PSMA Indices for Quantification of 18F-DCFPyL Uptake from PET/CT Images for Prostate Cancer Staging

[0299] This example demonstrates automated image segmentation, lesion detection, and calculation of a standardized index score based on hotspot indices assigned to detected lesions via embodiments of the approaches described herein. The automated image analysis procedures are used for evaluated cancer status of patients imaged via PET/CT scanning after being administered the radiopharmaceutical 18F-DCFPyL (PyL™).

[0300] In this example, a cascaded deep learning pipeline was used to segment relevant organs in the CT image, and segmentations are projected into PET image space. In particular, target regions corresponding to a bone volume corresponding to bones of the subject, a lymph volume corresponding to lymph regions, and a prostate volume corresponding to a prostate gland were segmented in the CT image and mapped to identify corresponding 3D volumes in the PET image. Likewise, aorta and liver volumes corresponding to an aorta portion and a liver were also segmented and mapped to the PET image for use as reference regions as described herein.

[0301] Hotspots were detected in the PET image. Hotspots that were considered to represent lesions are manually segmented, as well as additional lesions not detected by the algorithm. Each individual detected hotspot was quantified by calculating an individual hotspot index referred to as lesion miPSMA index (LPI). As described in Examples 6 and 7 above, the LPI used in this example is a continuous index computed using automatically

segmented (as opposed to manually identified) volumes. Accordingly, it offers advantages over previous approaches that utilize manual identification of various organs in images, and which only classify lesions using a small, finite, number of enumerated values. Accordingly, this approach provides more detailed information that can be utilized to manage treatment strategy and track disease progression and/or treatment efficacy over time in a finely grained and accurate fashion.

[0302] The LPI for each detected hotspot was computed based on reference values determined from blood pool (as measured from an identified aorta volume) and liver reference regions, e.g., similar to that described in Example 7 above. In particular, a blood pool reference intensity (SUV value) was measured using an aorta volume within the PET image, and a liver reference intensity was measured from a liver volume identified in the PET image. Both the blood pool and liver reference intensity levels were measured as the mean SUV (SUV_{mean}) within the corresponding volume in a PET image. Reference LPI index values of 1 and 2 were assigned to the blood pool and liver reference intensities, respectively. A maximal reference index level of 3 was assigned to a reference intensity corresponding to twice the liver reference intensity value.

[0303] Each individual detected hotspots was assigned LPI scores based (i) a measured hotspot intensity value for the hotspot and (ii) comparison with the blood pool and liver reference intensity values and the aforementioned reference index levels. In particular, for each hotspot, an individual hotspot intensity value corresponding to a mean lesion uptake was calculated as a mean SUV across voxels of the hotspot. For an individual hotspot, an LPI equal to 1 was assigned if the mean lesion standard uptake value (SUV_{mean}) equal to the blood pool reference value; an LPI equal to 2 was assigned for hotspots having mean lesion uptake values equal to the liver reference uptake value; and an LPI equal to 3 was assigned to hotspots having a mean lesion uptake value is equal to or above twice the liver reference

uptake. For hotspots having intensities in falling in between reference intensity values, individual hotspot LPIs were interpolated from based on the hotspot intensity value and reference intensity-index value pairs.

[0304] An aggregated lesion volume within the bone region was computed as a weighted sum of volumes of individual hotspots detected within the bone volume in the PET image, with the volume of each hotspot weighted by its corresponding LPI. In this manner a PSMA-weighted Total Lesion Volume (PLTV) index was computed for the bone region, denoted $PTLV_{bone}$. PLTV index values were also computed for the lymph ($PTLV_{lymph}$) and prostate ($PTLV_{prostate}$) regions analogously. For each of the three regions, PET/CT image data sets for subjects having various different indications were used to automatically determine PLTV index values.

[0305] Performance of the AI-based automated technique was evaluated based on comparison with manual organ segmentation and annotation of images to identify hotspots, and PLTV index values computed for different indications were compared across regions.

[0306] Using manual expert interpretation as a gold standard for comparison, the automated hotspot detection algorithm was determined to have sensitivity of 92.1% for bone lesions (97.2% in the 52 automatically segmented bones) and 96.2% for lymph lesions. On average, 17 bone hotspots were detected per scan and 23 lymph hotspots were detected per scan.

[0307] PLTV index values were computed using a sample dataset of 197 PET/CT images for the bone region, 99 PET/CT image for the lymph region, and 43 PET/CT images for the prostate region. In the data sets, 94% of individual hotspot LPI's determined were between 1 and 3, with minimum LPIs determined for bone, lymph, and prostate regions of 0.82, 1.1, and 1.3, respectively. Median LPI values for the bone, lymph, and prostate regions were 1.5, 2.0, and 2.3, respectively.

[0308] For each region, PLTV indices were computed for subjects having various different indications as follows: Treatment Response (TR), Screening (S), Newly Diagnosed (ND), Metastatic (M), Suspected Recurrence (SR), Recurrent (R). PLTV index values were compared across indications by calculating the means of the values in the interquartile range (IQR_{mean}), hence excluding outliers. Ordering indications by IQR_{mean} of the PLTV values yields TR<S<ND<R<SR<M for the bone region, S=M<R<ND<SR for lymph region, and M<SR<R<S<ND for prostate region, aligning well with clinical expectations of disease state.

[0309] FIG. 19 shows PLTV index values determined for the various indications for each region. FIG. 20 shows a scatter plot of individual hotspot LPI values for hotspots detected in each of the three regions.

[0310] In comparison with manual approaches for determining reference values for grading lesions, such as the of *Eiber et al., 2017*, the blood and liver automated reference values are based on a larger image volume compared to the manual reference method and are hence expected to be more robust. FIG. 21 compares reference values computed via the automated segmentation approaches described herein for the blood pool (left graph) and liver (right graph) regions with reference values computed using manual identification of organ boundaries. As shown in FIG. 21, in a sample of 20 PET/CT scans, the correlation (Pearson's r) between automated and manual reference was 0.92 for blood and 0.87 for liver.

[0311] Accordingly, this example demonstrates use of the automated segmentation, hotspot detection, and index value calculation for detecting cancer and tracking cancer progression and/or response to treatment over time.

D. Imaging Agents

[0312] In certain embodiments, 3D functional images are nuclear medicine images that use imaging agents comprising radiopharmaceuticals. Nuclear medicine images are

obtained following administration of a radiopharmaceutical to a patient, and provide information regarding the distribution of the radiopharmaceutical within the patient. Radiopharmaceuticals are compounds that comprise a radionuclide.

[0313] Nuclear medicine images (e.g., PET scans; e.g., SPECT scans; e.g., whole-body scans; e.g. composite PET-CT images; e.g., composite SPECT-CT images) detect radiation emitted from the radionuclides of radiopharmaceuticals to form an image. The distribution of a particular radiopharmaceutical within a patient may be determined by biological mechanisms such as blood flow or perfusion, as well as by specific enzymatic or receptor binding interactions. Different radiopharmaceuticals may be designed to take advantage of different biological mechanisms and/or particular specific enzymatic or receptor binding interactions and thus, when administered to a patient, selectively concentrate within particular types of tissue and/or regions within the patient. Greater amounts of radiation are emitted from regions within the patient that have higher concentrations of radiopharmaceutical than other regions, such that these regions appear brighter in nuclear medicine images. Accordingly, intensity variations within a nuclear medicine image can be used to map the distribution of radiopharmaceutical within the patient. This mapped distribution of radiopharmaceutical within the patient can be used to, for example, infer the presence of cancerous tissue within various regions of the patient's body.

[0314] For example, upon administration to a patient, technetium 99m methylenediphosphonate (^{99m}Tc MDP) selectively accumulates within the skeletal region of the patient, in particular at sites with abnormal osteogenesis associated with malignant bone lesions. The selective concentration of radiopharmaceutical at these sites produces identifiable hotspots – localized regions of high intensity in nuclear medicine images. Accordingly, presence of malignant bone lesions associated with metastatic prostate cancer can be inferred by identifying such hotspots within a whole-body scan of the patient. Risk

indices that correlate with patient overall survival and other prognostic metrics indicative of disease state, progression, treatment efficacy, and the like, can be computed based on automated analysis of intensity variations in whole-body scans obtained following administration of ^{99m}Tc MDP to a patient. In certain embodiments, other radiopharmaceuticals can also be used in a similar fashion to ^{99m}Tc MDP.

[0315] In certain embodiments, the particular radiopharmaceutical used depends on the particular nuclear medicine imaging modality used. For example ^{18}F sodium fluoride (NaF) also accumulates in bone lesions, similar to ^{99m}Tc MDP, but can be used with PET imaging. In certain embodiments, PET imaging may also utilize a radioactive form of the vitamin choline, which is readily absorbed by prostate cancer cells.

[0316] In certain embodiments, radiopharmaceuticals that selectively bind to particular proteins or receptors of interest – particularly those whose expression is increased in cancerous tissue may be used. Such proteins or receptors of interest include, but are not limited to tumor antigens, such as CEA, which is expressed in colorectal carcinomas, Her2/neu, which is expressed in multiple cancers, BRCA 1 and BRCA 2, expressed in breast and ovarian cancers; and TRP-1 and -2, expressed in melanoma.

[0317] For example, human prostate-specific membrane antigen (PSMA) is upregulated in prostate cancer, including metastatic disease. PSMA is expressed by virtually all prostate cancers and its expression is further increased in poorly differentiated, metastatic and hormone refractory carcinomas. Accordingly, radiopharmaceuticals corresponding to PSMA binding agents (e.g., compounds that a high affinity to PSMA) labelled with one or more radionuclide(s) can be used to obtain nuclear medicine images of a patient from which the presence and/or state of prostate cancer within a variety of regions (e.g., including, but not limited to skeletal regions) of the patient can be assessed. In certain embodiments, nuclear medicine images obtained using PSMA binding agents are used to identify the

presence of cancerous tissue within the prostate, when the disease is in a localized state. In certain embodiments, nuclear medicine images obtained using radiopharmaceuticals comprising PSMA binding agents are used to identify the presence of cancerous tissue within a variety of regions that include not only the prostate, but also other organs and tissue regions such as lungs, lymph nodes, and bones, as is relevant when the disease is metastatic.

[0318] In particular, upon administration to a patient, radionuclide labelled PSMA binding agents selectively accumulate within cancerous tissue, based on their affinity to PSMA. In a similar manner to that described above with regard to ^{99m}Tc MDP, the selective concentration of radionuclide labelled PSMA binding agents at particular sites within the patient produces detectable hotspots in nuclear medicine images. As PSMA binding agents concentrate within a variety of cancerous tissues and regions of the body expressing PSMA, localized cancer within a prostate of the patient and/or metastatic cancer in various regions of the patient's body can be detected, and evaluated. As described in the following, risk indices that correlate with patient overall survival and other prognostic metrics indicative of disease state, progression, treatment efficacy, and the like, can be computed based on automated analysis of intensity variations in nuclear medicine images obtained following administration of a PSMA binding agent radiopharmaceutical to a patient.

[0319] A variety of radionuclide labelled PSMA binding agents may be used as radiopharmaceutical imaging agents for nuclear medicine imaging to detect and evaluate prostate cancer. In certain embodiments, the particular radionuclide labelled PSMA binding agent that is used depends on factors such as the particular imaging modality (e.g., PET; e.g., SPECT) and the particular regions (e.g., organs) of the patient to be imaged. For example, certain radionuclide labelled PSMA binding agents are suited for PET imaging, while others are suited for SPECT imaging. For example, certain radionuclide labelled PSMA binding agents facilitate imaging a prostate of the patient, and are used primarily when the disease is

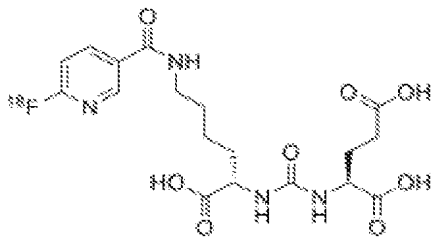
localized, while others facilitate imaging organs and regions throughout the patient's body, and are useful for evaluating metastatic prostate cancer.

[0320] A variety of PSMA binding agents and radionuclide labelled versions thereof are described in U.S. Patent Nos. 8,778,305, 8,211,401, and 8,962,799, each of which are incorporated herein by reference in their entireties.

i. PET imaging radionuclide labelled PSMA binding agents

[0321] In certain embodiments, the radionuclide labelled PSMA binding agent is a radionuclide labelled PSMA binding agent appropriate for PET imaging.

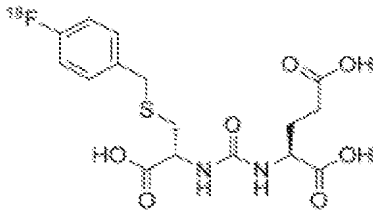
[0322] In certain embodiments, the radionuclide labelled PSMA binding agent comprises [18F]DCFPyL (also referred to as PyL™; also referred to as DCFPyL-18F):



[18F]DCFPyL,

or a pharmaceutically acceptable salt thereof.

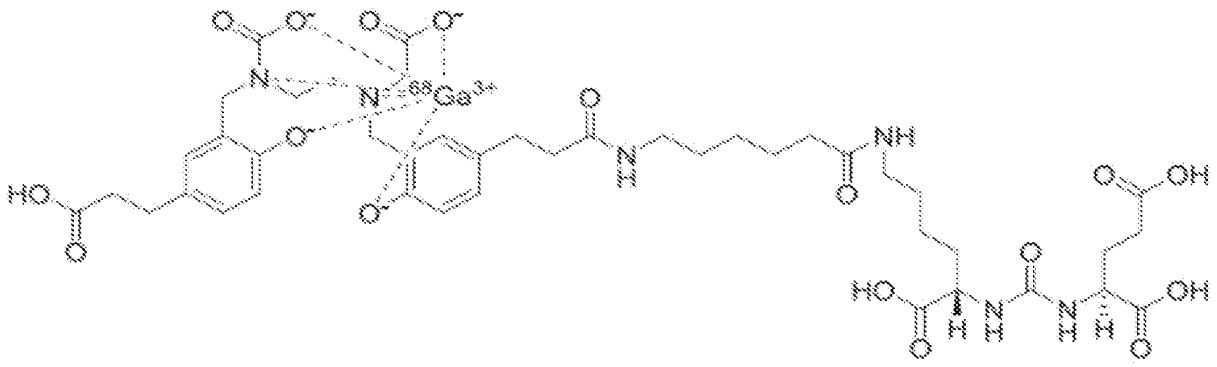
[0323] In certain embodiments, the radionuclide labelled PSMA binding agent comprises [18F]DCFBC:



[18F]DCFBC,

or a pharmaceutically acceptable salt thereof.

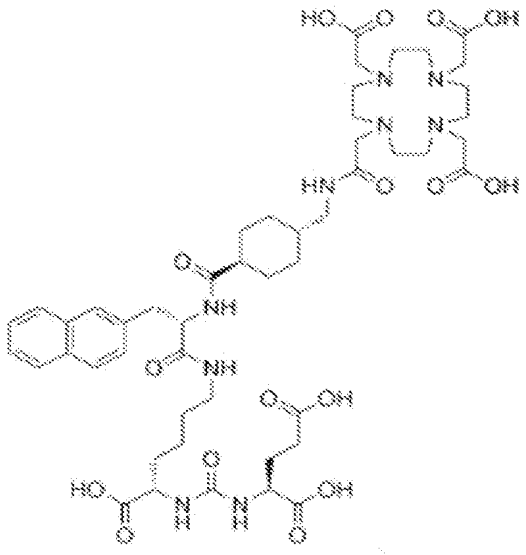
[0324] In certain embodiments, the radionuclide labelled PSMA binding agent comprises ^{68}Ga-PSMA-HBED-CC (also referred to as ^{68}Ga-PSMA-11):



^{68}Ga-PSMA-HBED-CC,

or a pharmaceutically acceptable salt thereof.

[0325] In certain embodiments, the radionuclide labelled PSMA binding agent comprises PSMA-617:

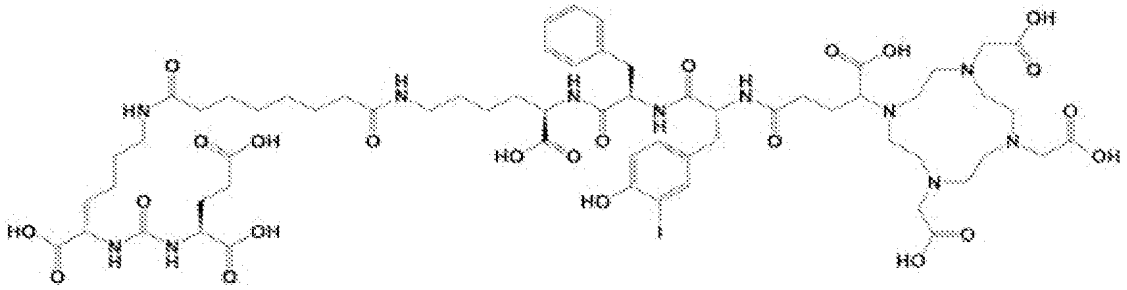


PSMA-617,

or a pharmaceutically acceptable salt thereof. In certain embodiments, the radionuclide labelled PSMA binding agent comprises ^{68}Ga-PSMA-617, which is PSMA-617 labelled with ^{68}Ga, or a pharmaceutically acceptable salt thereof. In certain embodiments, the

radionuclide labelled PSMA binding agent comprises ^{177}Lu-PSMA-617, which is PSMA-617 labelled with ^{177}Lu, or a pharmaceutically acceptable salt thereof.

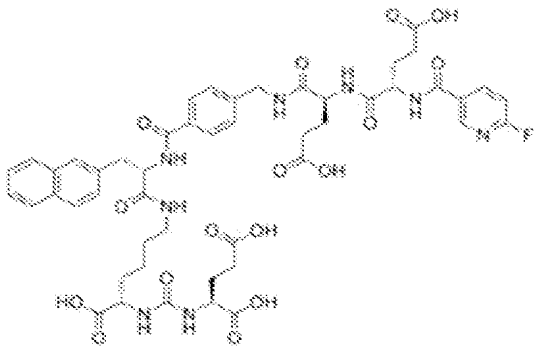
[0326] In certain embodiments, the radionuclide labelled PSMA binding agent comprises PSMA-I&T:



PSMA-I&T,

or a pharmaceutically acceptable salt thereof. In certain embodiments, the radionuclide labelled PSMA binding agent comprises ^{68}Ga-PSMA-I&T, which is PSMA-I&T labelled with ^{68}Ga, or a pharmaceutically acceptable salt thereof.

[0327] In certain embodiments, the radionuclide labelled PSMA binding agent comprises PSMA-1007:



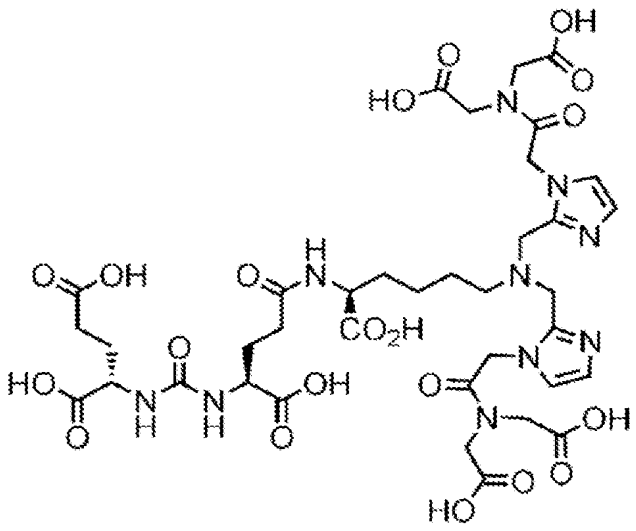
PSMA-1007,

or a pharmaceutically acceptable salt thereof. In certain embodiments, the radionuclide labelled PSMA binding agent comprises ^{18}F-PSMA-1007, which is PSMA-1007 labelled with ^{18}F, or a pharmaceutically acceptable salt thereof.

ii. SPECT imaging radionuclide labelled PSMA binding agents

[0328] In certain embodiments, the radionuclide labelled PSMA binding agent is a radionuclide labelled PSMA binding agent appropriate for SPECT imaging.

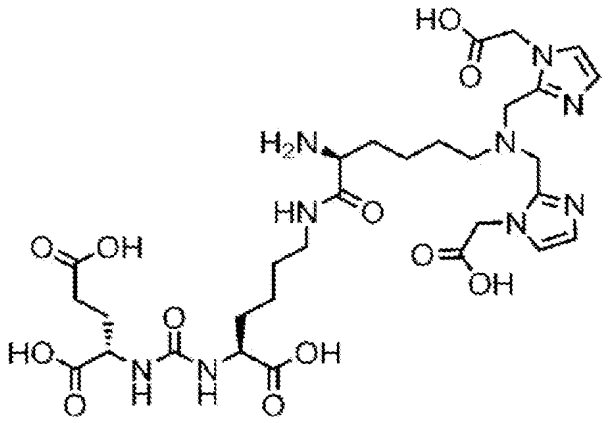
[0329] In certain embodiments, the radionuclide labelled PSMA binding agent comprises 1404 (also referred to as MIP-1404):



1404,

or a pharmaceutically acceptable salt thereof.

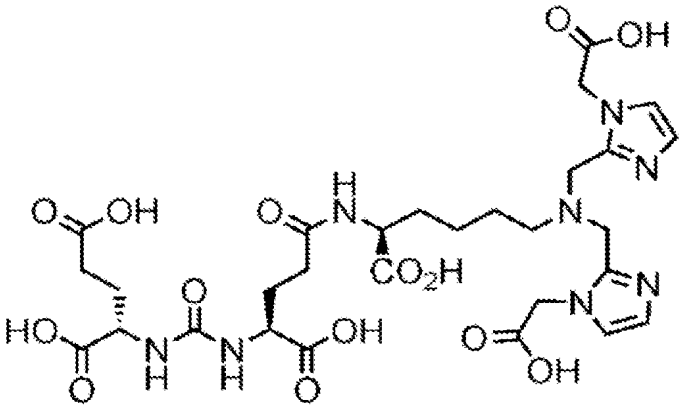
[0330] In certain embodiments, the radionuclide labelled PSMA binding agent comprises 1405 (also referred to as MIP-1405):



1405,

or a pharmaceutically acceptable salt thereof.

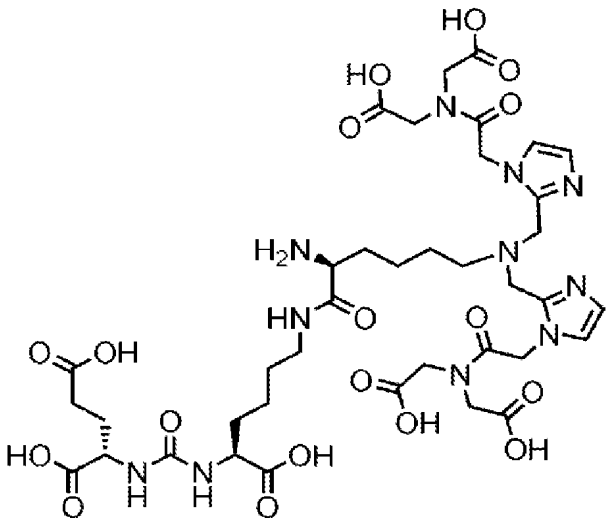
[0331] In certain embodiments, the radionuclide labelled PSMA binding agent comprises 1427 (also referred to as MIP-1427):



1427,

or a pharmaceutically acceptable salt thereof.

[0332] In certain embodiments, the radionuclide labelled PSMA binding agent comprises 1428 (also referred to as MIP-1428):

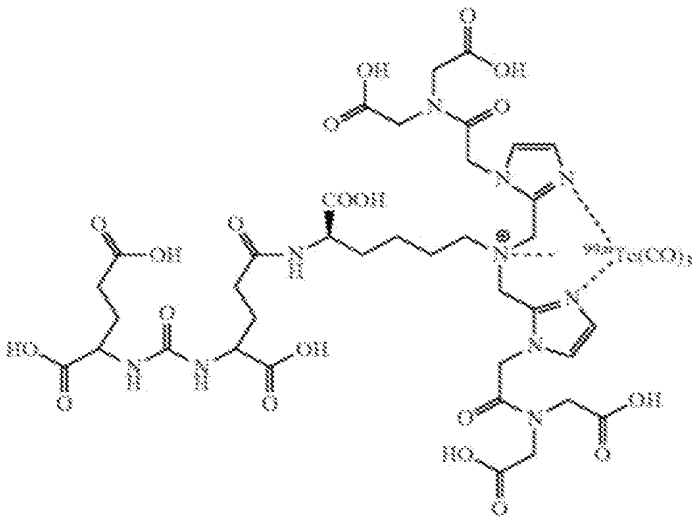


1428,

or a pharmaceutically acceptable salt thereof.

[0333] In certain embodiments, the PSMA binding agent is labelled with a radionuclide by chelating it to a radioisotope of a metal [e.g., a radioisotope of technetium (Tc) (e.g., technetium-99m (^{99m}Tc)); e.g., a radioisotope of rhenium (Re) (e.g., rhenium-188 (^{188}Re); e.g., rhenium-186 (^{186}Re)); e.g., a radioisotope of yttrium (Y) (e.g., ^{90}Y); e.g., a radioisotope of lutetium (Lu)(e.g., ^{177}Lu); e.g., a radioisotope of gallium (Ga) (e.g., ^{68}Ga; e.g., ^{67}Ga); e.g., a radioisotope of indium (e.g., ^{111}In); e.g., a radioisotope of copper (Cu) (e.g., ^{67}Cu)].

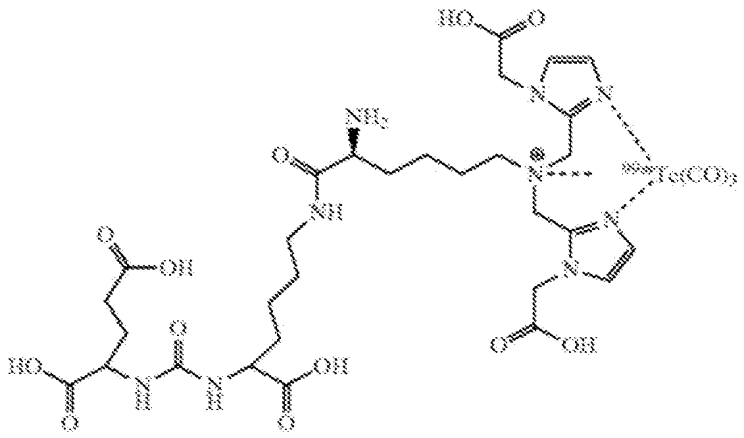
[0334] In certain embodiments, 1404 is labelled with a radionuclide (e.g., chelated to a radioisotope of a metal). In certain embodiments, the radionuclide labelled PSMA binding agent comprises ^{99m}Tc-MIP-1404, which is 1404 labelled with (e.g., chelated to) ^{99m}Tc:



^{99m}Tc-MIP-1404,

or a pharmaceutically acceptable salt thereof. In certain embodiments, 1404 may be chelated to other metal radioisotopes [e.g., a radioisotope of rhenium (Re) (e.g., rhenium-188 (^{188}Re); e.g., rhenium-186 (^{186}Re)); e.g., a radioisotope of yttrium (Y) (e.g., ^{90}Y); e.g., a radioisotope of lutetium (Lu)(e.g., ^{177}Lu); e.g., a radioisotope of gallium (Ga) (e.g., ^{68}Ga; e.g., ^{67}Ga); e.g., a radioisotope of indium (e.g., ^{111}In); e.g., a radioisotope of copper (Cu) (e.g., ^{67}Cu)] to form a compound having a structure similar to the structure shown above for ^{99m}Tc-MIP-1404, with the other metal radioisotope substituted for ^{99m}Tc.

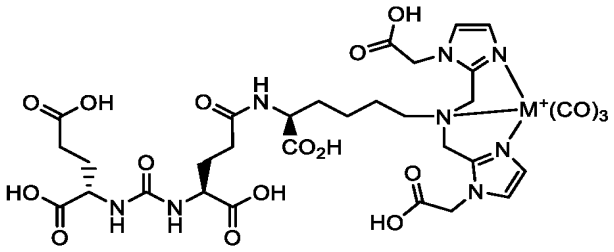
[0335] In certain embodiments, 1405 is labelled with a radionuclide (e.g., chelated to a radioisotope of a metal). In certain embodiments, the radionuclide labelled PSMA binding agent comprises ^{99m}Tc-MIP-1405, which is 1405 labelled with (e.g., chelated to) ^{99m}Tc:



^{99m}Tc-MIP-1405,

or a pharmaceutically acceptable salt thereof. In certain embodiments, 1405 may be chelated to other metal radioisotopes [e.g., a radioisotope of rhenium (Re) (e.g., rhenium-188 (^{188}Re); e.g., rhenium-186 (^{186}Re)); e.g., a radioisotope of yttrium (Y) (e.g., ^{90}Y); e.g., a radioisotope of lutetium (Lu)(e.g., ^{177}Lu); e.g., a radioisotope of gallium (Ga) (e.g., ^{68}Ga; e.g., ^{67}Ga); e.g., a radioisotope of indium (e.g., ^{111}In); e.g., a radioisotope of copper (Cu) (e.g., ^{67}Cu)] to form a compound having a structure similar to the structure shown above for ^{99m}Tc-MIP-1405, with the other metal radioisotope substituted for ^{99m}Tc.

[0336] In certain embodiments, 1427 is labelled with (e.g., chelated to) a radioisotope of a metal, to form a compound according to the formula below:

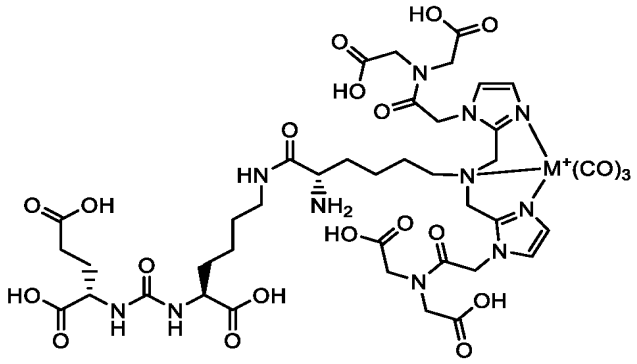


1427 chelated to a metal,

or a pharmaceutically acceptable salt thereof, wherein M is a metal radioisotope [e.g., a radioisotope of technetium (Tc) (e.g., technetium-99m (^{99m}Tc)); e.g., a radioisotope of

rhenium (Re) (e.g., rhenium-188 (^{188}Re); e.g., rhenium-186 (^{186}Re)); e.g., a radioisotope of yttrium (Y) (e.g., ^{90}Y); e.g., a radioisotope of lutetium (Lu)(e.g., ^{177}Lu); e.g., a radioisotope of gallium (Ga) (e.g., ^{68}Ga; e.g., ^{67}Ga); e.g., a radioisotope of indium (e.g., ^{111}In); e.g., a radioisotope of copper (Cu) (e.g., ^{67}Cu)] with which 1427 is labelled.

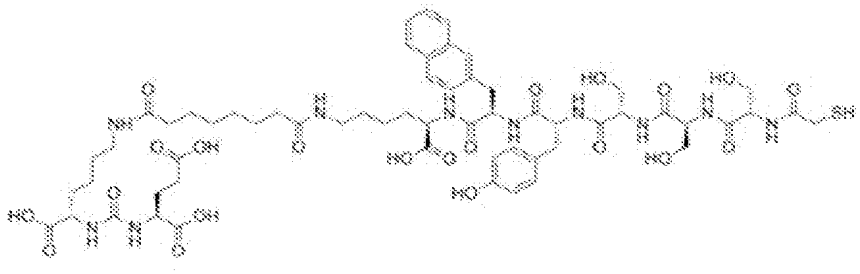
[0337] In certain embodiments, 1428 is labelled with (e.g., chelated to) a radioisotope of a metal, to form a compound according to the formula below:



1428 chelated to a metal,

or a pharmaceutically acceptable salt thereof, wherein M is a metal radioisotope [e.g., a radioisotope of technetium (Tc) (e.g., technetium-99m (^{99m}Tc)); e.g., a radioisotope of rhenium (Re) (e.g., rhenium-188 (^{188}Re); e.g., rhenium-186 (^{186}Re)); e.g., a radioisotope of yttrium (Y) (e.g., ^{90}Y); e.g., a radioisotope of lutetium (Lu)(e.g., ^{177}Lu); e.g., a radioisotope of gallium (Ga) (e.g., ^{68}Ga; e.g., ^{67}Ga); e.g., a radioisotope of indium (e.g., ^{111}In); e.g., a radioisotope of copper (Cu) (e.g., ^{67}Cu)] with which 1428 is labelled.

[0338] In certain embodiments, the radionuclide labelled PSMA binding agent comprises PSMA I&S:



PSMA I&S,

or a pharmaceutically acceptable salt thereof. In certain embodiments, the radionuclide labelled PSMA binding agent comprises ^{99m}Tc-PSMA I&S, which is PSMA I&S labelled with ^{99m}Tc, or a pharmaceutically acceptable salt thereof.

E. Computer System and Network Architecture

[0339] As shown in FIG. 17, an implementation of a network environment 1700 for use in providing systems, methods, and architectures described herein is shown and described. In brief overview, referring now to FIG. 17, a block diagram of an exemplary cloud computing environment 1700 is shown and described. The cloud computing environment 1700 may include one or more resource providers 1702a, 1702b, 1702c (collectively, 1702). Each resource provider 1702 may include computing resources. In some implementations, computing resources may include any hardware and/or software used to process data. For example, computing resources may include hardware and/or software capable of executing algorithms, computer programs, and/or computer applications. In some implementations, exemplary computing resources may include application servers and/or databases with storage and retrieval capabilities. Each resource provider 1702 may be connected to any other resource provider 1702 in the cloud computing environment 1700. In some implementations, the resource providers 1702 may be connected over a computer

network 1708. Each resource provider 1702 may be connected to one or more computing device 1704a, 1704b, 1704c (collectively, 1704), over the computer network 1708.

[0340] The cloud computing environment 1700 may include a resource manager 1706. The resource manager 1706 may be connected to the resource providers 1702 and the computing devices 1704 over the computer network 1708. In some implementations, the resource manager 1706 may facilitate the provision of computing resources by one or more resource providers 1702 to one or more computing devices 1704. The resource manager 1706 may receive a request for a computing resource from a particular computing device 1704. The resource manager 1706 may identify one or more resource providers 1702 capable of providing the computing resource requested by the computing device 1704. The resource manager 1706 may select a resource provider 1702 to provide the computing resource. The resource manager 1706 may facilitate a connection between the resource provider 1702 and a particular computing device 1704. In some implementations, the resource manager 1706 may establish a connection between a particular resource provider 1702 and a particular computing device 1704. In some implementations, the resource manager 1706 may redirect a particular computing device 1704 to a particular resource provider 1702 with the requested computing resource.

[0341] FIG. 18 shows an example of a computing device 1800 and a mobile computing device 1850 that can be used to implement the techniques described in this disclosure. The computing device 1800 is intended to represent various forms of digital computers, such as laptops, desktops, workstations, personal digital assistants, servers, blade servers, mainframes, and other appropriate computers. The mobile computing device 1850 is intended to represent various forms of mobile devices, such as personal digital assistants, cellular telephones, smart-phones, and other similar computing devices. The components

shown here, their connections and relationships, and their functions, are meant to be examples only, and are not meant to be limiting.

[0342] The computing device 1800 includes a processor 1802, a memory 1804, a storage device 1806, a high-speed interface 1808 connecting to the memory 1804 and multiple high-speed expansion ports 1810, and a low-speed interface 1812 connecting to a low-speed expansion port 1814 and the storage device 1806. Each of the processor 1802, the memory 1804, the storage device 1806, the high-speed interface 1808, the high-speed expansion ports 1810, and the low-speed interface 1812, are interconnected using various busses, and may be mounted on a common motherboard or in other manners as appropriate. The processor 1802 can process instructions for execution within the computing device 1800, including instructions stored in the memory 1804 or on the storage device 1806 to display graphical information for a GUI on an external input/output device, such as a display 1816 coupled to the high-speed interface 1808. In other implementations, multiple processors and/or multiple buses may be used, as appropriate, along with multiple memories and types of memory. Also, multiple computing devices may be connected, with each device providing portions of the necessary operations (e.g., as a server bank, a group of blade servers, or a multi-processor system). Thus, as the term is used herein, where a plurality of functions are described as being performed by "a processor", this encompasses embodiments wherein the plurality of functions are performed by any number of processors (one or more) of any number of computing devices (one or more). Furthermore, where a function is described as being performed by "a processor", this encompasses embodiments wherein the function is performed by any number of processors (one or more) of any number of computing devices (one or more) (e.g., in a distributed computing system).

[0343] The memory 1804 stores information within the computing device 1800. In some implementations, the memory 1804 is a volatile memory unit or units. In some

implementations, the memory 1804 is a non-volatile memory unit or units. The memory 1804 may also be another form of computer-readable medium, such as a magnetic or optical disk.

[0344] The storage device 1806 is capable of providing mass storage for the computing device 1800. In some implementations, the storage device 1806 may be or contain a computer-readable medium, such as a floppy disk device, a hard disk device, an optical disk device, or a tape device, a flash memory or other similar solid state memory device, or an array of devices, including devices in a storage area network or other configurations. Instructions can be stored in an information carrier. The instructions, when executed by one or more processing devices (for example, processor 1802), perform one or more methods, such as those described above. The instructions can also be stored by one or more storage devices such as computer- or machine-readable mediums (for example, the memory 1804, the storage device 1806, or memory on the processor 1802).

[0345] The high-speed interface 1808 manages bandwidth-intensive operations for the computing device 1800, while the low-speed interface 1812 manages lower bandwidth-intensive operations. Such allocation of functions is an example only. In some implementations, the high-speed interface 1808 is coupled to the memory 1804, the display 1816 (e.g., through a graphics processor or accelerator), and to the high-speed expansion ports 1810, which may accept various expansion cards (not shown). In the implementation, the low-speed interface 1812 is coupled to the storage device 1806 and the low-speed expansion port 1814. The low-speed expansion port 1814, which may include various communication ports (e.g., USB, Bluetooth®, Ethernet, wireless Ethernet) may be coupled to one or more input/output devices, such as a keyboard, a pointing device, a scanner, or a networking device such as a switch or router, e.g., through a network adapter.

[0346] The computing device 1800 may be implemented in a number of different forms, as shown in the figure. For example, it may be implemented as a standard server 1820, or multiple times in a group of such servers. In addition, it may be implemented in a personal computer such as a laptop computer 1822. It may also be implemented as part of a rack server system 1824. Alternatively, components from the computing device 1800 may be combined with other components in a mobile device (not shown), such as a mobile computing device 1850. Each of such devices may contain one or more of the computing device 1800 and the mobile computing device 1850, and an entire system may be made up of multiple computing devices communicating with each other.

[0347] The mobile computing device 1850 includes a processor 1852, a memory 1864, an input/output device such as a display 1854, a communication interface 1866, and a transceiver 1868, among other components. The mobile computing device 1850 may also be provided with a storage device, such as a micro-drive or other device, to provide additional storage. Each of the processor 1852, the memory 1864, the display 1854, the communication interface 1866, and the transceiver 1868, are interconnected using various buses, and several of the components may be mounted on a common motherboard or in other manners as appropriate.

[0348] The processor 1852 can execute instructions within the mobile computing device 1850, including instructions stored in the memory 1864. The processor 1852 may be implemented as a chipset of chips that include separate and multiple analog and digital processors. The processor 1852 may provide, for example, for coordination of the other components of the mobile computing device 1850, such as control of user interfaces, applications run by the mobile computing device 1850, and wireless communication by the mobile computing device 1850.

[0349] The processor 1852 may communicate with a user through a control interface 1858 and a display interface 1856 coupled to the display 1854. The display 1854 may be, for example, a TFT (Thin-Film-Transistor Liquid Crystal Display) display or an OLED (Organic Light Emitting Diode) display, or other appropriate display technology. The display interface 1856 may comprise appropriate circuitry for driving the display 1854 to present graphical and other information to a user. The control interface 1858 may receive commands from a user and convert them for submission to the processor 1852. In addition, an external interface 1862 may provide communication with the processor 1852, so as to enable near area communication of the mobile computing device 1850 with other devices. The external interface 1862 may provide, for example, for wired communication in some implementations, or for wireless communication in other implementations, and multiple interfaces may also be used.

[0350] The memory 1864 stores information within the mobile computing device 1850. The memory 1864 can be implemented as one or more of a computer-readable medium or media, a volatile memory unit or units, or a non-volatile memory unit or units. An expansion memory 1874 may also be provided and connected to the mobile computing device 1850 through an expansion interface 1872, which may include, for example, a SIMM (Single In Line Memory Module) card interface. The expansion memory 1874 may provide extra storage space for the mobile computing device 1850, or may also store applications or other information for the mobile computing device 1850. Specifically, the expansion memory 1874 may include instructions to carry out or supplement the processes described above, and may include secure information also. Thus, for example, the expansion memory 1874 may be provide as a security module for the mobile computing device 1850, and may be programmed with instructions that permit secure use of the mobile computing device 1850. In addition, secure applications may be provided via the SIMM cards, along with additional

information, such as placing identifying information on the SIMM card in a non-hackable manner.

[0351] The memory may include, for example, flash memory and/or NVRAM memory (non-volatile random access memory), as discussed below. In some implementations, instructions are stored in an information carrier. that the instructions, when executed by one or more processing devices (for example, processor 1852), perform one or more methods, such as those described above. The instructions can also be stored by one or more storage devices, such as one or more computer- or machine-readable mediums (for example, the memory 1864, the expansion memory 1874, or memory on the processor 1852). In some implementations, the instructions can be received in a propagated signal, for example, over the transceiver 1868 or the external interface 1862.

[0352] The mobile computing device 1850 may communicate wirelessly through the communication interface 1866, which may include digital signal processing circuitry where necessary. The communication interface 1866 may provide for communications under various modes or protocols, such as GSM voice calls (Global System for Mobile communications), SMS (Short Message Service), EMS (Enhanced Messaging Service), or MMS messaging (Multimedia Messaging Service), CDMA (code division multiple access), TDMA (time division multiple access), PDC (Personal Digital Cellular), WCDMA (Wideband Code Division Multiple Access), CDMA2000, or GPRS (General Packet Radio Service), among others. Such communication may occur, for example, through the transceiver 1868 using a radio-frequency. In addition, short-range communication may occur, such as using a Bluetooth®, Wi-Fi™, or other such transceiver (not shown). In addition, a GPS (Global Positioning System) receiver module 1870 may provide additional navigation- and location-related wireless data to the mobile computing device 1850, which may be used as appropriate by applications running on the mobile computing device 1850.

[0353] The mobile computing device 1850 may also communicate audibly using an audio codec 1860, which may receive spoken information from a user and convert it to usable digital information. The audio codec 1860 may likewise generate audible sound for a user, such as through a speaker, e.g., in a handset of the mobile computing device 1850. Such sound may include sound from voice telephone calls, may include recorded sound (e.g., voice messages, music files, etc.) and may also include sound generated by applications operating on the mobile computing device 1850.

[0354] The mobile computing device 1850 may be implemented in a number of different forms, as shown in the figure. For example, it may be implemented as a cellular telephone 1880. It may also be implemented as part of a smart-phone 1882, personal digital assistant, or other similar mobile device.

[0355] Various implementations of the systems and techniques described here can be realized in digital electronic circuitry, integrated circuitry, specially designed ASICs (application specific integrated circuits), computer hardware, firmware, software, and/or combinations thereof. These various implementations can include implementation in one or more computer programs that are executable and/or interpretable on a programmable system including at least one programmable processor, which may be special or general purpose, coupled to receive data and instructions from, and to transmit data and instructions to, a storage system, at least one input device, and at least one output device.

[0356] These computer programs (also known as programs, software, software applications or code) include machine instructions for a programmable processor, and can be implemented in a high-level procedural and/or object-oriented programming language, and/or in assembly/machine language. As used herein, the terms machine-readable medium and computer-readable medium refer to any computer program product, apparatus and/or device (e.g., magnetic discs, optical disks, memory, Programmable Logic Devices (PLDs)) used to

provide machine instructions and/or data to a programmable processor, including a machine-readable medium that receives machine instructions as a machine-readable signal. The term machine-readable signal refers to any signal used to provide machine instructions and/or data to a programmable processor.

[0357] To provide for interaction with a user, the systems and techniques described here can be implemented on a computer having a display device (e.g., a CRT (cathode ray tube) or LCD (liquid crystal display) monitor) for displaying information to the user and a keyboard and a pointing device (e.g., a mouse or a trackball) by which the user can provide input to the computer. Other kinds of devices can be used to provide for interaction with a user as well; for example, feedback provided to the user can be any form of sensory feedback (e.g., visual feedback, auditory feedback, or tactile feedback); and input from the user can be received in any form, including acoustic, speech, or tactile input.

[0358] The systems and techniques described here can be implemented in a computing system that includes a back end component (e.g., as a data server), or that includes a middleware component (e.g., an application server), or that includes a front end component (e.g., a client computer having a graphical user interface or a Web browser through which a user can interact with an implementation of the systems and techniques described here), or any combination of such back end, middleware, or front end components. The components of the system can be interconnected by any form or medium of digital data communication (e.g., a communication network). Examples of communication networks include a local area network (LAN), a wide area network (WAN), and the Internet.

[0359] The computing system can include clients and servers. A client and server are generally remote from each other and typically interact through a communication network. The relationship of client and server arises by virtue of computer programs running on the respective computers and having a client-server relationship to each other.

[0360] In some implementations, the various modules described herein can be separated, combined or incorporated into single or combined modules. The modules depicted in the figures are not intended to limit the systems described herein to the software architectures shown therein.

[0361] Elements of different implementations described herein may be combined to form other implementations not specifically set forth above. Elements may be left out of the processes, computer programs, databases, etc. described herein without adversely affecting their operation. In addition, the logic flows depicted in the figures do not require the particular order shown, or sequential order, to achieve desirable results. Various separate elements may be combined into one or more individual elements to perform the functions described herein.

[0362] Throughout the description, where apparatus and systems are described as having, including, or comprising specific components, or where processes and methods are described as having, including, or comprising specific steps, it is contemplated that, additionally, there are apparatus, and systems of the present invention that consist essentially of, or consist of, the recited components, and that there are processes and methods according to the present invention that consist essentially of, or consist of, the recited processing steps.

[0363] It should be understood that the order of steps or order for performing certain action is immaterial so long as the invention remains operable. Moreover, two or more steps or actions may be conducted simultaneously.

[0364] While the invention has been particularly shown and described with reference to specific preferred embodiments, it should be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

[0365] While the invention has been particularly shown and described with reference to specific preferred embodiments, it should be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. A method for automatically processing a 3D image to identify 3D volumes within the 3D image that correspond to particular target tissue regions, the method comprising:

(a) receiving, by a processor of a computing device, a 3D anatomical image of a subject obtained using an anatomical imaging modality, wherein the 3D anatomical image comprises a graphical representation of tissue within the subject;

(b) automatically identifying, by the processor, using one or more machine learning modules for each of a plurality of target tissue regions, a corresponding target volume of interest (VOI) within the 3D anatomical image;

(c) determining, by the processor, a 3D segmentation map representing a plurality of 3D segmentation masks, each 3D segmentation mask representing a particular identified target VOI; and

(d) storing and/or providing for display and/or further processing, the 3D segmentation map.

2. The method of claim 1, wherein the 3D anatomical image is a full body image.

3. The method of either of claims 1 or 2, wherein step (c) comprises digitally stitching together the plurality of 3D segmentation masks to form the 3D segmentation map.

4. The method of any one of the preceding claims, wherein step (b) comprises, for at least one specific target tissue region:

determining, using a first module, an initial VOI within the 3D anatomical image, the initial VOI corresponding to an anatomical region containing the specific target tissue region; and

identifying, using a second module, the target VOI corresponding to the specific target tissue region within the initial VOI.

5. The method of claim 4, wherein the second module is a CNN module that implements a CNN.

6. The method of either one of claims 4 or 5, wherein the first module is a CNN module that implements a CNN to perform a coarse segmentation to automatically identify the initial VOI corresponding to the anatomical region containing the specific target tissue region.

7. The method of any one of claims 4 to 6, wherein the first module receives a sub-sampled version of the anatomical image as input and identifies the initial VOI using the sub-sampled version of the anatomical image.

8. The method of any one of claims 4 to 7, wherein the first module is a first CNN module and the second module is a second CNN module, and wherein the first CNN module comprises additional filters in order to account for increased variability in image size with respect to the second CNN module.

9. The method of any one of claims 4 to 8, wherein the 3D anatomical image is a full body image and wherein step (b) comprises:

automatically determining, using one or more localization modules implementing machine learning technique(s), a plurality of initial VOIs within the 3D anatomical image, each initial VOI corresponding to a particular anatomical region and in which an associated subset of the target VOIs are located; and

for each initial VOI, automatically identifying, using one or more segmentation modules implementing machine learning technique(s) the associated subset of target VOIs.

10. The method of claim 9, wherein the plurality of initial VOIs comprises one or more members selected from the group consisting of:

a pelvic region initial VOI corresponding to a pelvic region of the subject;

a spine region initial VOI corresponding to a spine of the subject;

a left upper body region initial VOI corresponding to a left side of the subject's upper body; and

a right upper body region initial VOI corresponding to a right side of the subject's upper body.

11. The method of any one of the preceding claims, further comprising:

(e) receiving, by the processor, a 3D functional image of the subject obtained using a functional imaging modality; and

(f) identifying, by the processor, within the 3D functional image, one or more 3D volume(s), each corresponding to an identified target VOI, using the 3D segmentation map.

12. The method of claim 11, comprising:

(g) determining, by the processor, a cancer status for the subject.

13. The method of claim 12, comprising performing steps (a) – (g) repeatedly for a plurality of anatomical and corresponding functional images collected at different time points to determine, at each time point, a cancer status of the subject, thereby tracking cancer status over time.

14. The method of any one of claims 11 to 13, comprising:

(h) automatically adjusting, by the processor, intensities of voxels of the 3D functional image to correct for background uptake in one or more background tissue regions.

15. The method of claim 14, wherein the target tissue regions comprise the one or more background tissue regions and wherein step (h) comprises:

using the 3D segmentation map to identify, within the 3D functional image, one or more 3D background tissue volume(s), each corresponding a particular background tissue region; and

adjusting intensities of voxels of the 3D functional image based on intensities of voxels within the 3D background tissue volumes.

16. The method of either of claims 14 or 15, wherein the one or more background tissue regions comprise one or more members selected from the group consisting of: a bladder, a kidney, a duodenum, a small intestine, a spleen, a liver, a pancreas, a stomach, an adrenal gland, a rectum, and testes.

17. The method of any one of claims 11 to 16, comprising:

(i) automatically detecting, by the processor, one or more hotspots within the 3D functional image determined to represent lesions based on intensities of voxels within the 3D functional image.

18. The method of claim 17, wherein step (i) comprises using one or more thresholds.

19. The method of either one of claims 17 or 18, wherein step (i) comprises applying one or more filters to the 3D functional image.

20. The method of any one of claims 17 to 19, wherein step (i) comprises using a combination of two or more techniques for identification of hotspots in different sub-sets of the one or more 3D volumes identified within the 3D functional image.

21. The method of any one of claims 17 to 20, wherein step (i) comprises detecting an initial set of hotspots and, for at least a portion of the hotspots of the initial set, classifying each hotspot of at least a portion of the detected hotspots as either a cancerous lesion or not a cancerous lesion.

22. The method of any one of claims 17 to 21, wherein the target tissue regions comprise one or more background tissue regions and wherein the method comprises:

using the 3D segmentation map to identify, within the 3D functional image, one or more 3D background tissue volume(s), each corresponding a particular background tissue region; and

excluding voxels of the 3D within the 3D background tissue from the voxels used to automatically detect the one or more hotspots at step (i).

23. The method of any one of claims 17 to 22, comprising using the one or more detected hotspots to determine a cancer status for the subject.

24. The method of any one of claims 17 to 23, wherein the target tissue regions comprise one or more reference tissue regions and wherein the method comprises:

using the 3D segmentation map to identify, by the processor, within the 3D functional image, one or more 3D reference volume(s), each corresponding to a particular reference tissue region;

determining, by the processor, one or more reference intensity values, each associated with a particular 3D reference volume of the one or more 3D reference volume(s) and corresponding to a measure of intensity within the particular 3D reference volume;

determining, by the processor, one or more individual hotspot intensity values, each associated with a particular hotspot of at least a portion of the detected one or more hotspots and corresponding to a measure of intensity of the particular hotspot; and

determining, by the processor, one or more individual hotspot index values using the one or more individual hotspot intensity values and the one or more reference intensity values.

25. The method of claim 24, wherein the determining the one or more individual hotspot index values comprises mapping each of the one or more reference intensity values to a corresponding reference index value on a scale and, for each individual hotspot intensity value, using the reference intensity values and corresponding reference index values to interpolate a corresponding individual hotspot index value.

26. The method of either one of claims 24 or 25, wherein the reference tissue regions comprise one or more members selected from the group consisting of: a liver, an aorta, and a parotid gland.

27. The method of any one of claims 24 to 26, wherein:

a first reference intensity value (i) is a blood reference intensity value associated with a 3D reference volume corresponding to an aorta portion, and (ii) maps to a first reference index value;

a second reference intensity value (i) is a liver reference intensity value associated with a 3D reference volume corresponding to a liver, and (ii) maps to a second reference index value; and

the second reference intensity value is greater than the first reference intensity value and the second reference index value is greater than the first reference index value.

28. The method of any one of claims 24 to 27, wherein the reference intensity values comprises a maximum reference intensity value that maps to a maximum reference index value, and wherein hotspots having associated hotspot intensity values greater than the maximum reference intensity value are assigned hotspot index values equal to the maximum reference index value.

29. The method of any one of claims 24 to 28, comprising, determining, by the processor, an overall index value indicative of a cancer status of the subject using at least a portion of the one or more hotspot index values.

30. The method of claim 29, wherein the overall index value is determined as a weighted sum of at least a portion of the individual hotspot index values.

31. The method of claims 29 to 30, wherein:

the overall index value is associated with a particular target tissue region corresponding to a particular target VOI identified within the anatomical image; and

the overall index value is determined using hotspot index values of a subset of hotspots located within a particular 3D volume in the 3D functional image that corresponds to the particular identified target VOI.

32. The method of claim 31, wherein the particular target tissue region is selected from the group consisting of: a skeletal region comprising one or more bones of the subject, a lymph region, and a prostate region.

33. The method of any one of claims 11 to 32, wherein:

the 3D anatomical image is an *x*-ray computed tomography (CT) image, and

the 3D functional image is a 3D single photon emission computed tomography (SPECT) image.

34. The method of any one of claims 11 to 32, wherein:

the 3D anatomical image is an *x*-ray computed tomography (CT) image, and

the 3D functional image is a 3D positron emission tomography (PET) image.

35. The method of claim 34, wherein the 3D PET image of the subject is obtained following administration to the subject of a radiopharmaceutical comprising a prostate-specific membrane antigen (PSMA) binding agent.

36. The method of claim 35, wherein the radiopharmaceutical comprises [^{18}F]DCFPyL.

37. The method of any one of the preceding claims, wherein step (b) comprises cropping, by the processor, the 3D anatomical image to remove voxels representing air.

38. The method of any one of the preceding claims, wherein the target tissue regions comprise one or more members selected from the group consisting of: a left hip bone, a right hip bone, a sacrum and coccyx region, a left clavicle, a right clavicle, a left rib, a right rib, a left scapula, a right scapula, a sternum, a lumbar vertebra, a thoracic vertebra, a skull, a cervical vertebra, a left femur, a right femur, a left humerus, a right humerus, a prostate, a urinary bladder, a rectum, a left gluteus maximus, a right gluteus maximus, an aorta (e.g., a thoracic aorta portion; e.g., an abdominal aorta portion), a left kidney, a right kidney, a liver, a left lung, a right lung, a spleen, a ventricle, a left adrenal gland, a right adrenal gland, a gallbladder, a brain, a pancreas, a heart, a mandible, a left bronchi, a right bronchi, a trachea, a left common iliac artery, a right common iliac artery, and a parotid gland.

39. The method of any one of the preceding claims, wherein one or more of the target tissue regions comprise one or more specific bones selected from the group consisting of: a left clavicle, a right clavicle, a left femur, a right femur, a left fibula, a right fibula, a left hip bone, a right hip bone, a left humerus, a right humerus, a mandible, a left patella, a right patella, left radius, a right radius, a left tibia, a right tibia, a left ulna, a right ulna, a left rib, a right rib, a sacrum and coccyx, a left scapula, a right scapula, a skull, sternum, a vertebrae region, and an individual vertebra.

40. The method of claim 39, wherein one or more of the target tissue regions comprise one or more specific bones selected from the group consisting of: a left clavicle, a right clavicle, a left hip bone, a right hip bone, a left rib, a right rib, a sacrum and coccyx, a left scapula, a right scapula, a sternum, a vertebrae region, and an individual vertebra.

41. The method of any one of the preceding claims, wherein one or more of the target tissue regions comprise one or more soft-tissue regions selected from the group consisting of: a left adrenal gland, a right adrenal gland, an aorta, a brain, a left bronchi, a right bronchi, a gallbladder, a left gluteus maximus, a right gluteus maximus, a heart, a left common iliac artery, a right common iliac artery, a left kidney, a right kidney, a liver, a left lung, a right lung, a pancreas, a prostate, a rectum, a spleen , a trachea, a urinary bladder, a ventricle, and a parotid gland.

42. The method of claim 41, wherein the one or more target tissue regions comprise one or more soft-tissue regions selected from the group consisting of: a gallbladder, a left kidney, a right kidney, a liver, a left lung, a right lung, a prostate, and a urinary bladder.

43. The method of any one of the preceding claims, wherein the target tissue regions comprise one or more bone regions, each corresponding to a specific bone and one or more soft tissue regions, each corresponding to a specific soft-tissue region.

44. A method for automatically processing 3D images to automatically identify cancerous lesions within a subject, the method comprising:

(a) receiving, by a processor of a computing device, a 3D anatomical image of a subject obtained using an anatomical imaging modality, wherein the 3D anatomical image comprises a graphical representation of tissue within the subject;

(b) automatically identifying, by the processor, using one or more machine learning modules, for each of a plurality of target tissue regions, a corresponding target volume of interest (VOI) within the 3D anatomical image;

(c) determining, by the processor, a 3D segmentation map representing a plurality of 3D segmentation masks, each 3D segmentation mask representing a particular identified target VOI;

(d) receiving, by the processor, a 3D functional image of the subject obtained using a functional imaging modality;

(e) identifying, within the 3D functional image, one or more 3D volume(s), each corresponding to an identified target VOI, using the 3D segmentation map; and

(f) automatically detecting, by the processor, within at least a portion of the one or more 3D volumes identified within the 3D functional image, one or more hotspots determined to represent lesions based on intensities of voxels within the 3D functional image.

45. The method of claim 44, comprising using, by the processor, the one or more detected hotspots to determine a cancer status for the subject.

46. The method of either of claims 44 or 45, wherein the target tissue regions comprise one or more reference tissue regions and wherein the method comprises:

using the 3D segmentation map to identify, by the processor, within the 3D functional image, one or more 3D reference volume(s), each corresponding to a particular reference tissue region;

determining, by the processor, one or more reference intensity values, each associated with a particular 3D reference volume of the one or more 3D reference volume(s) and corresponding to a measure of intensity within the particular 3D reference volume;

determining, by the processor, one or more individual hotspot intensity values, each associated with a particular hotspot of at least a portion of the detected one or more hotspots and corresponding to a measure of intensity of the particular hotspot; and

determining, by the processor, one or more individual hotspot index values using the one or more individual hotspot intensity values and the one or more reference intensity values.

47. The method of claim 46, wherein the reference tissue regions comprise one or more members selected from the group consisting of: a liver, an aorta, and a parotid gland.

48. The method of any one of claims 45 to 47, comprising, determining, by the processor, an overall index value indicative of a cancer status of the subject using at least a portion of the one or more hotspot index values.

49. The method of claim 48, wherein the overall index value is determined as a weighted sum of at least a portion of the individual hotspot index values.

50. The method of any one of claims 44 to 49, wherein:

the 3D anatomical image is an *x*-ray computed tomography (CT) image, and

the 3D functional image is a 3D positron emission tomography (PET) image.

51. The method of claim 50, wherein the 3D PET image of the subject is obtained following administration to the subject of a radiopharmaceutical comprising a prostate-specific membrane antigen (PSMA) binding agent.

52. The method of claim 51, wherein the radiopharmaceutical comprises [^{18}F]DCFPyL.

53. A method for automatically processing 3D images to identify, and measure uptake of radiopharmaceutical in, cancerous lesions within a subject having or at risk for a cancer, the method comprising:

(a) receiving, by a processor of a computing device, a 3D anatomical image of a subject obtained using an anatomical imaging modality, wherein the 3D anatomical image comprises a graphical representation of tissue within the subject;

(b) automatically identifying, by the processor, using one or more machine learning modules, within the 3D anatomical image:

a first skeletal volume comprising a graphical representation of one or more bones of the subject;

a first aorta volume comprising a graphical representation of at least a portion of an aorta of the subject; and

a first liver volume comprising a graphical representation of a liver of the subject;

(c) determining, by the processor, a 3D segmentation map representing a plurality of 3D segmentation masks, including a skeletal mask representing the identified first skeletal volume, an aorta mask representing the identified first aorta volume, and a liver mask representing the identified first liver volume;

(d) receiving, by the processor, a 3D functional image of the subject obtained using a functional imaging modality;

(e) automatically identifying, within the 3D functional image, using the 3D segmentation map:

a second skeletal volume corresponding to the first identified skeletal volume, within the 3D anatomical image;

a second aorta volume corresponding to the first aorta volume, identified within the 3D anatomical image; and

a second liver volume corresponding to the first liver volume, identified within the 3D anatomical image;

(f) automatically detecting, by the processor, within the second skeletal volume, one or more hotspots determined to represent lesions based on intensities of voxels within the second skeletal volume; and

(g) determining, by the processor, for each of the one or more detected hotspots, an individual hotspot index value by:

determining an aorta reference intensity level based on a measure of intensity of voxels within the second aorta volume;

determining a liver reference intensity level based on a measure of intensity of voxels within the second liver volume; and

for each individual detected hotspot:

determining a corresponding individual hotspot intensity level based on a measure of intensity of voxels of the detected hotspot; and

determining a corresponding individual hotspot index level from the individual hotspot intensity level, the aorta reference intensity level, and the liver reference intensity level.

54. The method of claim 53, comprising determining, by the processor, an overall index value indicative of a cancer status of the subject based on the individual hotspot index values of at least a portion of the one or more detected hotspots.

55. The method of either of claims 53 or 54, wherein the subject has or is at risk for prostate cancer.

56. The method of any one of claims 53 to 55, wherein:

step (b) comprises automatically identifying, within the 3D anatomical image, a first prostate volume comprising a graphical representation of a prostate of the subject,

the 3D segmentation map determined at step (c) further includes a prostate mask representing the identified first prostate volume,

step (e) comprises automatically identifying, within the 3D functional image, a second prostate volume corresponding to the first identified prostate volume, within the 3D anatomical image,

step (f) comprises automatically detecting one or more hotspots in the second prostate volume, and the method further comprises:

determining, by the processor, (i) an overall bone index value indicative of a lesion content in the one or more bones of the subject based on the individual hotspot index values of at least a portion of the one or more detected hotspots located in the second skeletal volume and (ii) an overall prostate index value indicative of a lesion content in the prostate of the subject based on the individual hotspot index values of at least a portion of the one or more detected hotspots located in the second prostate volume.

57. The method of any one of claims 53 to 56, wherein the subject has or is at risk for metastatic cancer.

58. A method for automatically processing a set of full body 3D anatomical images of varying sizes to automatically identify, within each 3D anatomical image, a plurality of 3D volumes that correspond to particular target tissue regions, the method comprising:

(a) receiving, by a processor of a computing device, the set of 3D anatomical images of one or more subject(s) obtained using an anatomical imaging modality, wherein the 3D anatomical image comprises a graphical representation of tissue within each of the one or more subject(s), wherein the set of 3D anatomical images has a mean x-dimension, a mean y-dimension, and a mean z-dimension, at least one of which having a standard deviation at least 3% of the corresponding mean; and

(b) automatically determining, by the processor, using a localization module that implements a CNN, within each image of the set of 3D anatomical images, at least one initial VOI corresponding to a particular anatomical region that comprises one or more particular associated target tissue regions, thereby identifying at least one initial VOI for the corresponding 3D anatomical image; and

(c) for each initial VOI, automatically identifying, by the processor, using one or more segmentation modules each implementing a CNN, for each of the one or more particular target tissue regions associated with the particular anatomical region to which the initial VOI corresponds, a corresponding target VOI.

59. A system for automatically processing a 3D image to identify 3D volumes within the 3D image that correspond to particular target tissue regions, the system comprising:

a processor of a computing device; and

a memory having instructions stored thereon, wherein the instructions, when executed by the processor, cause the processor to:

(a) receive a 3D anatomical image of a subject obtained using an anatomical imaging modality, wherein the 3D anatomical image comprises a graphical representation of tissue within the subject;

(b) automatically identify, using one or more machine learning modules, for each of a plurality of target tissue regions, a corresponding target volume of interest (VOI) within the 3D anatomical image;

(c) determine 3D segmentation map representing a plurality of 3D segmentation masks, each 3D segmentation mask representing a particular identified target VOI; and

(d) store and/or provide the 3D segmentation map for display and/or further processing.

60. The system of claim 59, wherein the 3D anatomical image is a full body image.

61. The system of either of claims 59 or 60, wherein, at step (c) the instructions cause the processor to digitally stitch together the plurality of 3D segmentation masks to form the 3D segmentation map.

62. The system of any one of claims 59 to 61, wherein at step (b), the instructions cause the processor to, for at least one specific target tissue region:

determine, using a first module, an initial VOI within the 3D anatomical image, the initial VOI corresponding to an anatomical region containing the specific target tissue region; and

identify, using a second module, the target VOI corresponding to the specific target tissue region within the initial VOI.

63. The system of claim 62, wherein the second module is a CNN module that implements a CNN.

64. The system of either one of claims 62 or 63, wherein the first module is a CNN module that implements a CNN to perform a coarse segmentation to automatically identify the initial VOI corresponding to the anatomical region containing the specific target tissue region.

65. The system of any one of claims 62 to 64, wherein the first module receives a sub-sampled version of the anatomical image as input and identifies the initial VOI using the sub-sampled version of the anatomical image.

66. The system of any one of claims 62 to 65, wherein the first module is a first CNN module and the second module is a second CNN module, and wherein the first CNN module comprises additional filters in order to account for increased variability in image size with respect to the second CNN module.

67. The system of any one of claims 62 to 66, wherein the 3D anatomical image is a full body image and wherein, at step (b), the instructions cause the processor to:

automatically determine, using one or more localization modules implementing machine learning technique(s), a plurality of initial VOIs within the 3D anatomical image, each initial VOI corresponding to a particular anatomical region and in which an associated subset of the target VOIs are located; and

for each initial VOI, automatically identify, using one or more segmentation modules implementing machine learning technique(s) the associated subset of target VOIs.

68. The system of claim 67, wherein the plurality of initial VOIs comprises one or more members selected from the group consisting of:

a pelvic region initial VOI corresponding to a pelvic region of the subject;

a spine region initial VOI corresponding to a spine of the subject;

a left upper body region initial VOI corresponding to a left side of the subject's upper body; and

a right upper body region initial VOI corresponding to a right side of the subject's upper body.

69. The system of any one of claims 59 to 68, wherein the instructions cause the processor to:

(e) receive a 3D functional image of the subject obtained using a functional imaging modality; and

(f) identify, within the 3D functional image, one or more 3D volume(s), each corresponding to an identified target VOI, using the 3D segmentation map.

70. The system of claim 69, wherein the instructions cause the processor to:

(g) determine a cancer status for the subject.

71. The system of claim 70, wherein the instructions cause the processor to perform steps (a) – (g) repeatedly for a plurality of anatomical and corresponding functional images collected at different time points to determine, at each time point, a cancer status of the subject, thereby tracking cancer status over time.

72. The system of any one of claims 69 to 71, wherein the instructions cause the processor to:

(h) automatically adjust intensities of voxels of the 3D functional image to correct for background uptake in one or more background tissue regions.

73. The system of claim 72, wherein the target tissue regions comprise the one or more background tissue regions and wherein, at step (h), the instructions cause the processor to:

use the 3D segmentation map to identify, within the 3D functional image, one or more 3D background tissue volume(s), each corresponding a particular background tissue region; and

adjust intensities of voxels of the 3D functional image based on intensities of voxels within the 3D background tissue volumes.

74. The system of either of claims 72 or 73, wherein the one or more background tissue regions comprise one or more members selected from the group consisting of: a bladder, a kidney, a duodenum, a small intestine, a spleen, a liver, a pancreas, a stomach, an adrenal gland, a rectum, and testes.

75. The system of any one of claims 69 to 74, wherein the instructions cause the processor to:

(i) automatically detect one or more hotspots within the 3D functional image determined to represent lesions based on intensities of voxels within the 3D functional image.

76. The system of claim 75, wherein, at step (i), the instructions cause the processor to use one or more thresholds.

77. The system of either one of claims 75 or 76, wherein, at step (i), the instructions cause the processor to apply one or more filters to the 3D functional image.

78. The system of any one of claims 75 to 77, wherein, at step (i), the instructions cause the processor to use a combination of two or more techniques for identification of hotspots in different sub-sets of the one or more 3D volumes identified within the 3D functional image.

79. The system of any one of claims 75 to 78, wherein, at step (i), the instructions cause the processor to detect an initial set of hotspots and, for at least a portion of the hotspots of the initial set, classify each hotspot of at least a portion of the detected hotspots as either a cancerous lesion or not a cancerous lesion.

80. The system of any one of claims 75 to 79, wherein the target tissue regions comprise one or more background tissue regions and wherein the instructions cause the processor to:

use the 3D segmentation map to identify, within the 3D functional image, one or more 3D background tissue volume(s), each corresponding a particular background tissue region; and

exclude voxels of the 3D within the 3D background tissue from the voxels used to automatically detect the one or more hotspots at step (i).

81. The system of any one of claims 75 to 80, wherein the instructions cause the processor to use the one or more detected hotspots to determine a cancer status for the subject.

82. The system of any one of claims 75 to 81, wherein the target tissue regions comprise one or more reference tissue regions and wherein the instructions cause the processor to:

use the 3D segmentation map to identify, within the 3D functional image, one or more 3D reference volume(s), each corresponding to a particular reference tissue region;

determine one or more reference intensity values, each associated with a particular 3D reference volume of the one or more 3D reference volume(s) and corresponding to a measure of intensity within the particular 3D reference volume; and

determine one or more individual hotspot intensity values, each associated with a particular hotspot of at least a portion of the detected one or more hotspots and corresponding to a measure of intensity of the particular hotspot; and

determine one or more individual hotspot index values using the one or more individual hotspot intensity values and the one or more reference intensity values.

83. The system of claim 82, wherein the instructions cause the processor to determine the one or more individual hotspot index values by mapping each of the one or more reference intensity values to a corresponding reference index value on a scale and, for each individual hotspot intensity value, using the reference intensity values and corresponding reference index values to interpolate a corresponding individual hotspot index value.

84. The system of either one of claims 82 or 83, wherein the reference tissue regions comprise one or more members selected from the group consisting of: a liver, an aorta, and a parotid gland.

85. The system of any one of claims 82 to 84, wherein:

a first reference intensity value (i) is a blood reference intensity value associated with a 3D reference volume corresponding to an aorta portion, and (ii) maps to a first reference index value;

a second reference intensity value (i) is a liver reference intensity value associated with a 3D reference volume corresponding to a liver, and (ii) maps to a second reference index value; and

the second reference intensity value is greater than the first reference intensity value and the second reference index value is greater than the first reference index value.

86. The system of any one of claims 82 to 85, wherein the reference intensity values comprises a maximum reference intensity value that maps to a maximum reference index value, and wherein hotspots having associated hotspot intensity values greater than the maximum reference intensity value are assigned hotspot index values equal to the maximum reference index value.

87. The system of any one of claims 82 to 86, wherein the instructions cause the processor to determine an overall index value indicative of a cancer status of the subject using at least a portion of the one or more hotspot index values.

88. The system of claim 87, wherein the overall index value is determined as a weighted sum of at least a portion of the individual hotspot index values.

89. The system of claims 87 to 88, wherein:

the overall index value is associated with a particular target tissue region corresponding to a particular target VOI identified within the anatomical image; and

the overall index value is determined using hotspot index values of a subset of hotspots located within a particular 3D volume in the 3D functional image that corresponds to the particular identified target VOI.

90. The system of claim 89, wherein the particular target tissue region is selected from the group consisting of: a skeletal region comprising one or more bones of the subject, a lymph region, and a prostate region.

91. The system of any one of claims 69 to 90, wherein:

the 3D anatomical image is an *x*-ray computed tomography (CT) image, and

the 3D functional image is a 3D single photon emission computed tomography (SPECT) image.

92. The system of any one of claims 69 to 90, wherein:

the 3D anatomical image is an *x*-ray computed tomography (CT) image, and

the 3D functional image is a 3D positron emission tomography (PET) image.

93. The system of claim 92, wherein the 3D PET image of the subject is obtained following administration to the subject of a radiopharmaceutical comprising a prostate-specific membrane antigen (PSMA) binding agent.

94. The system of claim 93, wherein the radiopharmaceutical comprises [^{18}F]DCFPyL.

95. The system of any one of claims 59 to 94, wherein, at step (b), the instructions cause the processor to crop the 3D anatomical image to remove voxels representing air.

96. The system of any one of claims 59 to 95, wherein the target tissue regions comprise one or more members selected from the group consisting of: a left hip bone, a right hip bone, a sacrum and coccyx region, a left clavicle, a right clavicle, a left rib, a right rib, a left scapula, a right scapula, a sternum, a lumbar vertebra, a thoracic vertebra, a skull, a cervical vertebra, a left femur, a right femur, a left humerus, a right humerus, a prostate, a urinary bladder, a rectum, a left gluteus maximus, a right gluteus maximus, an aorta, a left kidney, a right kidney, a liver, a left lung, a right lung, a spleen, a ventricle, a left adrenal gland, a right adrenal gland, a gallbladder, a brain, a pancreas, a heart, a mandible, a left bronchi, a right bronchi, a trachea, a left common iliac artery, a right common iliac artery, and a parotid gland.

97. The system of any one of claims 59 to 96, wherein one or more of the target tissue regions comprise one or more specific bones selected from the group consisting of: a left clavicle, a right clavicle, a left femur, a right femur, a left fibula, a right fibula, a left hip bone, a right hip bone, a left humerus, a right humerus, a mandible, a left patella, a right patella, left radius, a right radius, a left tibia, a right tibia, a left ulna, a right ulna, a left rib, a right rib, a sacrum and coccyx, a left scapula, a right scapula, a skull, sternum, a vertebrae region, and an individual vertebra.

98. The system of claim 97, wherein one or more of the target tissue regions comprise one or more specific bones selected from the group consisting of: a left clavicle, a right clavicle, a left hip bone, a right hip bone, a left rib, a right rib, a sacrum and coccyx, a left scapula, a right scapula, a sternum, a vertebrae region, and an individual vertebra.

99. The system of any one of claims 59 to 98, wherein one or more of the target tissue regions comprise one or more soft-tissue regions selected from the group consisting of: a left adrenal gland, a right adrenal gland, an aorta, a brain, a left bronchi, a right bronchi, a gallbladder, a left gluteus maximus, a right gluteus maximus, a heart, a left common iliac artery, a right common iliac artery, a left kidney, a right kidney, a liver, a left lung, a right lung, a pancreas, a prostate, a rectum, a spleen , a trachea, a urinary bladder, a ventricle, and a parotid gland.

100. The system of claim 99, wherein the one or more target tissue regions comprise one or more soft-tissue regions selected from the group consisting of: a gallbladder, a left kidney, a right kidney, a liver, a left lung, a right lung, a prostate, and a urinary bladder.

101. The system of any one of claims 59 to 100, wherein the target tissue regions comprise one or more bone regions, each corresponding to a specific bone.

102. A system for automatically processing 3D images to automatically identify cancerous lesions within a subject, the system comprising:

a processor of a computing device; and

a memory having instructions stored thereon, wherein the instructions, when executed by the processor, cause the processor to:

(a) receive a 3D anatomical image of a subject obtained using an anatomical imaging modality, wherein the 3D anatomical image comprises a graphical representation of tissue within the subject;

(b) automatically identify, using one or more machine learning modules, for each of a plurality of target tissue regions, a corresponding target volume of interest (VOI) within the 3D anatomical image;

(c) determine a 3D segmentation map representing a plurality of 3D segmentation masks, each 3D segmentation mask representing a particular identified target VOI;

(d) receive a 3D functional image of the subject obtained using a functional imaging modality;

(e) identify, within the 3D functional image, one or more 3D volume(s), each corresponding to an identified target VOI, using the 3D segmentation map; and

(f) automatically detect, within at least a portion of the one or more 3D volumes identified within the 3D functional image, one or more hotspots determined to represent lesions based on intensities of voxels within the 3D functional image.

103. The system of claim 102, wherein the instructions cause the processor to use the one or more detected hotspots to determine a cancer status for the subject.

104. The system of either of claims 102 or 103, wherein the target tissue regions comprise one or more reference tissue regions and wherein the instructions cause the processor to:

use the 3D segmentation map to identify, within the 3D functional image, one or more 3D reference volume(s), each corresponding to a particular reference tissue region;

determine one or more reference intensity values, each associated with a particular 3D reference volume of the one or more 3D reference volume(s) and corresponding to a measure of intensity within the particular 3D reference volume;

determine one or more individual hotspot intensity values, each associated with a particular hotspot of at least a portion of the detected one or more hotspots and corresponding to a measure of intensity of the particular hotspot; and

determine one or more individual hotspot index values using the one or more individual hotspot intensity values and the one or more reference intensity values.

105. The system of claim 104, wherein the reference tissue regions comprise one or more members selected from the group consisting of: a liver, an aorta, and a parotid gland.

106. The system of any one of claims 103 to 105, wherein the instructions cause the processor to determine an overall index value indicative of a cancer status of the subject using at least a portion of the one or more hotspot index values.

107. The system of claim 106, wherein the overall index value is determined as a weighted sum of at least a portion of the individual hotspot index values.

108. The system of any one of claims 102 to 107, wherein:

the 3D anatomical image is an *x*-ray computed tomography (CT) image, and

the 3D functional image is a 3D positron emission tomography (PET) image.

109. The system of claim 108, wherein the 3D PET image of the subject is obtained following administration to the subject of a radiopharmaceutical comprising a prostate-specific membrane antigen (PSMA) binding agent.

110. The system of claim 109, wherein the radiopharmaceutical comprises [^{18}F]DCFPyL.

111. A system for automatically processing 3D images to identify, and measure uptake of radiopharmaceutical in, cancerous lesions within a subject having or at risk for a cancer, the system comprising:

a processor of a computing device; and

a memory having instructions stored thereon, wherein the instructions, when executed by the processor, cause the processor to:

(a) receive a 3D anatomical image of a subject obtained using an anatomical imaging modality, wherein the 3D anatomical image comprises a graphical representation of tissue within the subject;

(b) automatically identify using one or more machine learning modules, within the 3D anatomical image:

a first skeletal volume comprising a graphical representation of one or more bones of the subject;

a first aorta volume comprising a graphical representation of at least a portion of an aorta of the subject; and

a first liver volume comprising a graphical representation of a liver of the subject;

(c) determine a 3D segmentation map representing a plurality of 3D segmentation masks, including a skeletal mask representing the identified first

skeletal volume, an aorta mask representing the identified first aorta volume, and a liver mask representing the identified first liver volume;

(d) receive a 3D functional image of the subject obtained using a functional imaging modality;

(e) automatically identify, within the 3D functional image, using the 3D segmentation map:

a second skeletal volume corresponding to the first identified skeletal volume, within the 3D anatomical image;

a second aorta volume corresponding to the first aorta volume, identified within the 3D anatomical image; and

a second liver volume corresponding to the first liver volume, identified within the 3D anatomical image;

(f) automatically detect, within the second skeletal volume, one or more hotspots determined to represent lesions based on intensities of voxels within the second skeletal volume; and

(g) determine, for each of the one or more detected hotspots, an individual hotspot index value by:

determining an aorta reference intensity level based on a measure of intensity of voxels within the second aorta volume;

determining a liver reference intensity level based on a measure of intensity of voxels within the second liver volume; and

for each individual detected hotspot:

determining a corresponding individual hotspot intensity level based on a measure of intensity of voxels of the detected hotspot; and

determining a corresponding individual hotspot index level from the individual hotspot intensity level, the aorta reference intensity level, and the liver reference intensity level.

112. The system of claim 111, wherein the instructions cause the processor to determine an overall index value indicative of a cancer status of the subject based on the individual hotspot index values of at least a portion of the one or more detected hotspots.

113. The system of either of claims 111 or 112, wherein the subject has or is at risk for prostate cancer.

114. The system of any one of claims 111 to 113, wherein the instructions cause the processor to:

at step (b), automatically identify, within the 3D anatomical image, a first prostate volume comprising a graphical representation of a prostate of the subject;

at step (c), include a prostate mask representing the identified first prostate volume in the determined 3D segmentation map;

at step (e), automatically identify, within the 3D functional image, a second prostate volume corresponding to the first identified prostate volume, within the 3D anatomical image,

at step (f), automatically detect one or more hotspots in the second prostate volume; and

determine (i) an overall bone index value indicative of a lesion content in the one or more bones of the subject based on the individual hotspot index values of at least a portion of the one or more detected hotspots located in the second skeletal volume and (ii) an overall

prostate index value indicative of a lesion content in the prostate of the subject based on the individual hotspot index values of at least a portion of the one or more detected hotspots located in the second prostate volume.

115. The system of any one of claims 111 to 114, wherein the subject has or is at risk for metastatic cancer.

116. A system for automatically processing a set of full body 3D anatomical images of varying sizes to automatically identify, within each 3D anatomical image, a plurality of 3D volumes that correspond to particular target tissue regions, the system comprising:

a processor of a computing device; and

a memory having instructions stored thereon, wherein the instructions, when executed by the processor, cause the processor to:

(a) receive the set of 3D anatomical images of one or more subject(s) obtained using an anatomical imaging modality, wherein the 3D anatomical image comprises a graphical representation of tissue within each of the one or more subject(s), wherein the set of 3D anatomical images has a mean x-dimension, a mean y-dimension, and a mean z-dimension, at least one of which having a standard deviation at least 3% of the corresponding mean; and

(b) automatically determine, using a localization module that implements a CNN, within each image of the set of 3D anatomical images, at least one initial VOI corresponding to a particular anatomical region that comprises one or more particular associated target tissue regions, thereby identifying at least one initial VOI for the corresponding 3D anatomical image; and

(c) for each initial VOI, automatically identify, using one or more segmentation modules each implementing a CNN, for each of the one or more particular target tissue regions associated with the particular anatomical region to which the initial VOI corresponds, a corresponding target VOI.

SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION

Abstract

Presented herein are systems and methods that provide for automated analysis of three-dimensional (3D) medical images of a subject in order to automatically identify specific 3D volumes within the 3D images that correspond to specific anatomical regions (e.g., organs and/or tissue). Notably, the image analysis approaches described herein are not limited to a single particular organ or portion of the body. Instead, they are robust and widely applicable, providing for consistent, efficient, and accurate detection of anatomical regions, including soft tissue organs, in the entire body. In certain embodiments, the accurate identification of one or more such volumes is used to automatically determine quantitative metrics that represent uptake of radiopharmaceuticals in particular organs and/or tissue regions. These uptake metrics can be used to assess disease state in a subject, determine a prognosis for a subject, and/or determine efficacy of a treatment modality.

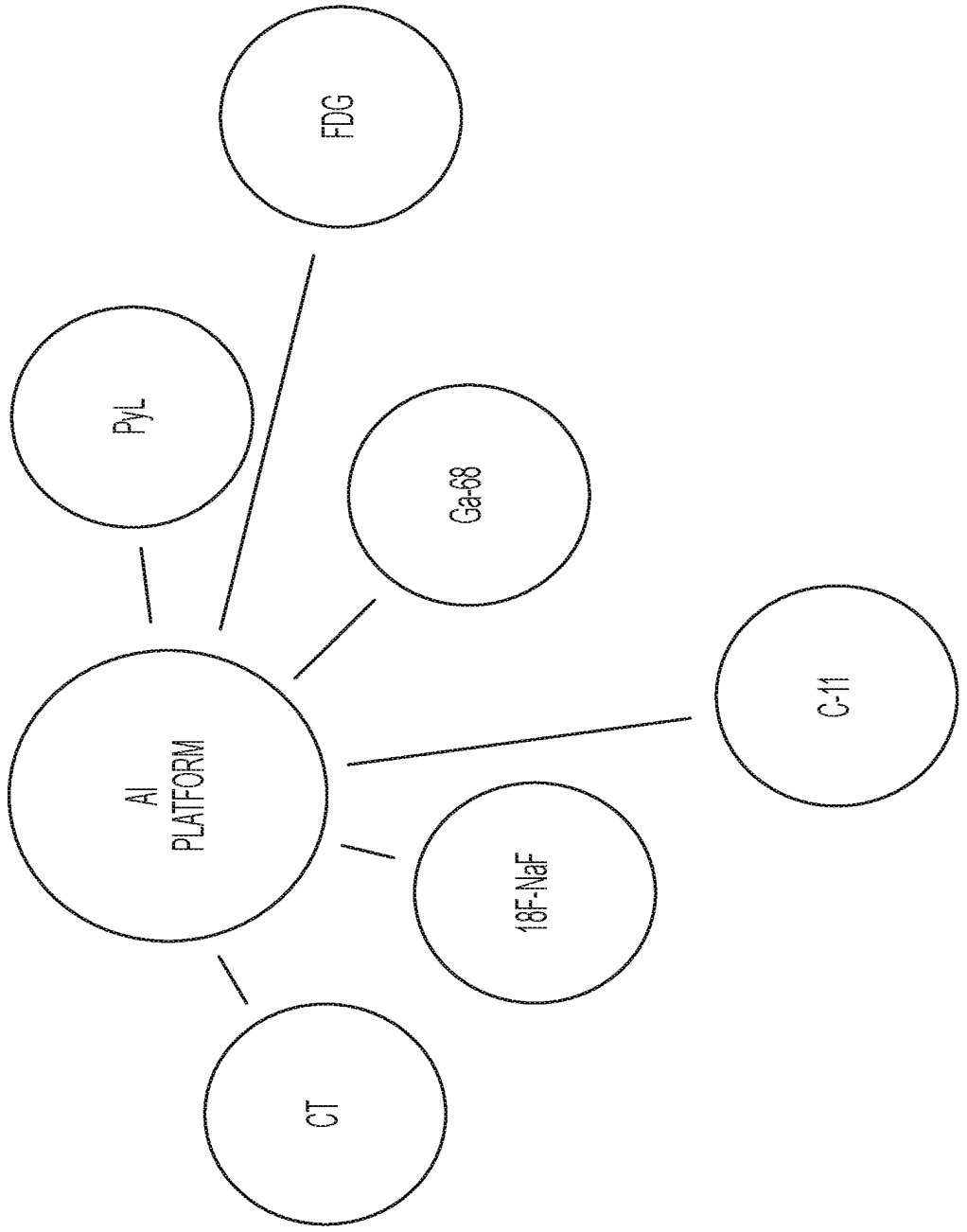


FIG. 1

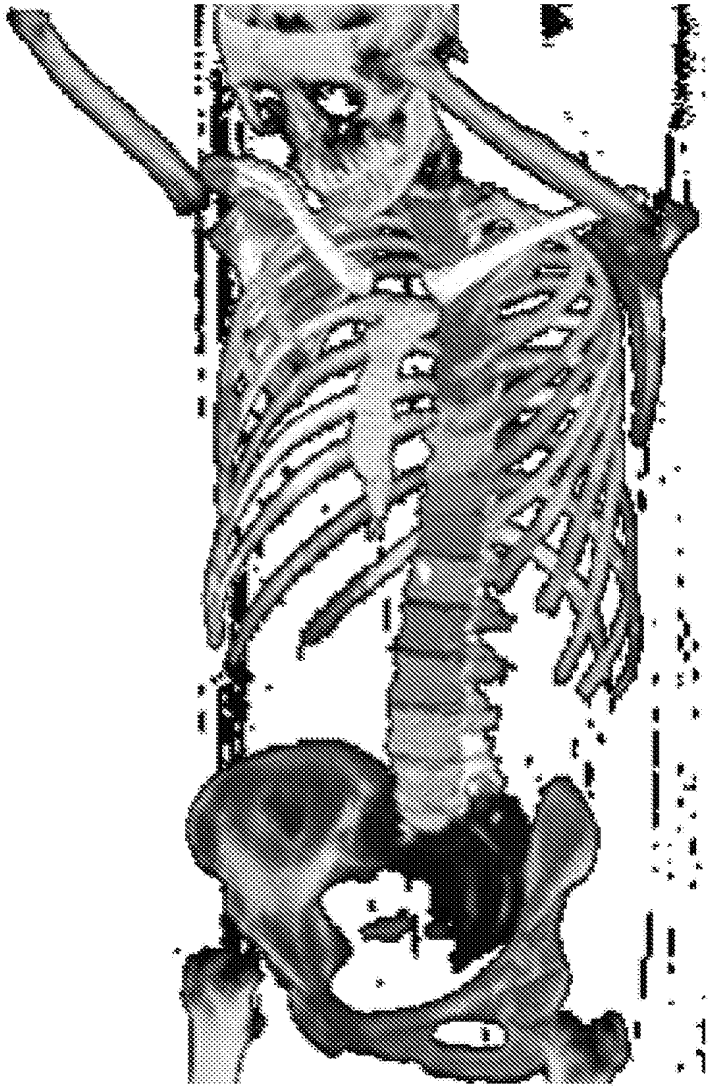


FIG. 2

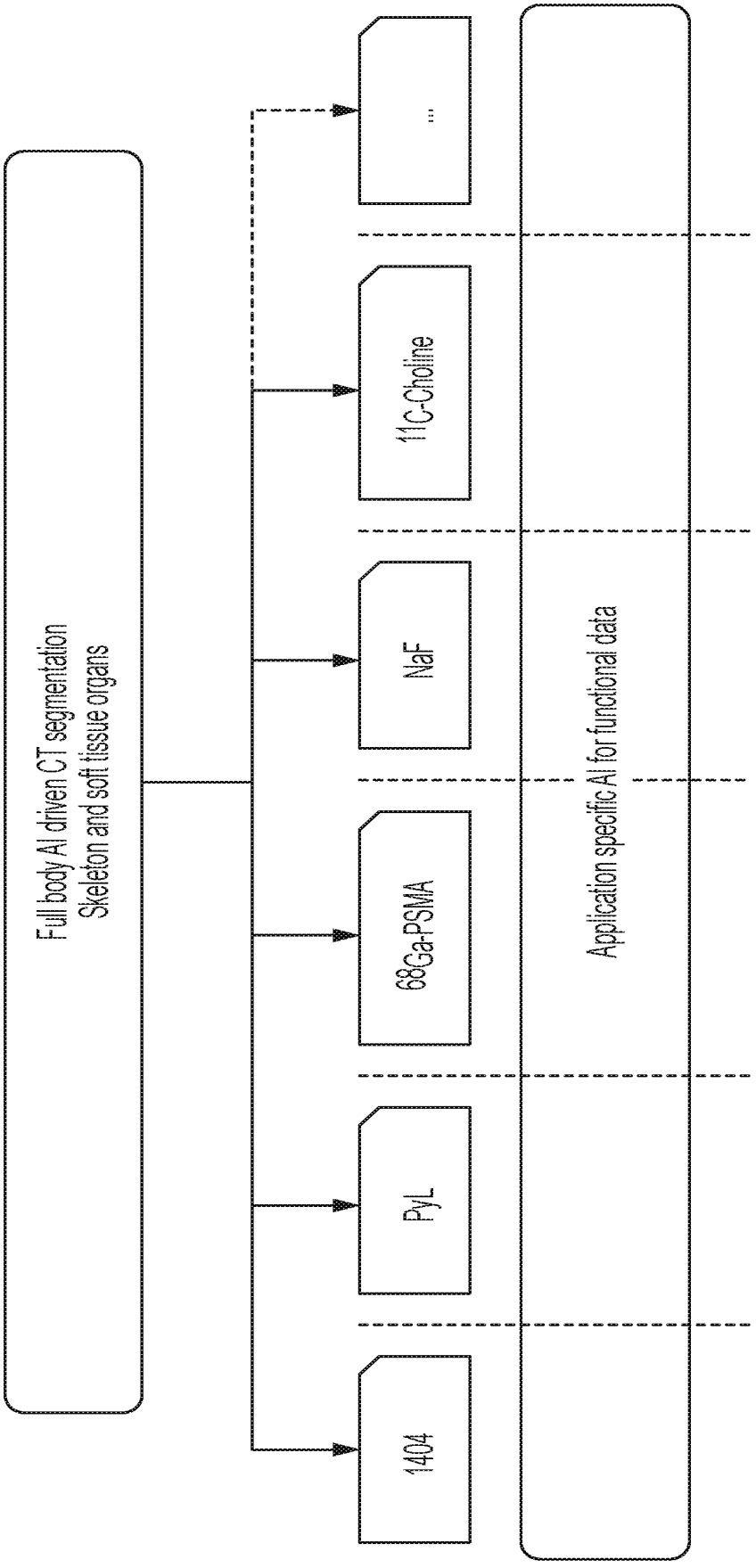

Full body AI driven CT segmentation
Skeleton and soft tissue organs
1404
PyL
68Ga-PSMA
NaF
11C-Choline
...
Application specific AI for functional data

FIG. 3

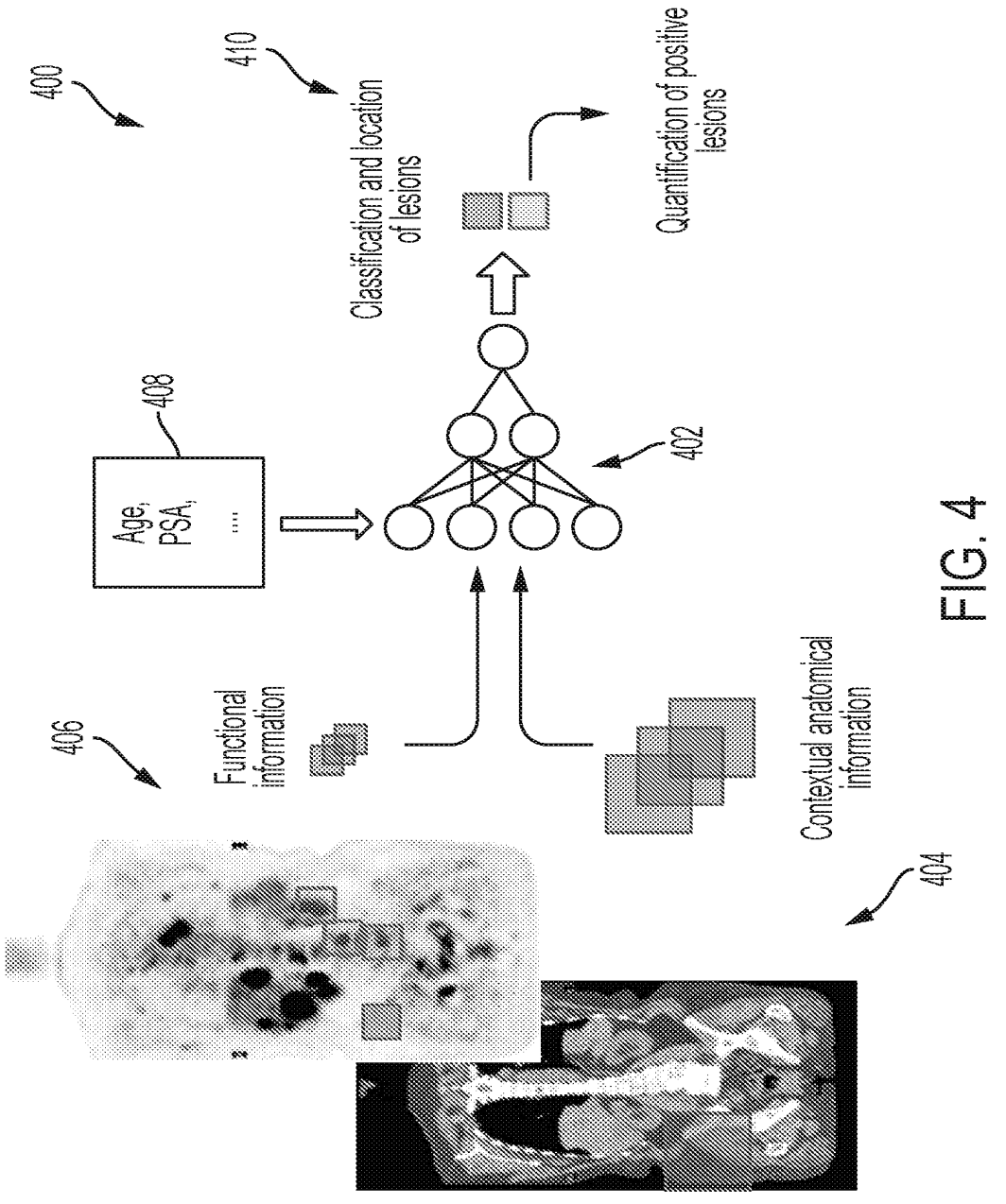

400
410
Classification and location of lesions
Quantification of positive lesions
408
Age, PSA, ...
402
406
Functional information
Contextual anatomical information
404

FIG. 4

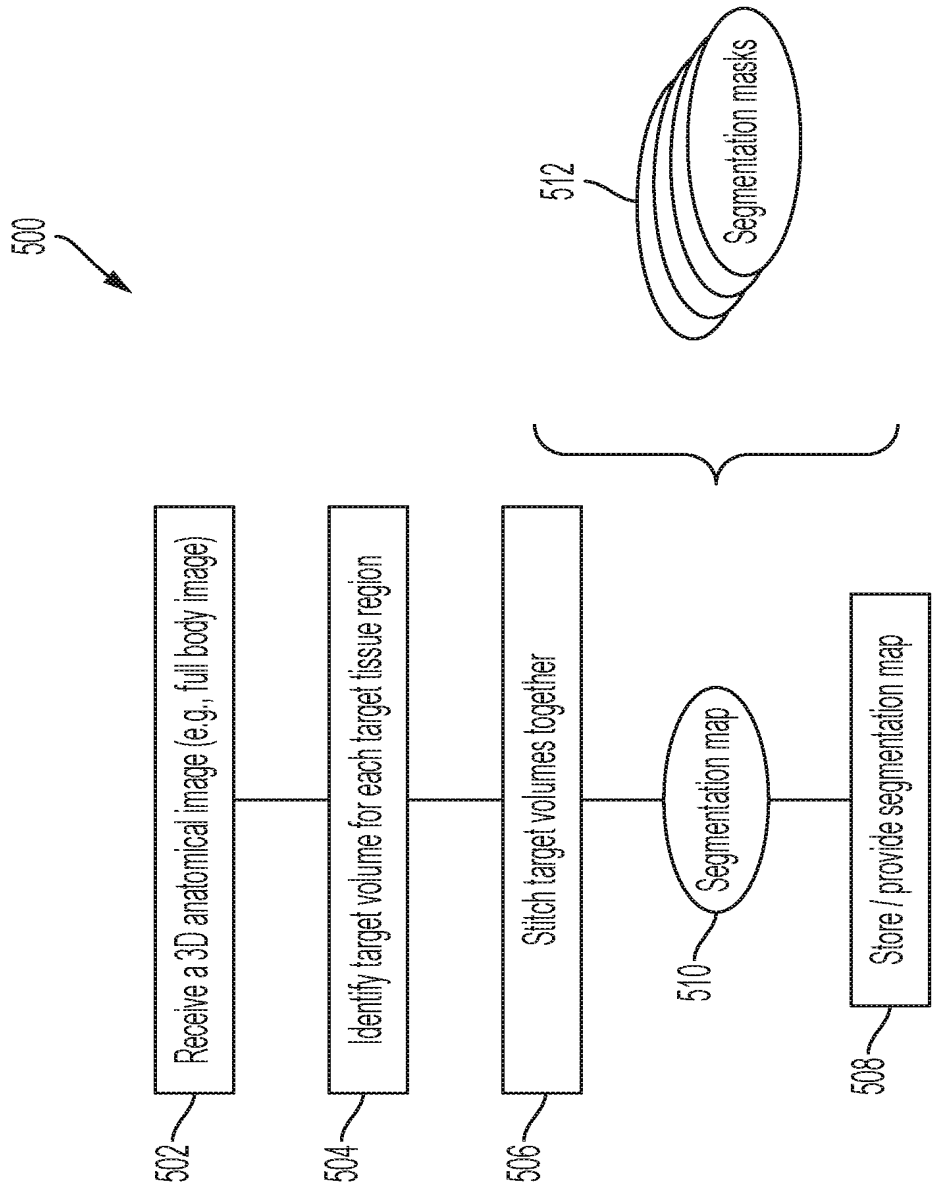

500
512
Segmentation masks
Receive a 3D anatomical image (e.g., full body image)
Identify target volume for each target tissue region
Stitch target volumes together
Segmentation map
Store / provide segmentation map
502
504
506
510
508

FIG. 5A

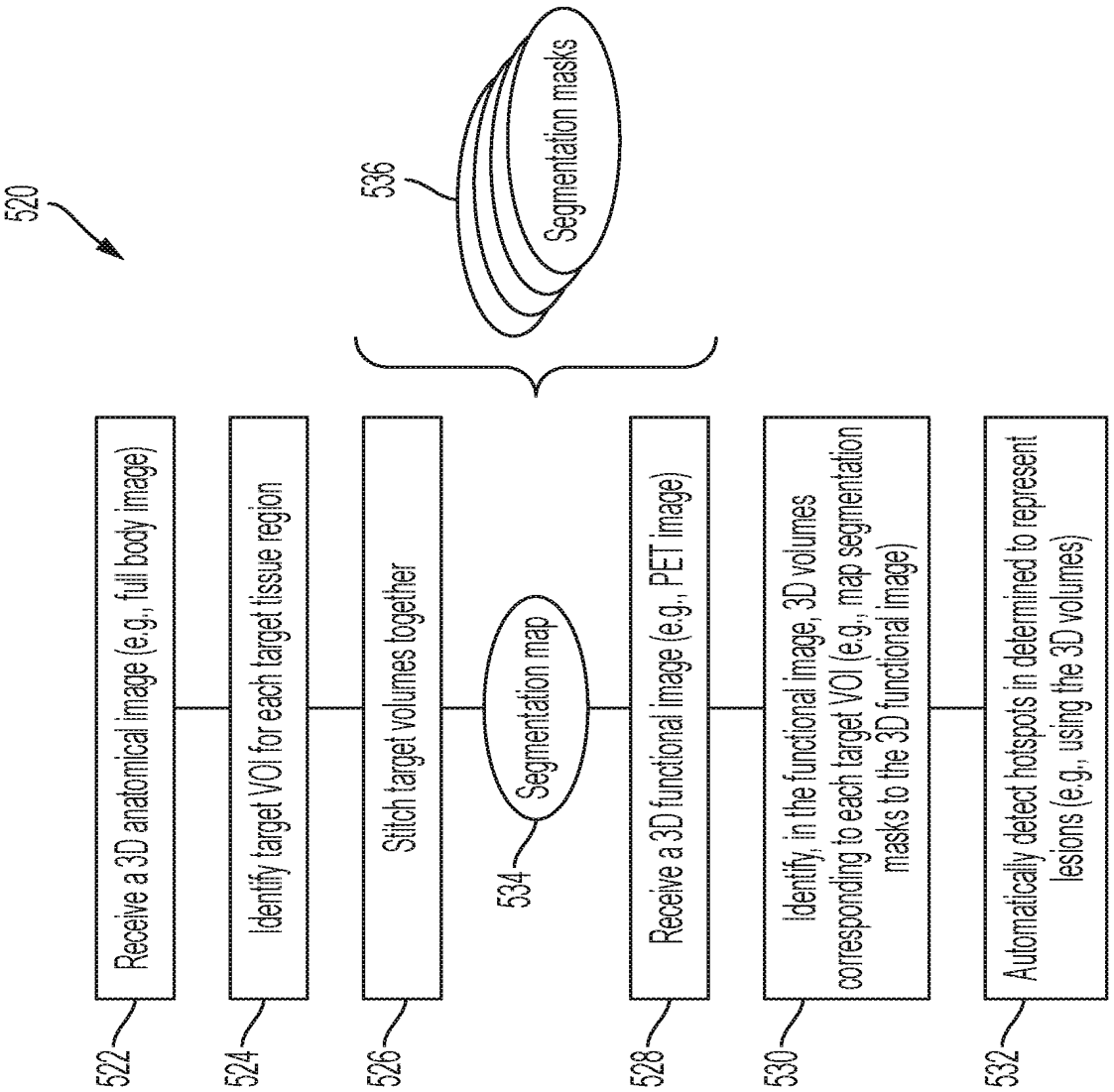

520
522
Receive a 3D anatomical image (e.g., full body image)
524
Identify target VOI for each target tissue region
526
Stitch target volumes together
534
Segmentation map
536
Segmentation masks
528
Receive a 3D functional image (e.g., PET image)
530
Identify, in the functional image, 3D volumes corresponding to each target VOI (e.g., map segmentation masks to the 3D functional image)
532
Automatically detect hotspots in determined to represent lesions (e.g., using the 3D volumes)

FIG. 5B

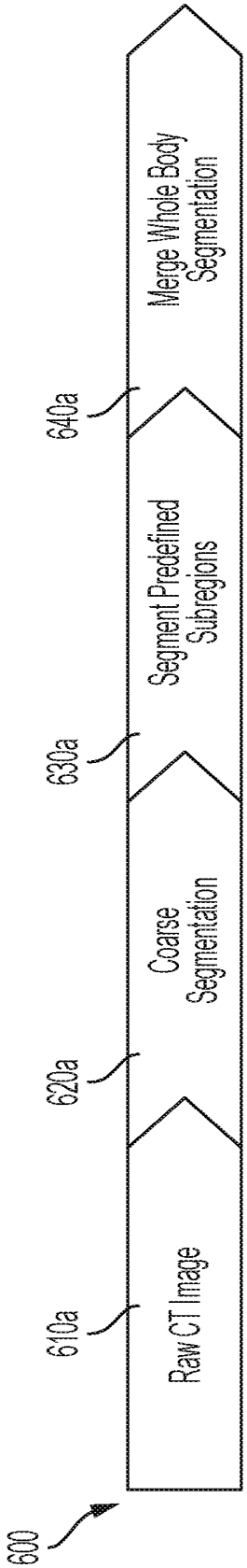

600
610a
Raw CT Image
620a
Coarse Segmentation
630a
Segment Predefined Subregions
640a
Merge Whole Body Segmentation

FIG. 6A

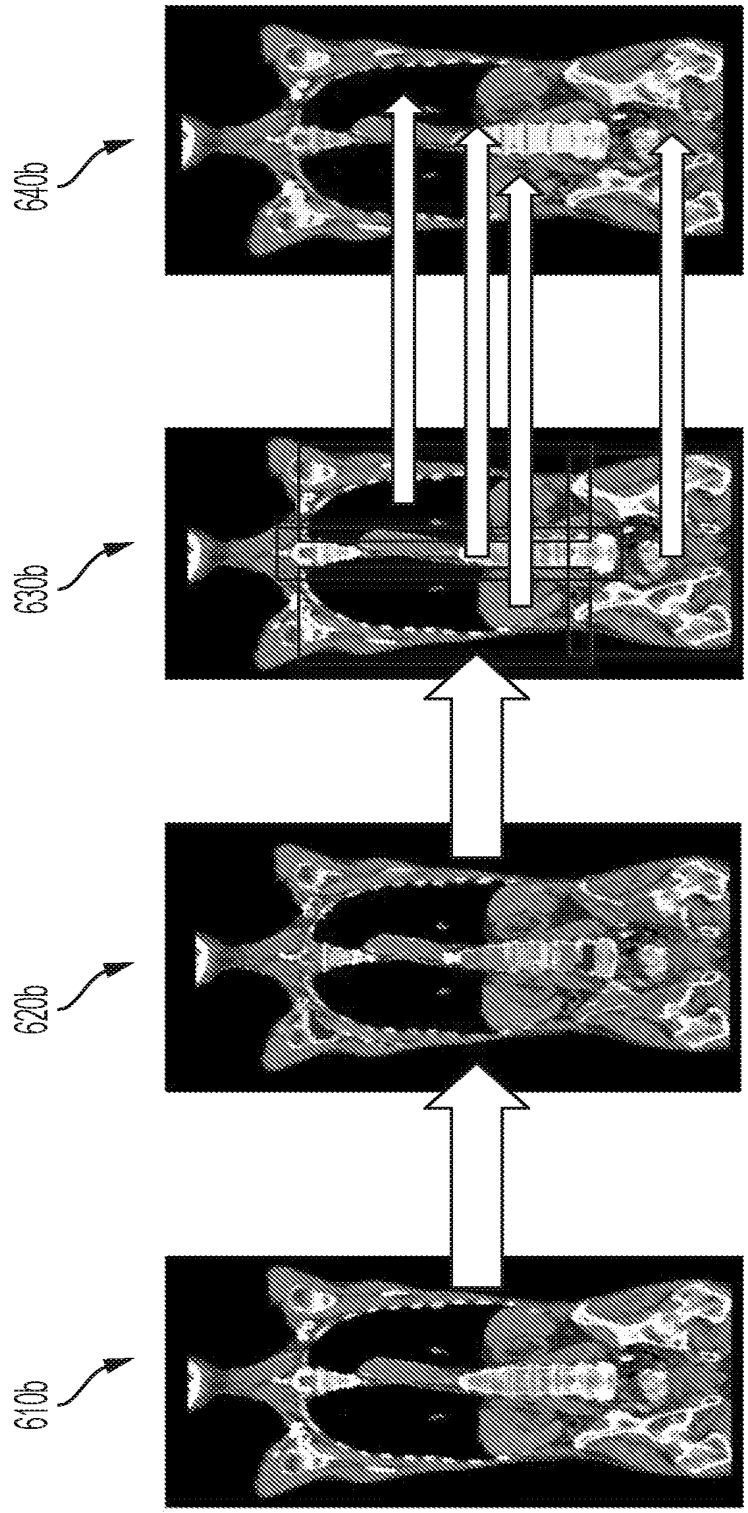

610b
620b
630b
640b

FIG. 6B

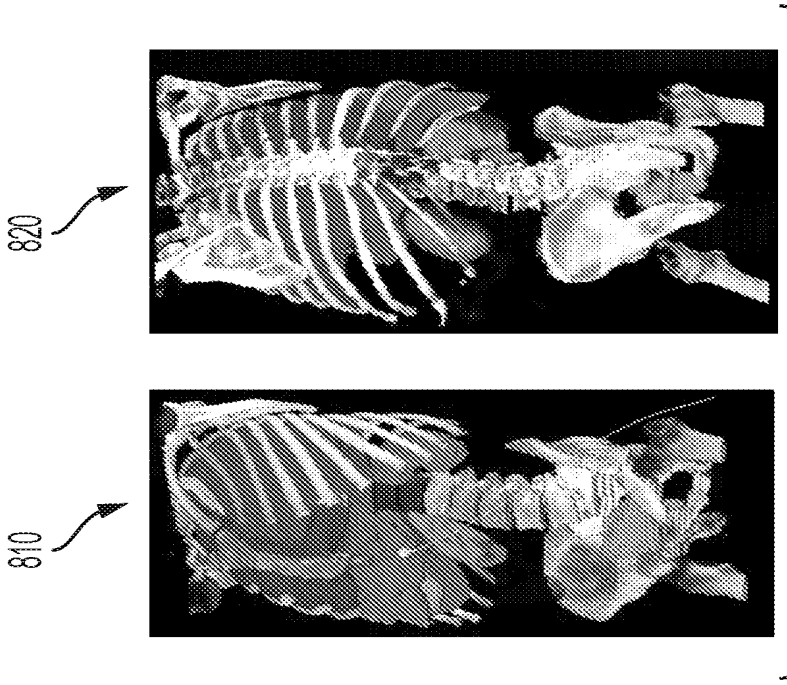


FIG. 8

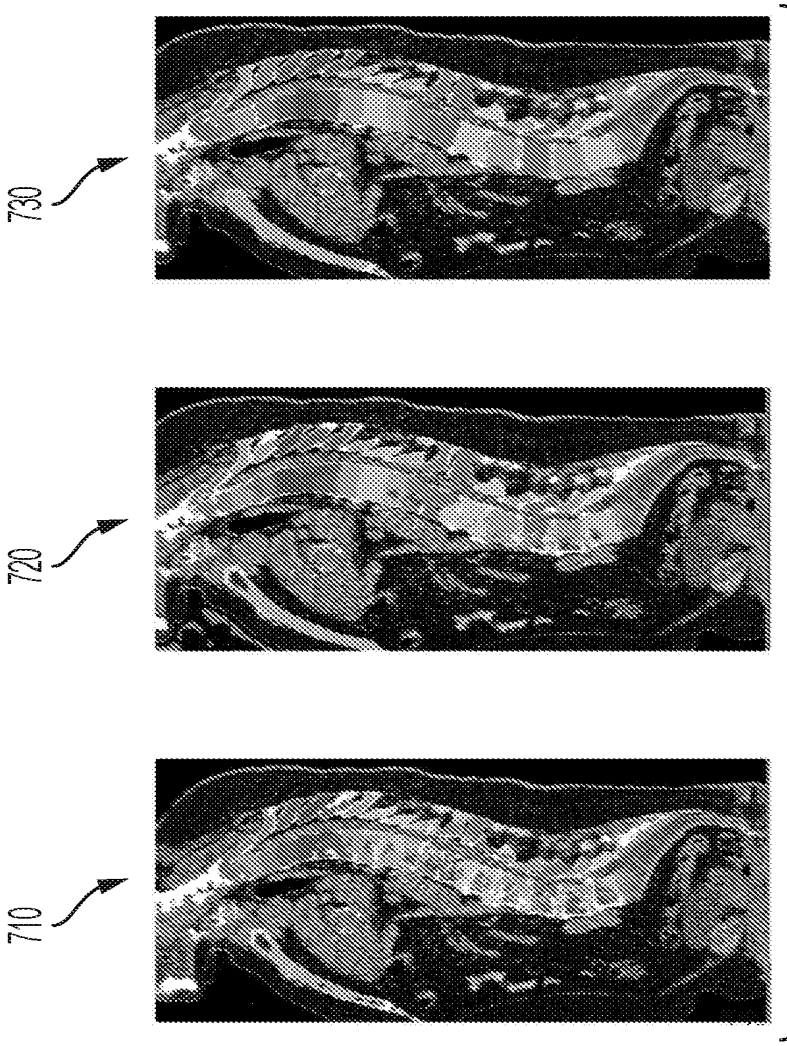


FIG. 7



FIG. 9A

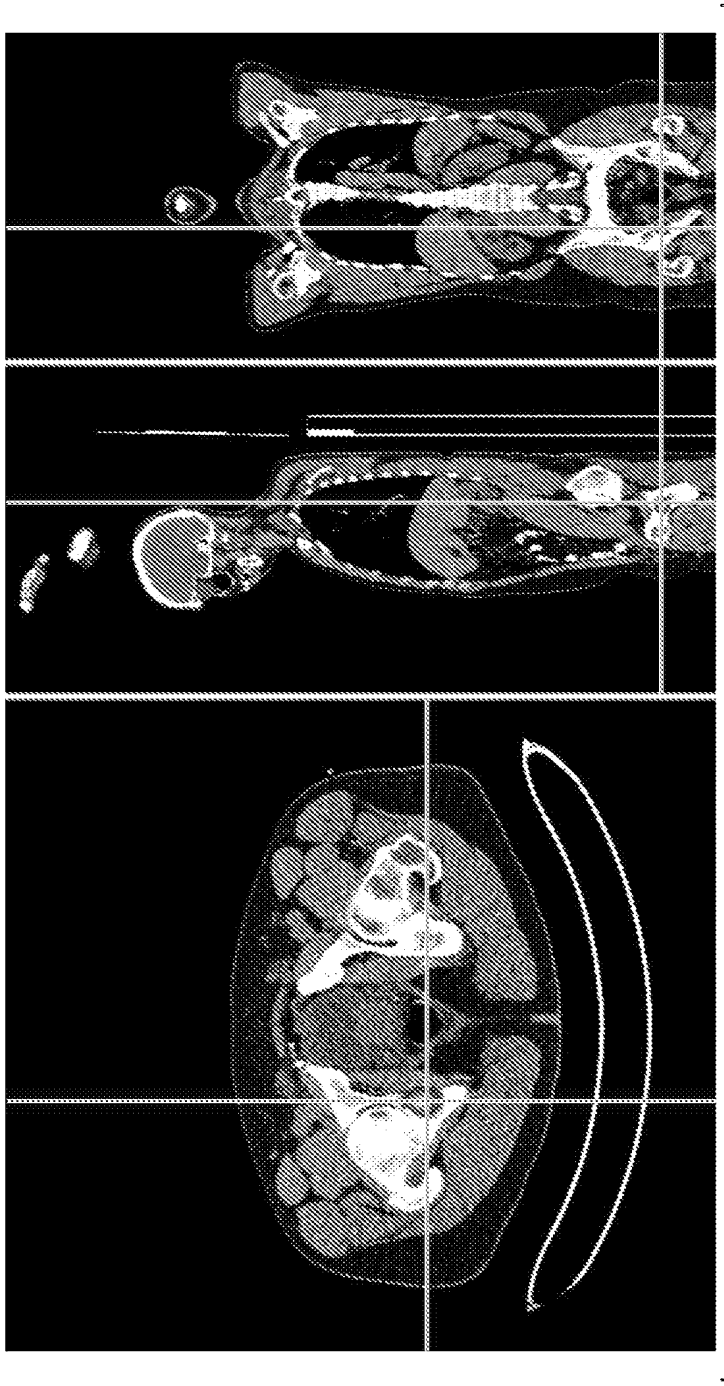


FIG. 9B



FIG. 9C

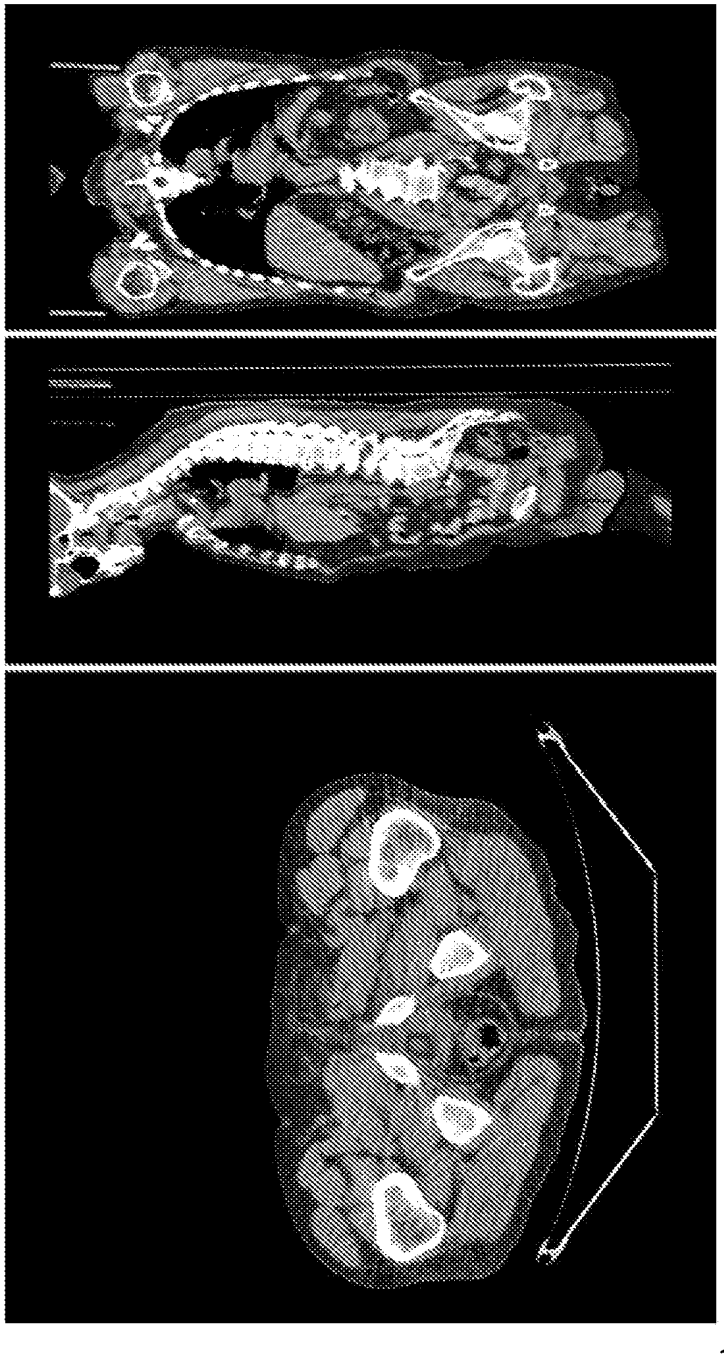


FIG. 9D

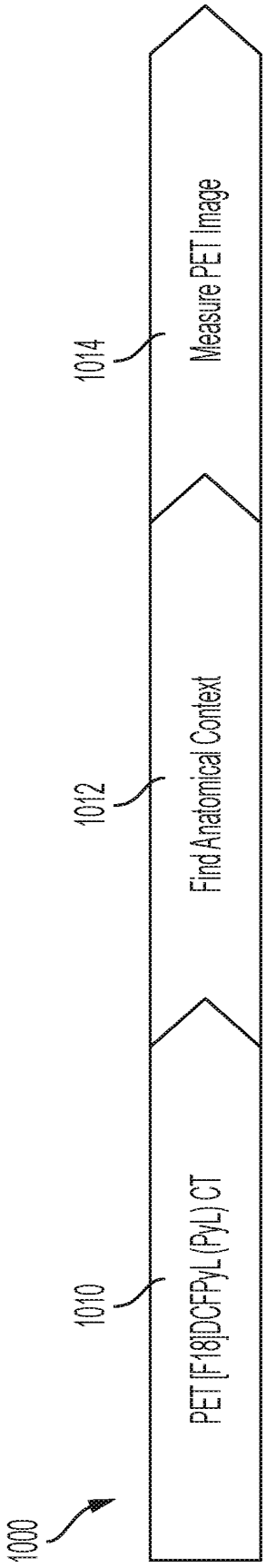


FIG. 10A

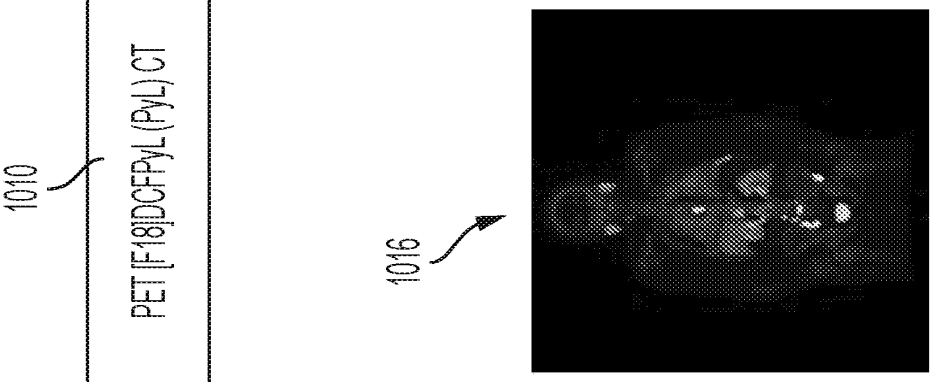


FIG. 10B

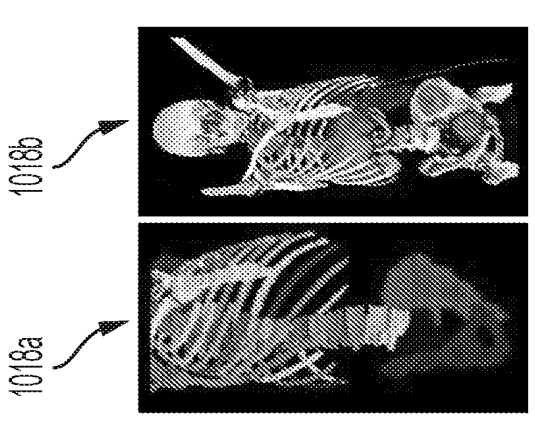


FIG. 10C

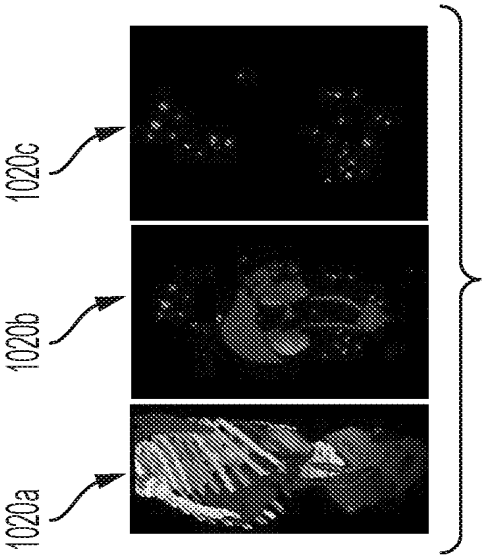


FIG. 10D

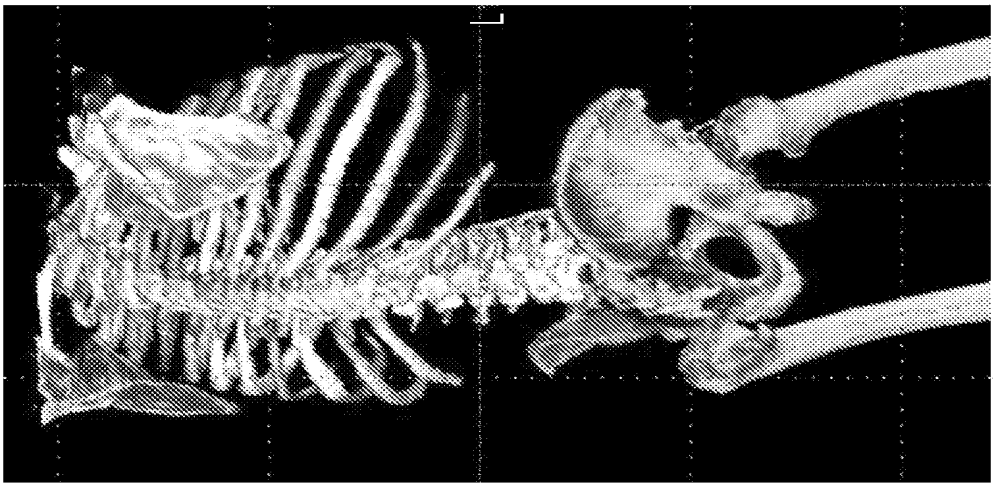


FIG. 11B

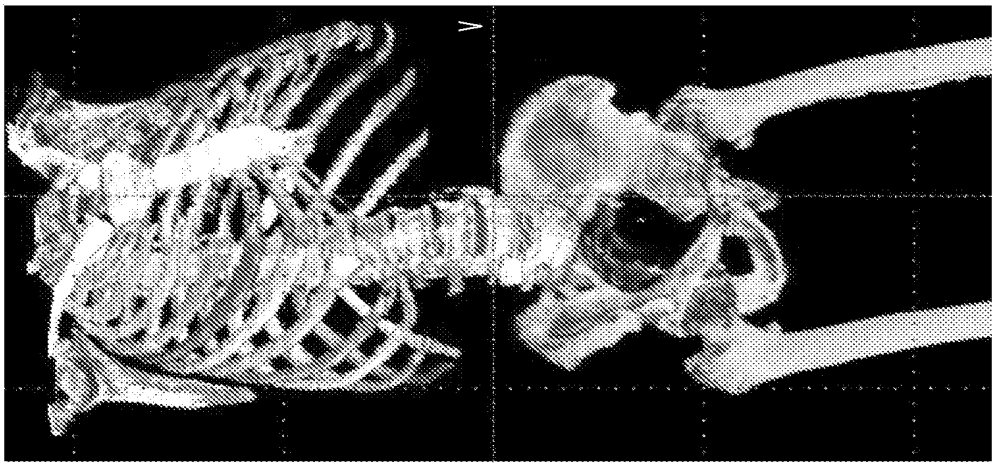


FIG. 11A

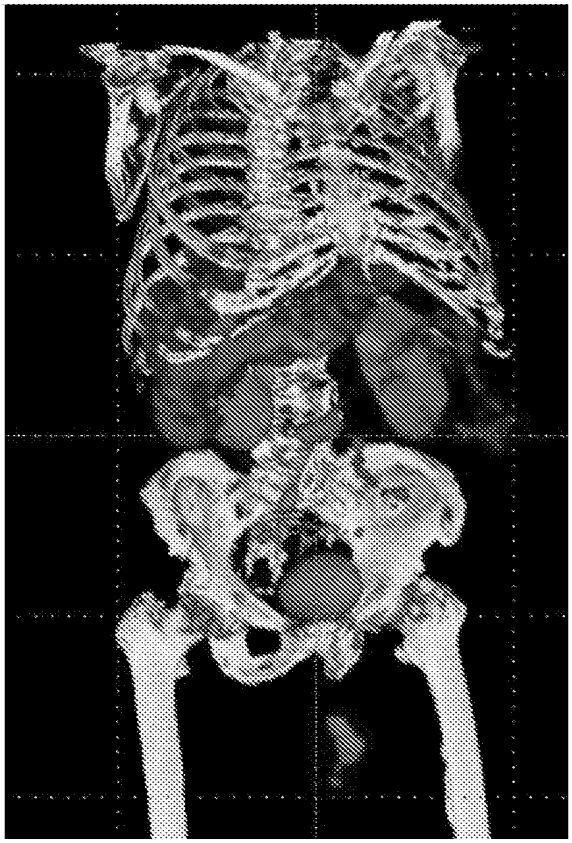


FIG. 12

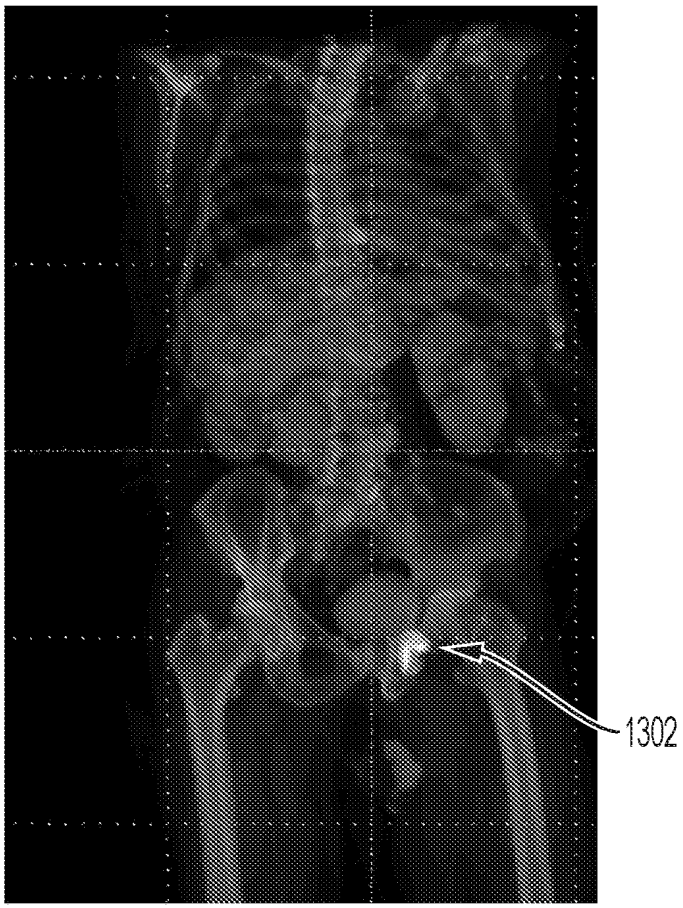


FIG. 13A

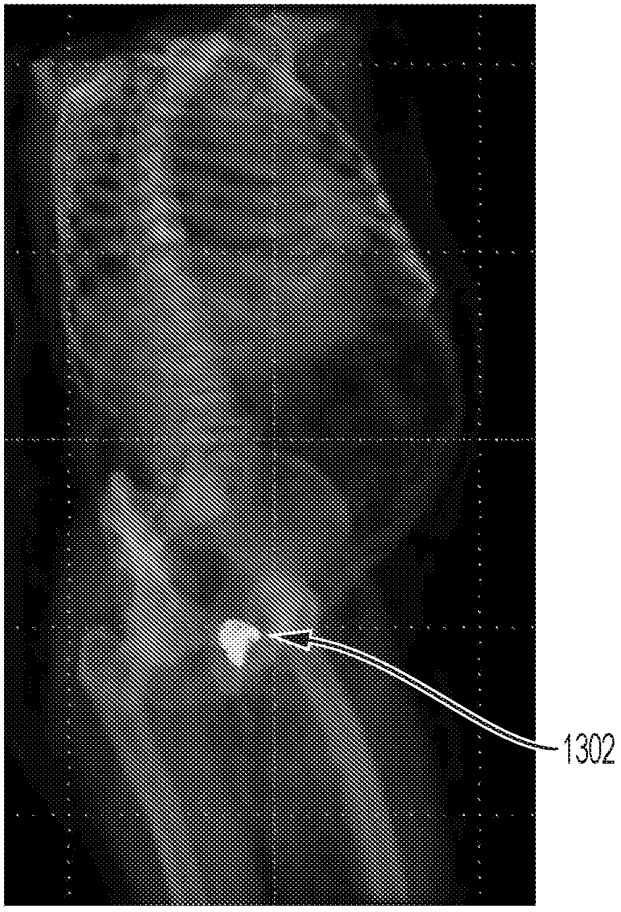


FIG. 13B

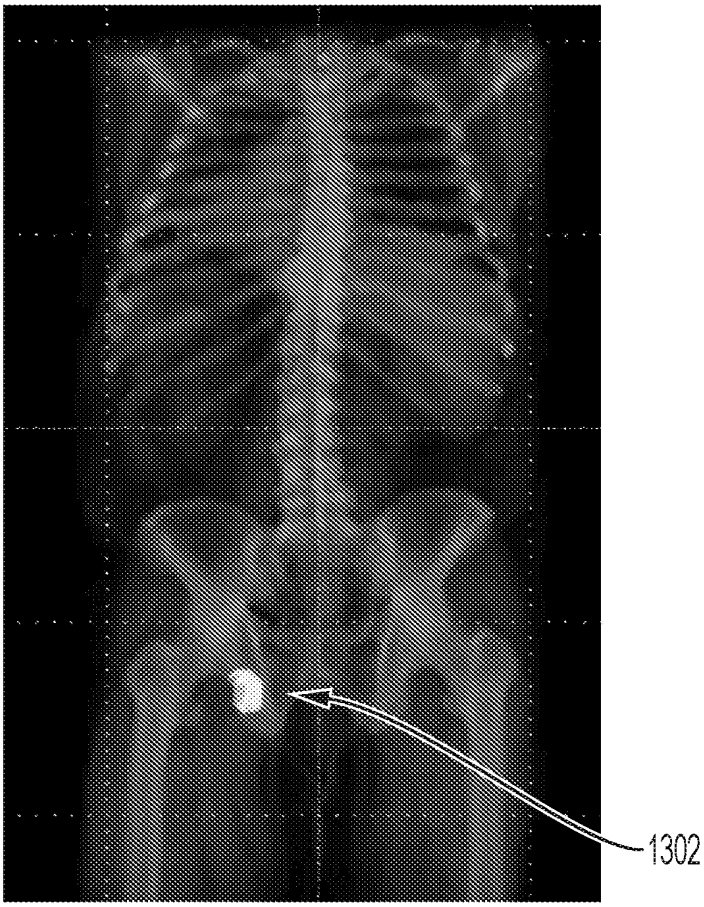


FIG. 13C

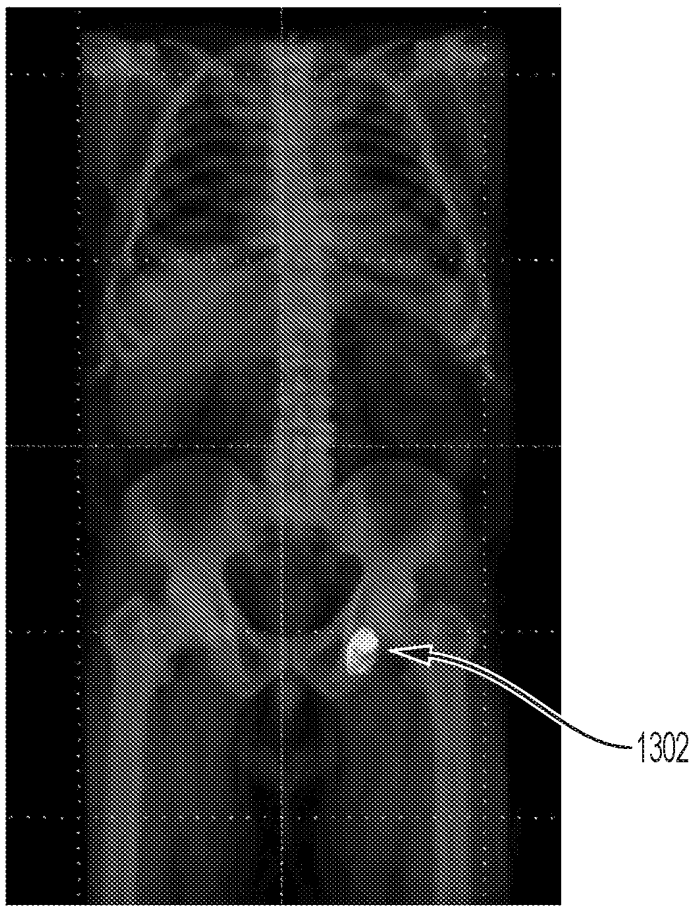


FIG. 13D

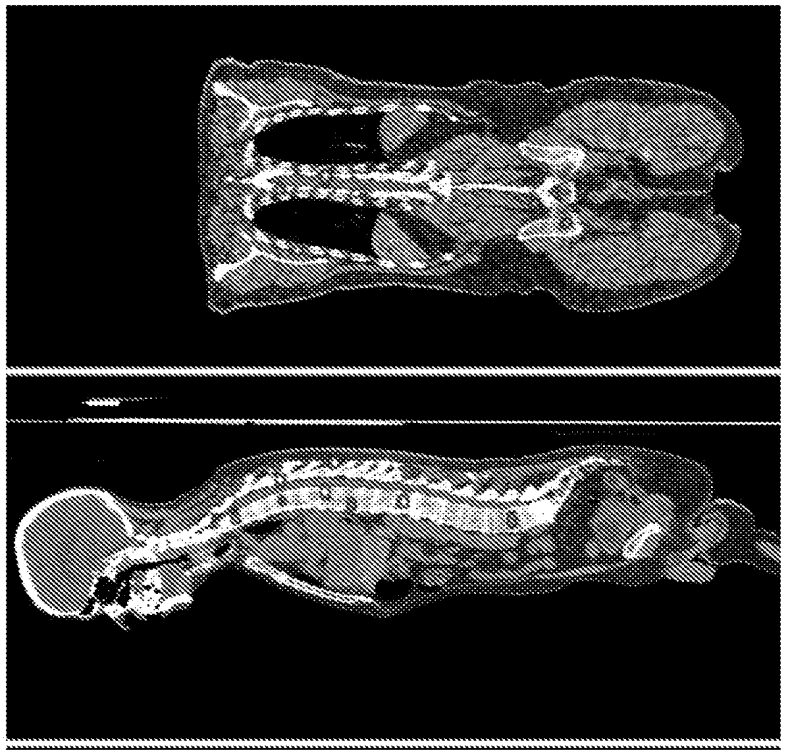


FIG. 14B

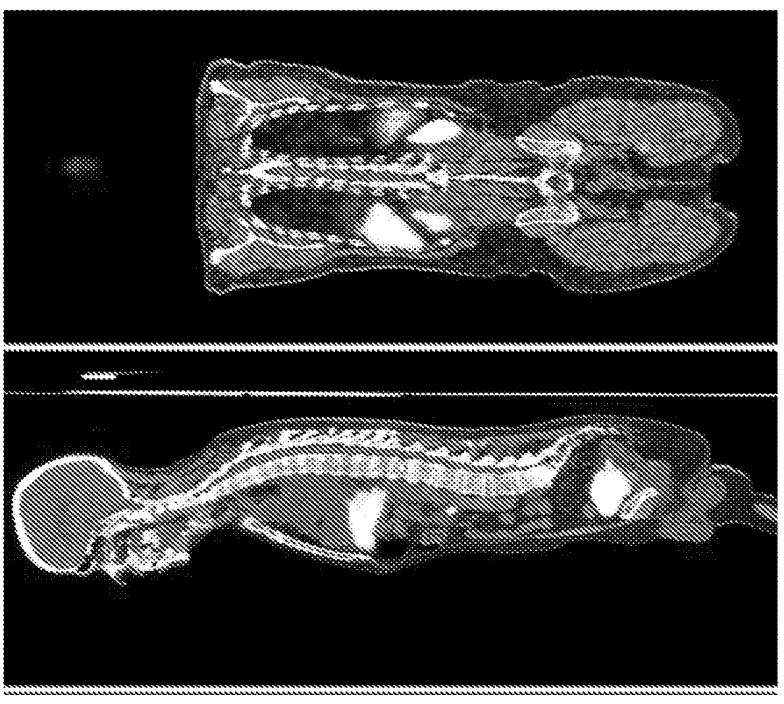


FIG. 14A



FIG. 15B

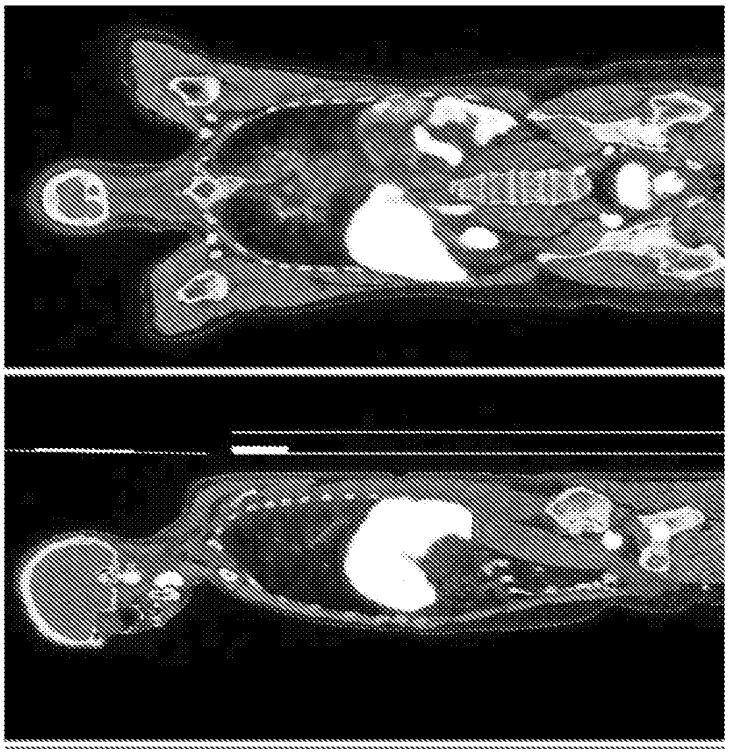


FIG. 15A

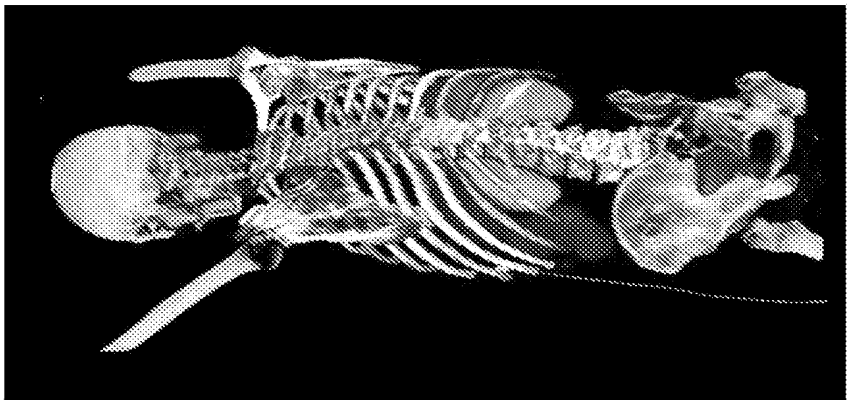


FIG. 16B



FIG. 16A

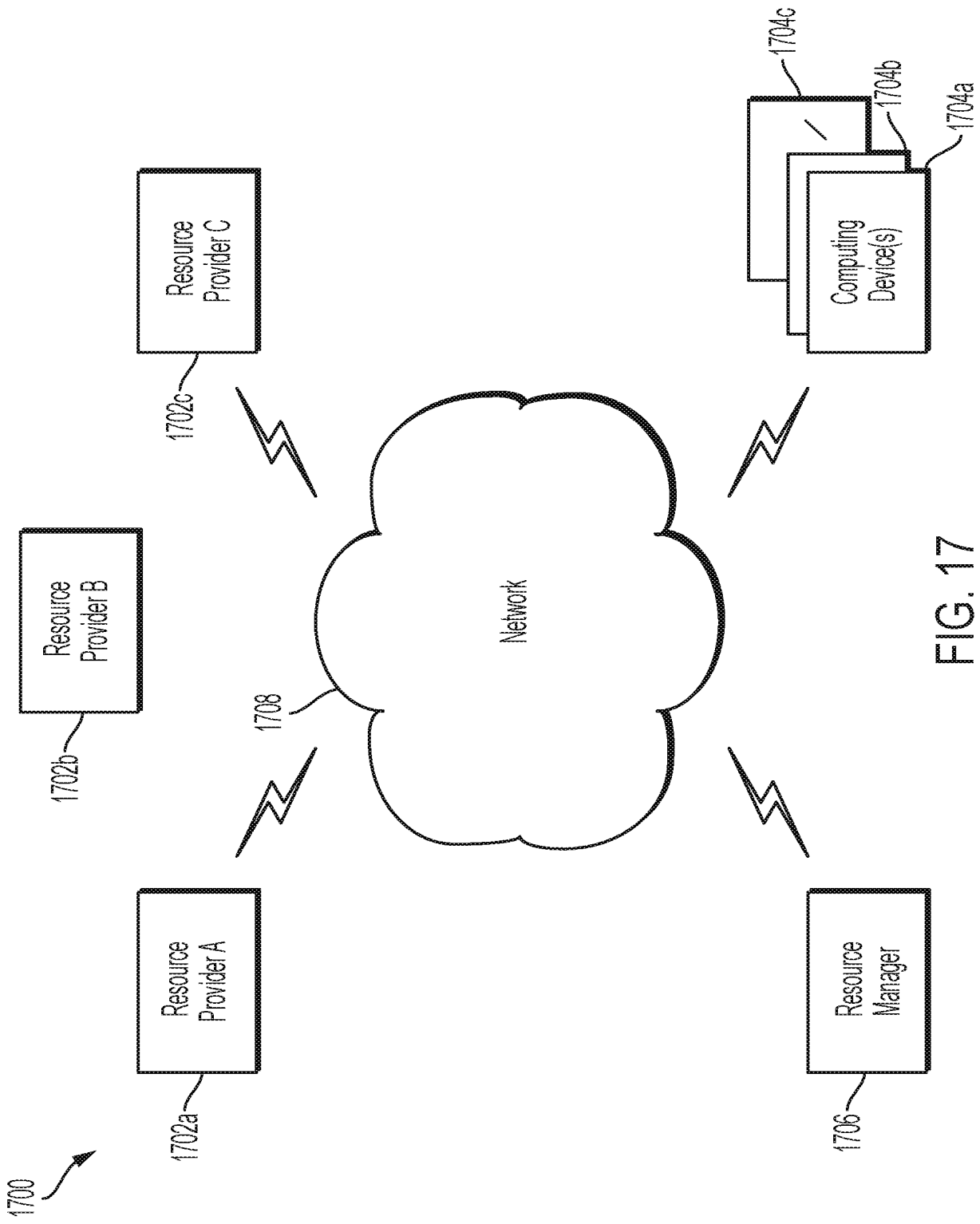

1700
Resource Provider A
1702a
Resource Provider B
1702b
Resource Provider C
1702c
Network
1708
Resource Manager
1706
Computing Device(s)
1704a
1704b
1704c

FIG. 17

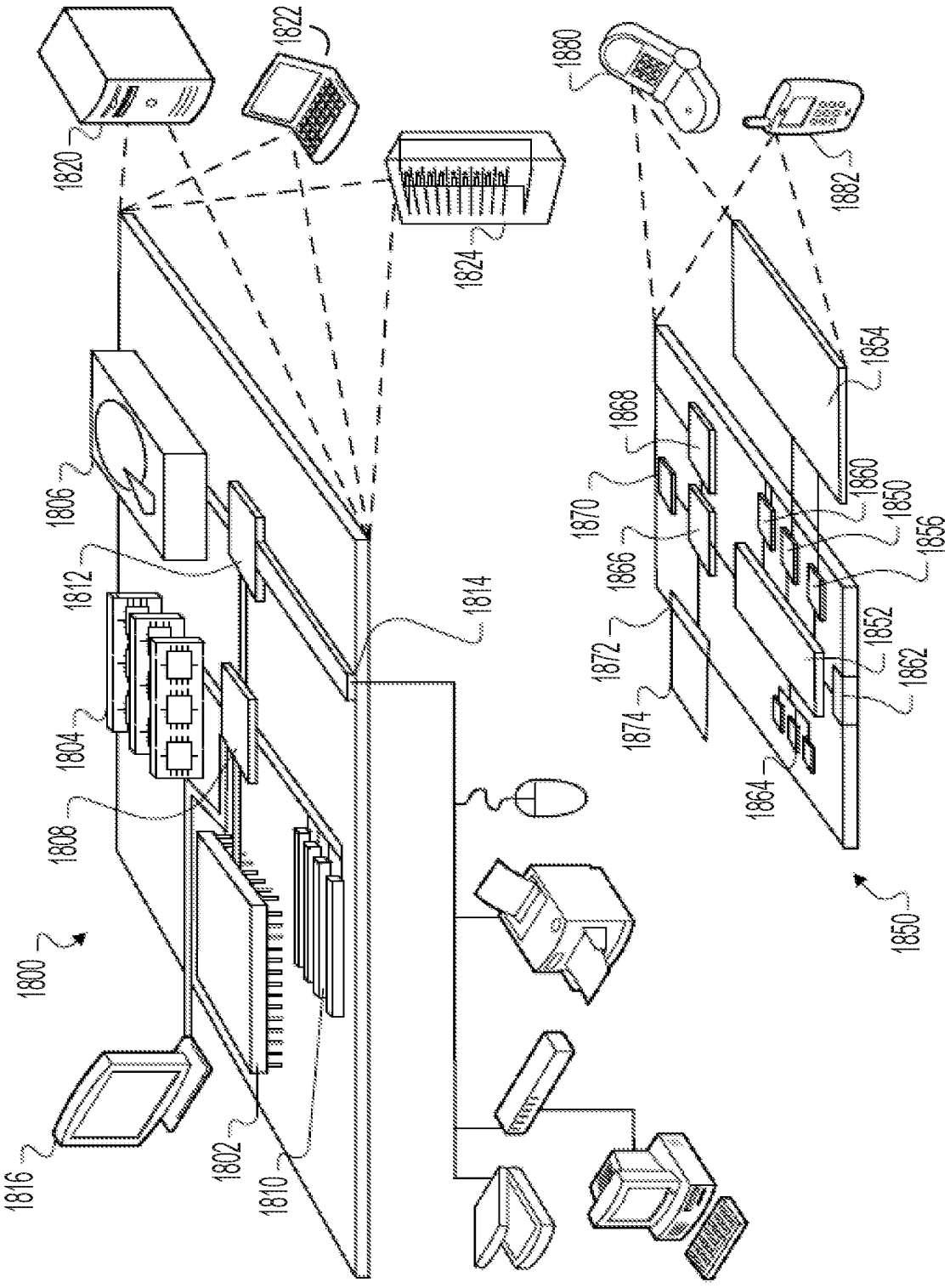

1800
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FIG. 18

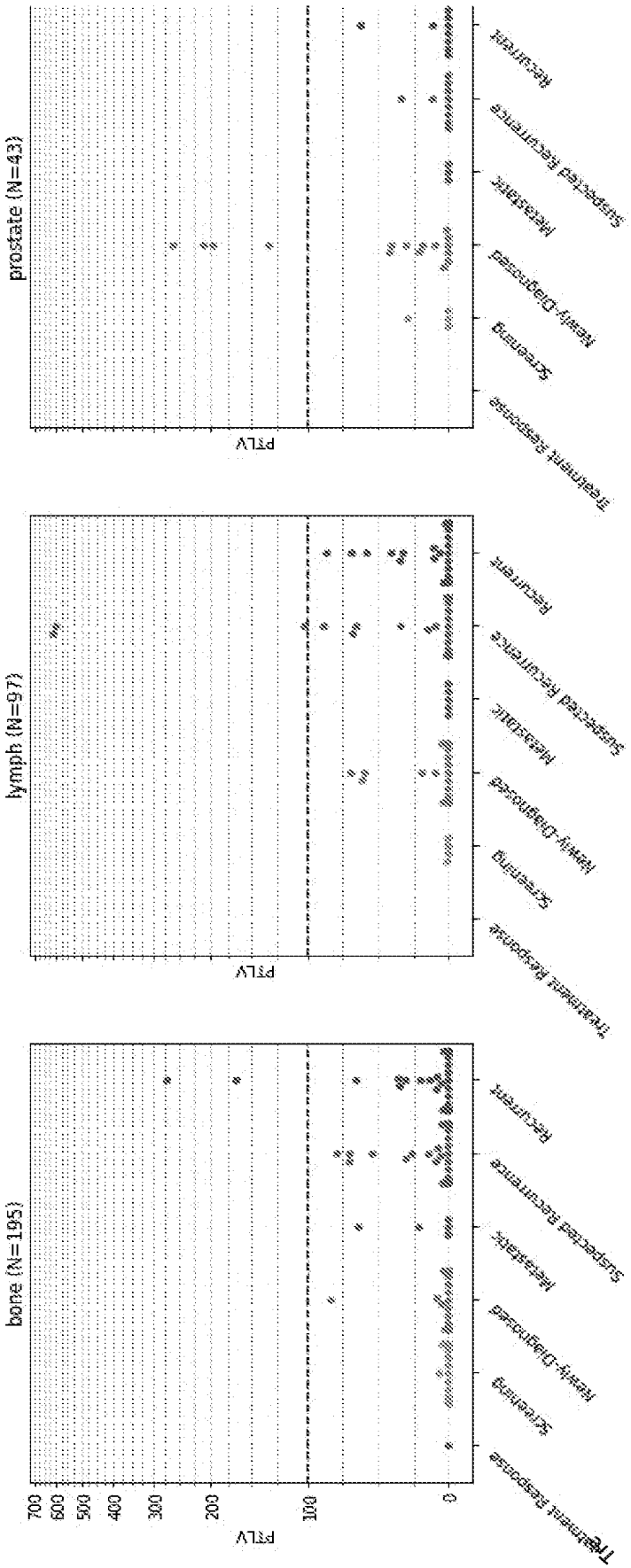

bone (N=195)
lymph (N=97)
prostate (N=43)
PSLV
700
600
500
400
300
200
100
0
Treatment Response
Screening
Newly-Diagnosed
Metastatic
Suspected Recurrence
Recurrent

FIG. 19

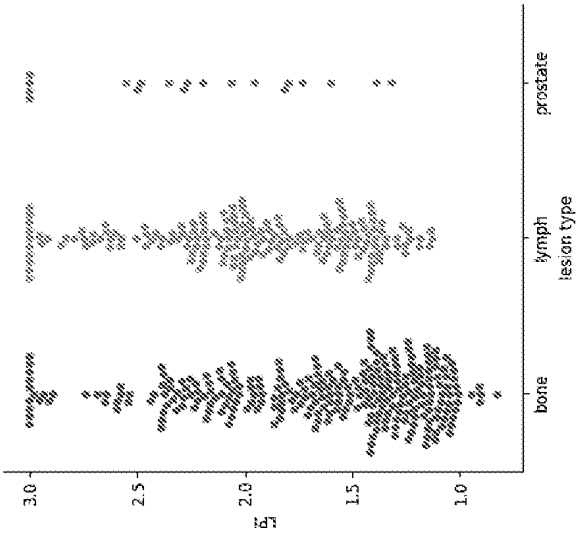

3.0
2.5
2.0
1.5
1.0
SUV
bone
lymph
prostate
lesion type

FIG. 20

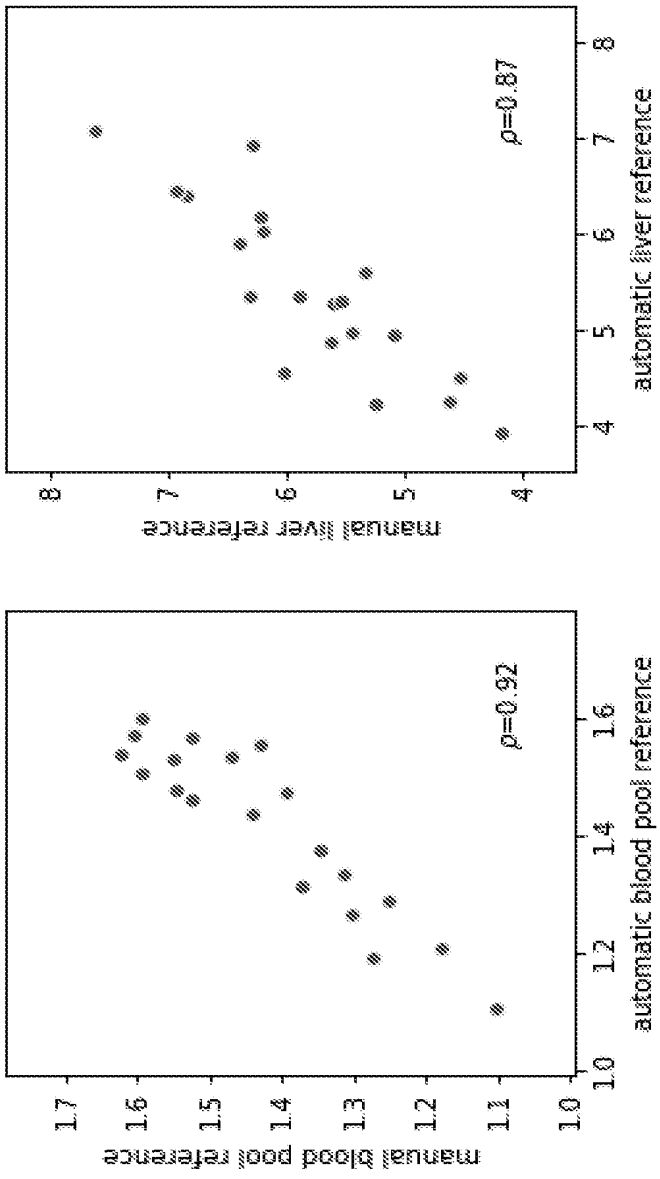

manual blood pool reference
automatic blood pool reference
ρ=0.92
manual liver reference
automatic liver reference
ρ=0.87

FIG. 21

COMBINED JOINT ASSIGNMENT & DECLARATION

A. ASSIGNMENT

WHEREAS, each of the below-named inventors whose name and residence is set forth in the following Table 1:

Inventor Name	City, State
1. Jens Filip Andreas Richter	Lund, Sweden
2. Kerstin Elsa Maria Johnsson	Lund, Sweden
3. Erik Konrad Gjertsson	Lund, Sweden
4. Aseem Undvall Anand	Queens, New York

Table 1

hereby declares and agrees, on behalf of himself/herself and all of his/her successors and assigns that each is aware of the patent application(s) entitled:

SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION; and

[ ] prepared for filing in the United States Patent and Trademark Office; or

[x] identified by United States Application No. 16/734599
filed in the United States Patent and Trademark Office on January 6, 2020; and

[x] identified by International Patent Application No. PCT/EP20/50132
filed on January 6, 2020; and

[x] and is also aware of the following priority applications:

Application No.	Filed
62/934,305	November 12, 2019
62/907,158	September 27, 2019
62/870,210	July 3, 2019
62/863,608	June 19, 2019
62/837,941	April 24, 2019
62/789,155	January 7, 2019

WHEREAS, **EXINI Diagnostics AB** (hereinafter "ASSIGNEE"), having a usual place of business at **Ideon Science Park, Scheelevägen 27, Gateway, SE-223 70 Lund, SWEDEN**, desires to acquire or confirm an interest therein;

NOW, THEREFORE, to all whom it may concern be it known that, in consideration of agreements previously and duly entered into between the parties, and/or for other good and valuable consideration, the receipt of which is hereby acknowledged, each of us hereby confirms, agrees, and/or declares that:

1. I have sold, assigned, and transferred and/or do hereby sell, assign, and transfer unto said ASSIGNEE, its successors, assigns, and legal representatives, my entire right, title, and interest in and throughout the United States of America, its territories and all foreign countries, in and to any and all inventions described in the patent application, and/or any priority applications noted above, including any right of priority thereto; and hereby confirm that my sale, assignment and transfer is and was effective at least as of the filing date of the patent application and/or priority application;

2. My sale, assignment and transfer applies to the above-referenced patent application, and to any application that is based in whole or in part on the patent application, including any divisional, continuing, substitute, renewal, reissue, reexamination and other applications, for example that claim priority to the patent application. Also, this sale, assignment and transfer pertains to any and all other rights arising under or pursuant to any and all international agreements, treaties, or laws relating to the protection of industrial property, including all rights of priority under the International Convention for the Protection of Industrial Property, and in and to any such patent(s) as may issue thereon including any and all original and reissued patents which have been or shall be issued in the United States and foreign countries; said inventions, applications, and patent(s) to be held and enjoyed by ASSIGNEE for its own use and for its successors, assigns and legal representatives, to the full end of the term for which said patent(s) may be granted as fully and entirely as the same would have been held by me had this sale, assignment and transfer not been made;

3. This Assignment, being of our entire right, title, and interest in and to the inventions, carries with it the right in ASSIGNEE, by attorneys and agents of ASSIGNEE selection, to apply for and receive any and all patent(s) for said inventions in its own name;

4. I, or my executor(s) and/or administrator(s) will execute upon request any other lawful documents and likewise will perform any other lawful acts which may be deemed necessary to secure fully the patent(s) to ASSIGNEE, its successors, assignees, and legal representatives, but at its expense and charges, including the execution of application for patents in foreign countries, the execution of substitution, reissue, divisional or continuation applications, and the giving of testimony, preliminary statements, or other statements in any interference or other proceeding in which the inventions or any applications or patents directed to the inventions may be involved by communicating to the ASSIGNEE all facts I know relating to the inventions and their history, and generally by doing everything possible which ASSIGNEE shall consider desirable for aiding in securing and maintaining proper patent protection for the inventions and for vesting title in the inventions and all applications for patent and all patents on the inventions in ASSIGNEE;

5. I hereby authorize ASSIGNEE or its attorneys or agents to insert the correct application number(s) and/or filing date(s) into this assignment document, if appropriate;

6. I hereby appoint ASSIGNEE as my common agent for purposes of prosecuting international patent applications and any national patent applications for which such common agency is recognized;

7. I hereby request the Commissioner for Patents of the United States Patent and Trademark Office to issue any and all patent(s) as shall be granted upon said application or applications based thereon to ASSIGNEE, its successors, assigns, and legal representatives;

8. I hereby covenant with said ASSIGNEE that no assignment, grant, mortgage, license, or other agreement affecting the rights and property herein conveyed has been made to others by me, and that full right to convey the same as herein expressed is possessed by me.

B. DECLARATION (37 CFR 1.63)

As a below named inventor, I hereby declare that:

This declaration is directed to the patent application entitled:

SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION; and

[ ] attached hereto or prepared for filing in the United States Patent and Trademark Office; or

[x] identified by United States Application No. 16/734599 filed in the United States Patent and Trademark Office on January 6, 2020; or

[ ] identified by International Patent Application No. _____ filed on _____.

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.

I have reviewed and understand the contents of the application, including the claims and am aware of the duty to disclose to the United States Patent and Trademark Office all information known to be material to patentability as defined in 37 CFR 1.56.

Signature: _____ Date: 2020-02-27

Jens Filip Andreas Richter

Witness Signature: _____

Witness Name (printed): _____

Witness Signature: _____

Witness Name (printed): _____

Signature: Kerstin Johnsson Date: 2012/2/27

Kerstin Elsa Maria Johnsson

Witness Signature: John Byl

Witness Name (printed): Johan Bryngelsson

Witness Signature: Hannele Sundstedt

Witness Name (printed): Hannele Sundstedt

Signature: _____ Date: 21-02-2022

Erik Konrad Gjertsson

Witness Signature: _____

Witness Name (printed): _____

Witness Signature: _____

Witness Name (printed): _____

Signature: _____ Date: 02/27/20
Aseem Undvall Anand

Witness Signature: _____

Witness Name (printed): Fredrik Lenberg

Witness Signature: _____

Witness Name (printed): MICHAEL KORER

The undersigned (whose title is supplied below) is authorized to act on behalf of **EXINI Diagnostics AB**.

Signature: _____ Date: 02/27/2020

Name (printed): Asseem Unkvall Anada

Title (printed): Vice President of Digital Technology

9575022v1

3010358-0164, -0165
EXI-008

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
18/127,991	03/29/2023	Jens Filip Andreas Richter	2010358-0284

CONFIRMATION NO. 4023

24280
CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

FORMALITIES LETTER

OC000000056410750

Date Mailed: 04/27/2023

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

An application number and filing date have been accorded to the above-identified nonprovisional application. The item(s) indicated below, however, are missing.

Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- Additional claim fees of $**13660** as an undiscounted 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.

SUMMARY OF FEES DUE:

The fee(s) required (including the fees noted above) are as follows. No entity status discount is in effect. If applicant is qualified for small entity status, a written assertion of small entity status must be submitted to establish small entity status. (See 37 CFR 1.27). If applicant is qualified for micro entity status, an acceptable Certification of Micro Entity Status must be submitted to establish micro entity status. (See 37 CFR 1.29 and forms PTO/SB/15A and 15B.)

- $**2400** for 5 independent claims over 3.
- $**10400** for 104 total claims over 20.
- $**860** for multiple dependent claim surcharge.
- $(**0**) previous unapplied payment amount.
- $**13660** TOTAL FEE BALANCE DUE.

Replies must be received in the USPTO within the set time period or must include a proper Certificate of Mailing or Transmission under 37 CFR 1.8 with a mailing or transmission date within the set time period. For more information and a suggested format, see Form PTO/SB/92 and MPEP 512.

Replies should be addressed to:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

REPLY VIA ELECTRONIC FILING

A reply may be submitted via electronic filing only by registered users of the appropriate USPTO patent electronic filing system and must include:

- A separate document having the document description, "**Applicant response to Pre-Exam Formalities Notice**"; and
- the item(s) for which a reply period is set forth above.

For more information about electronic filing, contact the Patent Electronic Business Center (EBC) 1-866-217-9197 or visit https://www.uspto.gov/ebc

NOTE: If the reply is not being submitted electronically, a copy of this notice must be included.

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**.

/gfrey/

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
18/127,991	03/29/2023		2240	2010358-0284	116	8

CONFIRMATION NO. 4023

FILING RECEIPT

24280
CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110



Date Mailed: 04/27/2023

Receipt is acknowledged of this non-provisional utility 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 FIRST INVENTOR, 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 corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction 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 provided that the request is grantable.

Inventor(s)

Jens Filip Andreas Richter, Lund, SWEDEN;
Kerstin Elsa Maria Johnsson, Lund, SWEDEN;
Erik Konrad Gjertsson, Lund, SWEDEN;
Aseem Undvall Anand, Queens, NY;

Applicant(s)

EXINI Diagnostics AB, Lund, SWEDEN;

Power of Attorney: The patent practitioners associated with Customer Number 24280

Domestic Priority data as claimed by applicant

This application is a DIV of 16/734,599 01/06/2020
which claims benefit of 62/934,305 11/12/2019
and claims benefit of 62/907,158 09/27/2019
and claims benefit of 62/870,210 07/03/2019
and claims benefit of 62/863,608 06/19/2019
and claims benefit of 62/837,941 04/24/2019
and claims benefit of 62/789,155 01/07/2019

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: 04/25/2023

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 18/127,991**

Projected Publication Date: 08/03/2023

Non-Publication Request: No

Early Publication Request: No

Title

SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION

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

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MULTIPLE DEPENDENT CLAIM FEE CALCULATION SHEET

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

Application Number	Filing Date
18/127,991	

Applicant(s) Jens Filip Andreas Richter

* 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)				
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32		(1)				
33		(1)				
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	Indep	Depend	Indep	Depend	Indep	Depend
51		(1)				
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56		(1)				
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99		(1)				
100		(1)				

MULTIPLE DEPENDENT CLAIM FEE CALCULATION SHEET

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

Application Number	Filing Date
18/127,991	

Applicant(s) Jens Filip Andreas Richter

* May be used for additional claims or amendments

CLAIMS	AS FILED		AFTER FIRST AMENDMENT		AFTER SECOND AMENDMENT	
	Indep	Depend	Indep	Depend	Indep	Depend
101		(1)				
102	1					
103		1				
104		2				
105		2				
106		(1)				
107		(1)				
108		(1)				
109		(1)				
110		(1)				
111	1					
112		1				
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114		(1)				
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Total Indep	8					
Total Depend	116	↵		↵		↵
Total Claims			0		0	

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	Indep	Depend	Indep	Depend	Indep	Depend
151						
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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 18/127,991

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	320
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	700
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	800
TOTAL CLAIMS (37 CFR 1.16(i))	124 minus 20 =	* 104			OR	x 100 =	10400
INDEPENDENT CLAIMS (37 CFR 1.16(h))	8 minus 3 =	* 5				x 480 =	2400
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).						420
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							860
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	5500

APPLICATION AS AMENDED - PART II

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

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

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

Docket No.: 2010358-0284
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
EXINI Diagnostics AB

Application No.: 18/127,991 Confirmation No.: 4023

Filed: March 29, 2023 Art Unit: 3793

For: SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION Examiner: Not Yet Assigned

PRELIMINARY AMENDMENT UNDER 37 C.F.R. § 1.115

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

Dear Commissioner:

INTRODUCTORY COMMENTS

Prior to examination on the merits, Applicant requests entry of this Preliminary Amendment in which:

- **Amendments to the Specification** begin on page **2** of this paper;
- **Amendments to the Claims** begin on page **3** of this paper; and
- **Remarks** begin on page **11** of this paper.

AMENDMENTS TO THE SPECIFICATION

Applicant respectfully requests amendment to the specification by the following change(s):

Please amend paragraph [0001] under the heading "Cross Reference to Related Applications" as follows:

[0001] This application is a divisional of U.S. Non-Provisional Application No. 16/734,599 (now U.S. Patent No. 11,657,508), filed January 6, 2020, which claims priority to and benefit of U.S. Provisional Application No. 62/789,155, filed January 07, 2019, U.S. Provisional Application No. 62/837,941, filed April 24, 2019, U.S. Provisional Application No. 62/863,608, filed June 19, 2019, U.S. Provisional Application No. 62/870,210, filed July 03, 2019, U.S. Provisional Application No. 62/907,158, filed September 27, 2019, U.S. Provisional Application No. 62/934,305, filed November 12, 2019, the content of each of which are hereby incorporated by reference in their entirety.

AMENDMENTS TO THE CLAIMS

The Listing of Claims presented below replaces all prior versions and listings of claims in the above-referenced application.

1 - 43. (Canceled)

44. (Original) A method for automatically processing 3D images to automatically identify cancerous lesions within a subject, the method comprising:

(a) receiving, by a processor of a computing device, a 3D anatomical image of a subject obtained using an anatomical imaging modality, wherein the 3D anatomical image comprises a graphical representation of tissue within the subject;

(b) automatically identifying, by the processor, using one or more machine learning modules, for each of a plurality of target tissue regions, a corresponding target volume of interest (VOI) within the 3D anatomical image;

(c) determining, by the processor, a 3D segmentation map representing a plurality of 3D segmentation masks, each 3D segmentation mask representing a particular identified target VOI;

(d) receiving, by the processor, a 3D functional image of the subject obtained using a functional imaging modality;

(e) identifying, within the 3D functional image, one or more 3D volume(s), each corresponding to an identified target VOI, using the 3D segmentation map; and

(f) automatically detecting, by the processor, within at least a portion of the one or more 3D volumes identified within the 3D functional image, one or more hotspots determined to represent lesions based on intensities of voxels within the 3D functional image.

45. (Original) The method of claim 44, comprising using, by the processor, the one or more detected hotspots to determine a cancer status for the subject.

46. (Currently Amended) The method of ~~either of~~ claim[[s]] 44[[or 45]], wherein the target tissue regions comprise one or more reference tissue regions and wherein the method comprises:

using the 3D segmentation map to identify, by the processor, within the 3D functional image, one or more 3D reference volume(s), each corresponding to a particular reference tissue region;

determining, by the processor, one or more reference intensity values, each associated with a particular 3D reference volume of the one or more 3D reference volume(s) and corresponding to a measure of intensity within the particular 3D reference volume;

determining, by the processor, one or more individual hotspot intensity values, each associated with a particular hotspot of at least a portion of the detected one or more hotspots and corresponding to a measure of intensity of the particular hotspot; and

determining, by the processor, one or more individual hotspot index values using the one or more individual hotspot intensity values and the one or more reference intensity values.

47. (Original) The method of claim 46, wherein the reference tissue regions comprise one or more members selected from the group consisting of: a liver, an aorta, and a parotid gland.

48. (Currently Amended) The method of ~~any one of~~ claim[[s]] 45[[to 47]], comprising, determining, by the processor, an overall index value indicative of a cancer status of the subject using at least a portion of the one or more hotspot index values.

49. (Original) The method of claim 48, wherein the overall index value is determined as a weighted sum of at least a portion of the individual hotspot index values.

50. (Currently Amended) The method of ~~any one of~~ claim[[s]] 44[[to 49]], wherein:

the 3D anatomical image is an *x*-ray computed tomography (CT) image, and

the 3D functional image is a 3D positron emission tomography (PET) image.

51. (Original) The method of claim 50, wherein the 3D PET image of the subject is obtained following administration to the subject of a radiopharmaceutical comprising a prostate-specific membrane antigen (PSMA) binding agent.

52. (Original) The method of claim 51, wherein the radiopharmaceutical comprises [^{18}F]DCFPyL.

53 - 101. (Canceled)

102. (Original) A system for automatically processing 3D images to automatically identify cancerous lesions within a subject, the system comprising:

a processor of a computing device; and

a memory having instructions stored thereon, wherein the instructions, when executed by the processor, cause the processor to:

(a) receive a 3D anatomical image of a subject obtained using an anatomical imaging modality, wherein the 3D anatomical image comprises a graphical representation of tissue within the subject;

(b) automatically identify, using one or more machine learning modules, for each of a plurality of target tissue regions, a corresponding target volume of interest (VOI) within the 3D anatomical image;

(c) determine a 3D segmentation map representing a plurality of 3D segmentation masks, each 3D segmentation mask representing a particular identified target VOI;

(d) receive a 3D functional image of the subject obtained using a functional imaging modality;

(e) identify, within the 3D functional image, one or more 3D volume(s), each corresponding to an identified target VOI, using the 3D segmentation map; and

(f) automatically detect, within at least a portion of the one or more 3D volumes identified within the 3D functional image, one or more hotspots determined to represent lesions based on intensities of voxels within the 3D functional image.

103. (Original) The system of claim 102, wherein the instructions cause the processor to use the one or more detected hotspots to determine a cancer status for the subject.

104. (Currently Amended) The system of ~~either of~~ claim[[s]] 102[[or 103]], wherein the target tissue regions comprise one or more reference tissue regions and wherein the instructions cause the processor to:

use the 3D segmentation map to identify, within the 3D functional image, one or more 3D reference volume(s), each corresponding to a particular reference tissue region;

determine one or more reference intensity values, each associated with a particular 3D reference volume of the one or more 3D reference volume(s) and corresponding to a measure of intensity within the particular 3D reference volume;

determine one or more individual hotspot intensity values, each associated with a particular hotspot of at least a portion of the detected one or more hotspots and corresponding to a measure of intensity of the particular hotspot; and

determine one or more individual hotspot index values using the one or more individual hotspot intensity values and the one or more reference intensity values.

105. (Original) The system of claim 104, wherein the reference tissue regions comprise one or more members selected from the group consisting of: a liver, an aorta, and a parotid gland.

106. (Currently Amended) The system of ~~any one of~~ claim[[s]] 103[[to 105]], wherein the instructions cause the processor to determine an overall index value indicative of a cancer status of the subject using at least a portion of the one or more hotspot index values.

107. (Original) The system of claim 106, wherein the overall index value is determined as a weighted sum of at least a portion of the individual hotspot index values.

108. (Currently Amended) The system of ~~any one of~~ claim[[s]] 102[[to 107]], wherein:

the 3D anatomical image is an *x*-ray computed tomography (CT) image, and

the 3D functional image is a 3D positron emission tomography (PET) image.

109. (Original) The system of claim 108, wherein the 3D PET image of the subject is obtained following administration to the subject of a radiopharmaceutical comprising a prostate-specific membrane antigen (PSMA) binding agent.

110. (Original) The system of claim 109, wherein the radiopharmaceutical comprises [^{18}F]DCFPyL.

111 - 116. (Canceled)

117. (New) The method of claim 44, wherein the target tissue regions comprise one or more background tissue regions and wherein the method comprises:

at step (e), using the 3D segmentation map to identify, within the 3D functional image, as at least a portion of the one or more 3D volumes, one or more 3D background tissue volume(s), each corresponding a particular background tissue region; and

excluding voxels of the 3D within the 3D background tissue from the voxels used to automatically detect the one or more hotspots at step (f).

118. (New) The method of claim 48, wherein:

the overall index value is associated with a particular target tissue region corresponding to a particular target VOI identified within the anatomical image; and

the overall index value is determined using hotspot index values of a subset of hotspots located within a particular 3D volume in the 3D functional image that corresponds to the particular identified target VOI.

119. (New) The method of claim 118, wherein the particular target tissue region is selected from the group consisting of: a skeletal region comprising one or more bones of the subject, a lymph region, and a prostate region.

120. (New) The method of claim 51, wherein the radiopharmaceutical comprises ^{68}Ga-PSMA-11.

121. (New) The method of claim 51, wherein the radiopharmaceutical comprises ^{68}Ga-PSMA-617.

122. (New) The method of claim 51, wherein the radiopharmaceutical comprises ^{68}Ga-PSMA-I&T.

123. (New) The method of claim 51, wherein the radiopharmaceutical comprises ^{18}F-PSMA-1007.

124. (New) The system of claim 102, wherein the target tissue regions comprise one or more background tissue regions and wherein the instructions cause the processor to:

at step (e), using the 3D segmentation map to identify, within the 3D functional image, as at least a portion of the one or more 3D volumes, one or more 3D background tissue volume(s), each corresponding a particular background tissue region; and

exclude voxels of the 3D within the 3D background tissue from the voxels used to automatically detect the one or more hotspots at step (f).

125. (New) The system of claim 106, wherein:

the overall index value is associated with a particular target tissue region corresponding to a particular target VOI identified within the anatomical image; and

the overall index value is determined using hotspot index values of a subset of hotspots located within a particular 3D volume in the 3D functional image that corresponds to the particular identified target VOI.

126. (New) The system of claim 124, wherein the particular target tissue region is selected from the group consisting of: a skeletal region comprising one or more bones of the subject, a lymph region, and a prostate region.

127. (New) The system of claim 109, wherein the radiopharmaceutical comprises ^{68}Ga-PSMA-11.

128. (New) The method of claim 109, wherein the radiopharmaceutical comprises ^{68}Ga-PSMA-617.

129. (New) The method of claim 109, wherein the radiopharmaceutical comprises ^{68}Ga-PSMA-I&T.

130. (New) The method of claim 109, wherein the radiopharmaceutical comprises ^{18}F-PSMA-1007.

REMARKS

Status of Claims

Prior to entry of this amendment, claims 1 – 116 were pending and under consideration. With entry of this Amendment, claims 46, 48, 50, 104, 106, and 108 are amended and claims 1 – 43, 53 – 101, and 111 - 116 are canceled without prejudice or disclaimer. New claims 117 – 130 are added. Support for the amendments and new claims may be found in the specification as filed, for example at original claims 22, 31, 32, 46, 48, 50, 104, 106, and 108, as well as at paragraphs [0034], [0050], [0051], [0099], [0108], [0109], and [0324] – [0327]. No new matter is added.

Accordingly, upon entry of this amendment, claims 44 – 52, 102 – 110, and 117 - 130 will be pending and under consideration. Applicant respectfully requests reconsideration and withdrawal of the rejections and allowance of the present application in view of the amendments and for at least the reasons that follow.

Amendment to the Specification

The specification has been amended to update the Cross-Reference to Related Applications paragraph. The amendment to the speciation are fully supported by the specification and drawings as originally filed. No new matter is added.

Conclusion

It is Applicant's believe that all of the claims are in condition for allowance. If, at any time, it appears that a phone discussion would be helpful, Applicant invites the Examiner to call the undersigned at (617) 248-4814, with any questions or to resolve any issues pertaining to the above-identified application in order to expedite prosecution of this case.

Dated: June 26, 2023

Respectfully submitted,

Electronic signature: /Ronen Adato/
Ronen Adato, PhD, JD
Registration No.: 76,341
CHOATE, HALL & STEWART LLP
Two International Place
Boston, Massachusetts 02110
(617) 248-4814
Attorney for Applicant

Docket No.: 2010358-0284
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
EXINI Diagnostics AB

Application No.: 18/127,991 Confirmation No.: 4023

Filed: March 29, 2023 Art Unit: 3793

For: SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION Examiner: Not Yet Assigned

INFORMATION DISCLOSURE STATEMENT

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

Dear Commissioner:

Pursuant to 37 C.F.R. § 1.56, 1.97 and 1.98, the attention of the Patent and Trademark Office is hereby directed to the references listed on the attached PTO/SB/08. It is respectfully requested that the information be expressly considered during the prosecution of this application, and that the references be made of record therein and appear among the "References Cited" on any patent to issue therefrom.

This Information Disclosure Statement is filed within three months of the U.S. filing date (37 C.F.R. § 1.97(b)(1)).

In accordance with 37 C.F.R. § 1.98(a)(2)(ii), Applicant has not submitted copies of U.S. patents and U.S. patent applications. Applicant submits herewith copies of foreign patents and non-patent literature in accordance with 37 C.F.R. § 1.98(a)(2).

The documents cited in the attached form PTO/SB/08 marked by an double asterisk (**) are not supplied because they were previously cited by or submitted to the Office in prior

application number 16/734,599 filed January 6, 2020 and relied upon in this application for an earlier filing date under 35 U.S.C. § 120.

In accordance with 37 C.F.R. § 1.97(g), the filing of this Information Disclosure Statement shall not be construed to mean that a search has been made or that no other material information as defined in 37 C.F.R. § 1.56(a) exists. In accordance with 37 C.F.R. § 1.97(h), the filing of this Information Disclosure Statement shall not be construed to be an admission that any patent, publication or other information referred to therein is "prior art" for this invention unless specifically designated as such.

It is submitted that the Information Disclosure Statement is in compliance with 37 C.F.R. § 1.98 and the Examiner is respectfully requested to consider the listed references.

Dated: June 26, 2023

Respectfully submitted,

Electronic signature: /Ronen Adato/
Ronen Adato, PhD, JD
Registration No.: 76,341
CHOATE, HALL & STEWART LLP
Two International Place
Boston, Massachusetts 02110
(617) 248-4814
Attorney for Applicant

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 12

Complete if Known	
Application Number	18/127,991
Filing Date	March 29, 2023
First Named Inventor	Jens Filip Andreas Richter
Art Unit	3793
Examiner Name	Not Yet Assigned
Attorney Docket Number	2010358-0284

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (*if known*)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Additional Information
	A1*	US-5,762,608-A	06-09-1998	Warne et al.	
	A2*	US-7,450,747-B2	11-11-2008	Jabri et al.	
	A3*	US-7,751,605-B2	07-06-2010	Gündel et al	
	A4*	US-7,935,055-B2	05-03-2011	Burckhardt	
	A5*	US-7,970,194-B2	06-28-2011	Kimura	
	A6*	US-8,199,985	06-12-2012	Jakobsson et al.	
	A7*	US-8,211,401	07-03-2012	Babich et al.	
	A8*	US-8,467,856-B2	06-18-2013	Renisch et al.	
	A9*	US-8,538,166	09-17-2013	Gordon et al.	
	A10*	US-8,705,887	04-22-2014	Ma et al.	
	A11*	US-8,778,305	07-15-2014	Pomper et al.	
	A12*	US-8,855,387-B2	10-07-2014	Hamadeh et al.	
	A13*	US-8,962,799	02-24-2015	Babich et al.	
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	A15*	US-9,466,133-B2	10-11-2016	Sowards-Emmerd et al.	Corresponds to CN103607954A.
	A16*	US-9,710,915-B2	07-18-2017	Firouzian et al.	
	A17*	US-9,721,340-B2	08-01-2017	Gillies et al.	
	A18*	US-10,058,393-B2	08-28-2018	Bonutti et al.	
	A19*	US-10,223,610-B1	03-05-2019	Akselrod-Ballin et al.	
	A20*	US-10,311,971-B2	06-04-2019	Opfer et al.	
	A21*	US-10,330,763-B2	06-25-2019	James et al.	
	A22*	US-10,339,653-B2	07-02-2019	Gillies et al.	
	A23*	US-10,340,044-B2	07-02-2019	Yao et al.	
	A24*	US-10,340,046	07-02-2019	Baker	
	A25*	US-10,492,723-B2	12-03-2019	Madabhushi et al.	
	A26*	US-10,600,184-B2	03-24-2020	Golden et al.	
	A27*	US-10,665,346-B2	05-26-2020	Baker	
	A28*	US-10,748,652-B2	08-18-2020	Yao et al.	
	A29*	US-10,762,993-B2	09-01-2020	Baker	
	A30*	US-10,818,386-B2	10-27-2020	Yao et al.	
	A31*	US-10,943,681-B2	03-09-2021	Yao et al.	
	A32*	US-10,973,486	04-13-2021	Sjostrand et al.	
	A33*	US-11,011,257-B2	05-18-2021	Lints et al.	
	A34*	US-11,321,844-B2	05-03-2022	Johnsson et al.	
	A35*	US-11,386,988-B2	07-12-2022	Johnsson et al.	
	A36*	US-11,424,035-B2	08-23-2022	Baker	
	A37*	US-11,534,125-B2	12-27-2022	Sjöstrand et al.	
	A38*	US-11,564,621-B2	01-31-2023	Anand et al.	
	A39*	US-11,657,508-B2	05-23-2023	Richter et al.	
	A40*	US-2003/0215120-A1	11-20-2003	Uppaluri et al.	
	A41*	US-2005/0281381-A1	12-22-2005	Guendel	
	A42*	US-2006/0062425-A1	03-23-2006	Shen et al.	
	A43*	US-2006/0064396-A1	03-23-2006	Wei et al.	
	A44*	US-2006/0078183-A1	04-13-2006	deCharms	
	A45*	US-2007/0081712-A1	04-12-2007	Huang et al.	

Examiner Signature		Date Considered	

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Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 2 of 12

Complete if Known	
Application Number	18/127,991
Filing Date	March 29, 2023
First Named Inventor	Jens Filip Andreas Richter
Art Unit	3793
Examiner Name	Not Yet Assigned
Attorney Docket Number	2010358-0284

	A46*	US-2007/0081713-A1	04-12-2007	Jerebko	
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Examiner Signature		Date Considered	

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				Application Number	18/127,991
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				First Named Inventor	Jens Filip Andreas Richter
				Art Unit	3793
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Examiner Name	Not Yet Assigned
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. * CITE NO.: Those application(s) which are marked with an single asterisk (*) next to the Cite No. are not supplied (under 37 CFR 1.98(a)(2)(iii)) because that application was filed after June 30, 2003 or is available in the IFW. ** CITE NO.: Those document(s) which are marked with an double asterisk (**) next to the Cite No. are not supplied because they were previously cited by or submitted to the Office in a prior application relied upon in this application for an earlier filing date under 35 U.S.C. 120. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

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NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	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, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
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Examiner Signature		Date Considered	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 10 of 12

Complete if Known	
Application Number	18/127,991
Filing Date	March 29, 2023
First Named Inventor	Jens Filip Andreas Richter
Art Unit	3793
Examiner Name	Not Yet Assigned
Attorney Docket Number	2010358-0284

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Examiner Signature		Date Considered	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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Sheet 11 of 12

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Filing Date	March 29, 2023
First Named Inventor	Jens Filip Andreas Richter
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Attorney Docket Number	2010358-0284

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Examiner Signature		Date Considered	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 12 of 12

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Filing Date	March 29, 2023
First Named Inventor	Jens Filip Andreas Richter
Art Unit	3793
Examiner Name	Not Yet Assigned
Attorney Docket Number	2010358-0284

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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1]Applicant's unique citation designation number (optional). [2]Applicant is to place a check mark here if English language Translation is attached.

Examiner Signature		Date Considered	

11484461

Electronic Patent Application Fee Transmittal

Application Number:	18127991
Filing Date:	29-Mar-2023
Title of Invention:	SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION
First Named Inventor/Applicant Name:	Jens Filip Andreas Richter
Filer:	Ronen Adato/Caroline Lawlor
Attorney Docket Number:	2010358-0284

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
CLAIMS IN EXCESS OF 20	1202	12	100	1200
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**1200**

Electronic Acknowledgement Receipt

EFS ID:	48204193
Application Number:	18127991
International Application Number:	
Confirmation Number:	4023
Title of Invention:	SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION
First Named Inventor/Applicant Name:	Jens Filip Andreas Richter
Customer Number:	24280
Filer:	Ronen Adato/Caroline Lawlor
Filer Authorized By:	Ronen Adato
Attorney Docket Number:	2010358-0284
Receipt Date:	26-JUN-2023
Filing Date:	29-MAR-2023
Time Stamp:	13:46:17
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1200
RAM confirmation Number	E20236PD48207433
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The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

MIM Ex1004

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Applicant Response to Pre-Exam Formalities Notice	2023-06-26_Response_to_NTFMP.PDF	18327 ba30aff6de8041c0c73fad5caad8fcf7937bdda5	no	2
Warnings:					
Information:					
2		2023-06-26_Preliminary_Amendment.PDF	45409 371bf8c41cbff023cb5de65bccd1a4bc56e9e88d	yes	12

Multipart Description/PDF files in .zip description

Document Description	Start	End
Preliminary Amendment	1	1
Specification	2	2
Claims	3	10
Applicant Arguments/Remarks Made in an Amendment	11	12

Warnings:					
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3	Transmittal Letter	Information_Disclosure_Statement.pdf	18842 0a818af99f11e50c5ee62b460713b54d89256b0a	no	2
Warnings:					
Information:					
4	Foreign Reference	2023-02-09_GB2457577A.pdf	521925 7a6af0bd9eb29006197bc602436859d2dbfa6348	no	14
Warnings:					
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5	Foreign Reference	JP2019521481A.PDF	1178041 69e92680a08db3393b1ae572165240cdf825b408	no	17
Warnings:					
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6	Foreign Reference	2023-01-13_JP2017067489A.pdf	838140 489f812550118745b031f0b97403271a9066b3df	no	58
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7	Foreign Reference	2023-02-17_WO2013126147A2.pdf	970167 d6b307c95662ce1297ea1df86947d28fa1f9534e	no	30
Warnings:					
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8	Foreign Reference	WO2022008374A1.PDF	5428850 0f4427199bf2632808e746ccd9945c048266ad26	no	277
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10	Non Patent Literature	GORTHI_ETAL_2009.PDF	15364859 c5b9572117b7055fd15ad512e1da7439e288be65	no	13
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12	Non Patent Literature	INOUE_2015.PDF	253679 c923a2167639e2fabf6eb187874eebfcc56fc8d2	no	4
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14	Non Patent Literature	KAWAKAMI_2013.PDF	2117167 b552c240e4ee3e00cb41872bfc4a4224a3036511	no	4
Warnings:					
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15	Non Patent Literature	KERTESZ_ETAL_2022_FP.PDF	9772540 ccd0b268aaf40a8b6e65b1a31c42055c796b5d91	no	17
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17	Non Patent Literature	KHURSHID_ETAL_2018.PDF	1386019 26243b539f714dc564a8bddb0081e85c842c52a2	no	10
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19	Non Patent Literature	NOGI_ETAL_2012.PDF	1068753 eee88b8cfec1b97f0f9cd5bd2fc268b89ae89612	no	3
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23	Non Patent Literature	SHI_ETAL_2022.PDF	5233389 2ca4f07fe54b94fafe10b9e99e827768e9e68d40	no	13
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24	Non Patent Literature	TENG_ETAL_2006.PDF	420876 7e568d17175d8046b611dfee2cfe521f95c96f8a	no	4
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25	Non Patent Literature	VALLADARES_ETAL_2022.PDF	2231366 1f35abea3821b2d7bbe66dd02444cd0bab1f0279	no	11
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26	Non Patent Literature	WASHINO_2007.PDF	957181 a2326d9a09ed26172ba14150e45b53804265d2de	no	9
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27	Information Disclosure Statement (IDS) Form (SB08)	IDS_Citation_by_Applicant_262_References.pdf	133095 8872706ab9cfb2d60218c379e63b25625ea80a7d	no	12
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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.

Docket No.: 2010358-0284
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
EXINI Diagnostics AB

Application No.: 18/127,991 Confirmation No.: 4023

Filed: March 29, 2023 Art Unit: 3793

For: SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION Examiner: Not Yet Assigned

RESPONSE TO NOTICE TO FILE MISSING PARTS OF APPLICATION

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

Dear Commissioner:

The present submission is responsive to the Notice to File Missing Parts of Provisional Application mailed in the above referenced application on April 27, 2023 ("Notice"). The initial deadline for responding to the Notice is June 27, 2023. Accordingly, Applicant respectfully submits that the Response is timely filed on June 26, 2023.

With this Response Applicant submits herewith a Preliminary Amendment and payment of excess claim fees due for twelve (12) total claims in excess of twenty (calculated after entry of the Preliminary Amendment submitted herewith).

Please charge our Credit Card in the amount of $1,200 covering the fees set forth in 37 C.F.R. § 1.16(i). It is Applicant's belief that all fees due in connection with this Response are being paid. If, however, Applicant's understanding is incorrect, the Director is hereby authorized to charge any deficiency in the fees necessary for the processing of this Response to our Deposit Account No. 03-1721, referencing order no. 2010358-0284. Applicant respectfully requests that a notice be issued explaining any such discrepancy.

Dated: June 26, 2023

Respectfully submitted,

Electronic signature: /Ronen Adato/
Ronen Adato, PhD, JD
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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
18/127,991	03/29/2023	3793	3440	2010358-0284	32	2

CONFIRMATION NO. 4023

UPDATED FILING RECEIPT

24280
CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

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Date Mailed: 06/30/2023

Receipt is acknowledged of this non-provisional utility 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 FIRST INVENTOR, 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 corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction 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 provided that the request is grantable.

Inventor(s)

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Kerstin Elsa Maria Johnsson, Lund, SWEDEN;
Erik Konrad Gjertsson, Lund, SWEDEN;
Aseem Undvall Anand, Queens, NY;

Applicant(s)

EXINI Diagnostics AB, Lund, SWEDEN;

Power of Attorney: The patent practitioners associated with Customer Number 24280

Domestic Priority data as claimed by applicant

This application is a DIV of 16/734,599 01/06/2020 PAT 11,657,508
which claims benefit of 62/934,305 11/12/2019
and claims benefit of 62/907,158 09/27/2019
and claims benefit of 62/870,210 07/03/2019
and claims benefit of 62/863,608 06/19/2019
and claims benefit of 62/837,941 04/24/2019
and claims benefit of 62/789,155 01/07/2019

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: 04/25/2023

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 18/127,991**

Projected Publication Date: 10/05/2023

Non-Publication Request: No

Early Publication Request: No

Title

SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION

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).

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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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.

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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).

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MULTIPLE DEPENDENT CLAIM FEE CALCULATION SHEET

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

Application Number	Filing Date
18/127,991	

Applicant(s) Jens Filip Andreas Richter

* 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)				
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12		(1)				
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16		(1)				
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41		(1)				
42		(1)				
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44	1		1			
45		1		1		
46		2		1		
47		2		1		
48		(1)		1		
49		(1)		1		
50		(1)		1		

	*		*		*	
	Indep	Depend	Indep	Depend	Indep	Depend
51		(1)		1		
52		(1)		1		
53	1					
54		1				
55		2				
56		(1)				
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99		(1)				
100		(1)				

MULTIPLE DEPENDENT CLAIM FEE CALCULATION SHEET

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

Application Number	Filing Date
18/127,991	

Applicant(s) Jens Filip Andreas Richter

* May be used for additional claims or amendments

CLAIMS	AS FILED		AFTER FIRST AMENDMENT		AFTER SECOND AMENDMENT	
	Indep	Depend	Indep	Depend	Indep	Depend
101		(1)				
102	1		1			
103		1		1		
104		2		1		
105		2		1		
106		(1)		1		
107		(1)		1		
108		(1)		1		
109		(1)		1		
110		(1)		1		
111	1					
112		1				
113		2				
114		(1)				
115		(1)				
116	1					
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118				1		
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Total Indep	8		2			
Total Depend	116	↵	30	↵		↵
Total Claims			0		0	

	*		*		*	
	Indep	Depend	Indep	Depend	Indep	Depend
151						
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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 18/127,991

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	320
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	700
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	800
TOTAL CLAIMS (37 CFR 1.16(i))	32 minus 20 =	* 12			OR	x 100 =	1200
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*				x =	0
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).						420
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	2240

APPLICATION AS AMENDED - PART II

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

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

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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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
18/127,991	03/29/2023	Jens Filip Andreas Richter	2010358-0284

CONFIRMATION NO. 4023

24280
CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

PUBLICATION NOTICE

OC000000062918768

Date Mailed: 10/05/2023

Title:SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION

Publication No.US-2023-0316530-A1
Publication Date:10/05/2023

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.

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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

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/127,991	Richter et al.
	Examiner	Art Unit
	JOSEPH M SANTOS RODRIGUEZ	3793

CPC - Searched*		
Symbol	Date	Examiner
G06T7/11	10/04/2023	

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
see search	10/04/2023	JS

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
G16H50	20	10/04/2023	JS

/JOSEPH M SANTOS RODRIGUEZ/ Primary Examiner, Art Unit 3793	

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/127,991	Richter et al.
	Examiner	**Art Unit**
	JOSEPH M SANTOS RODRIGUEZ	3793

CPC						
Symbol					**Type**	**Version**
G06T	/	7	/	11	F	2017-01-01
G16H	/	50	/	50	I	2018-01-01
G16H	/	30	/	20	I	2018-01-01
G16H	/	50	/	30	I	2018-01-01
G16H	/	50	/	20	I	2018-01-01
G16H	/	30	/	40	I	2018-01-01
A61B	/	6	/	032	I	2013-01-01
A61B	/	6	/	037	I	2013-01-01
A61B	/	6	/	463	I	2013-01-01
A61B	/	6	/	466	I	2013-01-01
A61B	/	6	/	481	I	2013-01-01
A61B	/	6	/	505	I	2013-01-01
A61B	/	6	/	507	I	2013-01-01
A61B	/	6	/	5205	I	2013-01-01
A61B	/	6	/	5241	I	2013-01-01
A61B	/	6	/	5247	I	2013-01-01
A61K	/	51	/	0455	I	2013-01-01
G06V	/	20	/	64	I	2022-01-01
G06V	/	20	/	695	I	2022-01-01
G06V	/	20	/	698	I	2022-01-01
G06V	/	30	/	2504	I	2022-01-01
G06F	/	18	/	214	I	2023-01-01
G06V	/	2201	/	031	A	2022-01-01
G06V	/	2201	/	033	A	2022-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	31	
/JOSEPH M SANTOS RODRIGUEZ/ Primary Examiner, Art Unit 3793	04 October 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	44	1

U.S. Patent and Trademark Office

Part of Paper No.: 20231004

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/127,991	Richter et al.
	Examiner	**Art Unit**
	JOSEPH M SANTOS RODRIGUEZ	3793

INTERNATIONAL CLASSIFICATION					
CLAIMED					
G06T	/	7	/	00	

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	31	
/JOSEPH M SANTOS RODRIGUEZ/ Primary Examiner, Art Unit 3793	04 October 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	44	1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/127,991	Richter et al.
	Examiner	**Art Unit**
	JOSEPH M SANTOS RODRIGUEZ	3793

☑ 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

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	31	
/JOSEPH M SANTOS RODRIGUEZ/ Primary Examiner, Art Unit 3793	04 October 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	44	1

Used in Lieu of PTO/SB/08A/B
(Based on PTO 10-07 version)

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 12

Complete if Known	
Application Number	18/127,991
Filing Date	March 29, 2023
First Named Inventor	Jens Filip Andreas Richter
Art Unit	3793
Examiner Name	Not Yet Assigned
Attorney Docket Number	2010358-0284

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (*if known*)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Additional Information
	A1*	US-5,762,608-A	06-09-1998	Warne et al.	
	A2*	US-7,450,747-B2	11-11-2008	Jabri et al.	
	A3*	US-7,751,605-B2	07-06-2010	Gündel et al	
	A4*	US-7,935,055-B2	05-03-2011	Burckhardt	
	A5*	US-7,970,194-B2	06-28-2011	Kimura	
	A6*	US-8,199,985	06-12-2012	Jakobsson et al.	
	A7*	US-8,211,401	07-03-2012	Babich et al.	
	A8*	US-8,467,856-B2	06-18-2013	Renisch et al.	
	A9*	US-8,538,166	09-17-2013	Gordon et al.	
	A10*	US-8,705,887	04-22-2014	Ma et al.	
	A11*	US-8,778,305	07-15-2014	Pomper et al.	
	A12*	US-8,855,387-B2	10-07-2014	Hamadeh et al.	
	A13*	US-8,962,799	02-24-2015	Babich et al.	
	A14*	US-9,002,081-B2	04-07-2015	Brown	
	A15*	US-9,466,133-B2	10-11-2016	Sowards-Emmerd et al.	Corresponds to CN103607954A.
	A16*	US-9,710,915-B2	07-18-2017	Firouzian et al.	
	A17*	US-9,721,340-B2	08-01-2017	Gillies et al.	
	A18*	US-10,058,393-B2	08-28-2018	Bonutti et al.	
	A19*	US-10,223,610-B1	03-05-2019	Akselrod-Ballin et al.	
	A20*	US-10,311,971-B2	06-04-2019	Opfer et al.	
	A21*	US-10,330,763-B2	06-25-2019	James et al.	
	A22*	US-10,339,653-B2	07-02-2019	Gillies et al.	
	A23*	US-10,340,044-B2	07-02-2019	Yao et al.	
	A24*	US-10,340,046	07-02-2019	Baker	
	A25*	US-10,492,723-B2	12-03-2019	Madabhushi et al.	
	A26*	US-10,600,184-B2	03-24-2020	Golden et al.	
	A27*	US-10,665,346-B2	05-26-2020	Baker	
	A28*	US-10,748,652-B2	08-18-2020	Yao et al.	
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. * CITE NO.: Those application(s) which are marked with an single asterisk (*) next to the Cite No. are not supplied (under 37 CFR 1.98(a)(2)(iii)) because that application was filed after June 30, 2003 or is available in the IFW. ** CITE NO.: Those document(s) which are marked with an double asterisk (**) next to the Cite No. are not supplied because they were previously cited by or submitted to the Office in a prior application relied upon in this application for an earlier filing date under 35 U.S.C. 120. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

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NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No.[1]	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, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
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				First Named Inventor	Jens Filip Andreas Richter
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PE2E SEARCH - Search History (Prior Art)

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			MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L10	17	("8538166" | "8705887" | "20060062425" | "20070081712").pn. OR ("8855387").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/01/28 12:01 PM
L11	35	(Artificial Intelligence) More like doc: US-8855387-B2 Text: (US-20130094704-A1 OR EP-2227784-B1 OR US-RE47609-E OR WO-2009084995-A1 OR EP-2227784-A1 OR US-9002081-B2 OR US-20140105471-A1 OR EP-2227784-A4 OR CA-3134745-A1 OR US-20220180487-A1 OR WO-2020219619-A1 OR AU-2020263381-A1 OR EP-3959683-A1 OR US-7295691-B2 OR JP-2022530040-A OR CN-113748443-A OR US-20030215120-A1 OR US-7397475-B2 OR JP-2014006130-A OR JP-2017198697-A).did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/01/28 12:01 PM
L12	693661	(G06T7/11 or A61B6/032 or A61B6/037 or A61B6/463 or A61B6/466 or A61B6/481 or A61B6/505 or A61B6/507 or A61B6/5205 or A61B6/5241 or A61B6/5247 or A61K51/0455 or G06F18/214 or G06V20/64 or G06V20/695 or G06V20/698 or G06V30/2504 or G16H30/20 or	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/01/28 01:06 PM

		G16H30/40 or G16H50/20 or G16H50/30 or G16H50/50 or G06V2201/031 or G06V2201/033 or G06T2207/10104 or G06T2207/10108 or G06T2207/20084).cpc.					
L13	263	((("RICHTER") near3 ("Jens")) OR (("JOHNSSON") near3 ("Kerstin")) OR (("GJERTSSON") near3 ("Erik")) OR (("ANAND") near3 ("Aseem"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/01/28 01:06 PM
L14	8349	uptak$3 near3 radio$	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/01/28 01:06 PM
L15	1307743	cancer$ OR tumor OR tuomor	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/01/28 01:06 PM
L16	278	hotspot near3 index	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/01/28 01:06 PM
L17	4	3 AND 4 AND 5	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/01/28 01:06 PM
L18	92	("7450747" | "7751605" | "7935055" | "7970194" | "8199985" | "8211401" | "8467856" | "8538166" | "8705887" | "8778305" | "8855387" | "8962799" | "9002081" | "9466133" | "9710915" | "9721340" | "10058393" | "10223610" | "10311971" | "10330763" | "10339653" | "10340044" | "10340046" | "RE47609" | "10492723" | "10600184" | "10665346" | "10748652" | "10762993" | "10818386" | "10943681" | "10973486" | "11011257" | "11321844" | "11386988" | "11424035" |	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/01/28 01:06 PM

		"20030215120" | "20050281381" | "20060062425" | "20060064396" | "20060078183" | "20070081712" | "20070081713" | "20070100225" | "20070115204" | "20080027315" | "20090309874" | "20100215581" | "20100266170" | "20100322488" | "20110063288" | "20110255763" | "20120123253" | "20130038707" | "20130094704" | "20130129168" | "20130211231" | "20130281841" | "20150110716" | "20150331995" | "20160203263" | "20160335395" | "20170083682" | "20180144828" | "20180259608" | "20180360402" | "20190038239" | "20190105009" | "20190209116" | "20190388049" | "20200027559" | "20200051238" | "20200074634" | "20200085382" | "20200126666" | "20200170604" | "20200193594" | "20200193603" | "20200245960" | "20200315455" | "20200342600" | "20200352518" | "20200357117" | "20200357118" | "20200357521" | "20210032206" | "20210082547" | "20210093249" | "20210183485" | "20210233633" | "20210334974" | "20210335480").pn. OR ("11534125").urpn. AND (PGPB | USPT |					

		USOC).dbnm.					
L19	32	(Artificial Intelligence) More like doc: US-11534125-B2 Text: (US-20200337658-A1 OR WO-2020219620-A1 OR CA-3136127-A1 OR AU-2020261370-A1 OR EP-3959684-A1 OR CN-113710159-A OR JP-2022530039-A OR TW-202105407-A OR EP-2227784-B1 OR US-RE47609-E OR US-8855387-B2 OR US-20130094704-A1 OR WO-2009084995-A1 OR EP-2227784-A1 OR US-20200245960-A1 OR CN-113272859-A OR TW-202040518-A OR JP-2022048246-A OR CA-3134745-A1 OR US-20210335480-A1).did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/01/28 01:06 PM
L20	11	"20130094704"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/01/28 01:06 PM
L21	17	("8538166" | "8705887" | "20060062425" | "20070081712").pn. OR ("8855387").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/01/28 01:06 PM
L22	35	(Artificial Intelligence) More like doc: US-8855387-B2 Text: (US-20130094704-A1 OR EP-2227784-B1 OR US-RE47609-E OR WO-2009084995-A1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV,	ADJ	ON	ON	2023/01/28 01:06 PM

		OR EP-2227784-A1 OR US-9002081-B2 OR US-20140105471-A1 OR EP-2227784-A4 OR CA-3134745-A1 OR US-20220180487-A1 OR WO-2020219619-A1 OR AU-2020263381-A1 OR EP-3959683-A1 OR US-7295691-B2 OR JP-2022530040-A OR CN-113748443-A OR US-20030215120-A1 OR US-7397475-B2 OR JP-2014006130-A OR JP-2017198697-A).did.	MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L23	1	20220079451a	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/02/02 11:34 AM
L24	6	"20220079451"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/02/02 11:34 AM
L25	0	"20140114187"7	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV,	ADJ	ON	ON	2023/02/02 11:44 AM

			MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L26	14	"20140114187"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/02/02 11:45 AM
L27	57761	third near3 optical near2 (fiber OR waveguide)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/02/02 11:56 AM
L28	784657	arrange$ near5 fibers	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/02/02 11:56 AM
L29	16408	27 AND 28	(US-PGPUB; USPAT;	ADJ	ON	ON	2023/02/02

			USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				11:56 AM
L30	292249	(center OR between) SAME 28	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/02/02 11:57 AM
L31	8459	27 AND 30	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/02/02 11:57 AM
L32	12	("6839496" | "7206259" | "20060018595" | "20060126435" | "20070123776" | "20070291275" | "20080043243" | "20080204859" | "20100087732").pn. OR ("9949717").urpn. AND (PGPB | USPT |	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/02/02 11:57 AM

		USOC).dbnm.					
L33	0	32 AND 31	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/02/02 11:58 AM
L34	47246	(A61B5/0095 OR A61B8/54 OR G01N21/1702 OR G02B6/02076 OR A61B6/5252 OR G02B2006/12097 OR G02B2006/12107 OR G02B2006/12138 OR A61B8/08 OR A61B8/4416 OR A61B8/4444 OR A61B8/4488 OR A61B8/4494 OR A61B6/502 OR A61B6/4417 OR A61B6/00 OR A61B8/4483 OR G03B42/06 OR A61B5/055 OR G02B6/122 OR G02B6/124).cpc.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/02/02 11:58 AM
L35	29	31 AND 34	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/02/02 11:58 AM
L36	1	"10670804".pn.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/02/02 12:01 PM
L37	106803	bundle near3 optical near2 (fiber OR waveguide)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/02/02 12:05 PM
L38	11491	ultraso$ AND 37	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH,	ADJ	ON	ON	2023/02/02 12:05 PM

			TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L39	1414	34 AND 38	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/02/02 12:05 PM
L40	1579	ultraso$ SAME 37	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/02/02 12:06 PM
L41	411	34 AND 40	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/02/02 12:06 PM
L42	104	34 AND 40	(US-PGPUB; USPAT; DERWENT)	ADJ	ON	ON	2023/02/02 12:06 PM
L43	836509	(G06T7/11 or A61B6/032 or	(US-PGPUB; USPAT; USOCR; FIT (AU, AP,	ADJ	ON	ON	2023/10/04 05:40 PM

		A61B6/037 or A61B6/463 or A61B6/466 or A61B6/481 or A61B6/505 or A61B6/507 or A61B6/5205 or A61B6/5241 or A61B6/5247 or A61K51/0455 or G06F18/214 or G06V20/64 or G06V20/695 or G06V20/698 or G06V30/2504 or G16H30/20 or G16H30/40 or G16H50/20 or G16H50/30 or G16H50/50 or G06V2201/031 or G06V2201/033 or G06T2207/10104 or G06T2207/10108 or G06T2207/20084).cpc.	AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L44	274	((("RICHTER") near3 ("Jens")) OR (("JOHNSSON") near3 ("Kerstin")) OR (("GJERTSSON") near3 ("Erik")) OR (("ANAND") near3 ("Aseem"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/10/04 05:40 PM
L45	8554	uptak$3 near3 radio$	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/10/04 05:40 PM
L46	1365613	cancer$ OR tumor OR tuomor	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/10/04 05:40 PM
L47	296	hotspot near3 index	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/10/04 05:40 PM
L48	8	3 AND 4 AND 5	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/10/04 05:40 PM
L49	93	("7450747" | "7751605" | "7935055" | "7970194" | "8199985" | "8211401" | "8467856" | "8538166" | "8705887" | "8778305" | "8855387" | "8962799" | "9002081" | "9466133" | "9710915" | "9721340" | "10058393" | "10223610" | "10311971" | "10330763" |	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/10/04 05:40 PM

		"10339653" | "10340044" | "10340046" | "RE47609" | "10492723" | "10600184" | "10665346" | "10748652" | "10762993" | "10818386" | "10943681" | "10973486" | "11011257" | "11321844" | "11386988" | "11424035" | "20030215120" | "20050281381" | "20060062425" | "20060064396" | "20060078183" | "20070081712" | "20070081713" | "20070100225" | "20070115204" | "20080027315" | "20090309874" | "20100215581" | "20100266170" | "20100322488" | "20110063288" | "20110255763" | "20120123253" | "20130038707" | "20130094704" | "20130129168" | "20130211231" | "20130281841" | "20150110716" | "20150331995" | "20160203263" | "20160335395" | "20170083682" | "20180144828" | "20180259608" | "20180360402" | "20190038239" | "20190105009" | "20190209116" | "20190388049" | "20200027559" | "20200051238" | "20200074634" | "20200085382" | "20200126666" | "20200170604" | "20200193594" | "20200193603" |				

		"20200245960" | "20200315455" | "20200342600" | "20200352518" | "20200357117" | "20200357118" | "20200357521" | "20210032206" | "20210082547" | "20210093249" | "20210183485" | "20210233633" | "20210334974" | "20210335480").pn. OR ("11534125").urpn. AND (PGPB | USPT | USOC).dbnm.					
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L51	14	"20130094704"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO;	ADJ	ON	ON	2023/10/04 05:40 PM

			JPO; DERWENT; IBM_TDB)				
L52	20	("8538166" | "8705887" | "20060062425" | "20070081712").pn. OR ("8855387").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/10/04 05:40 PM
L53	34	(Artificial Intelligence) More like doc: US-8855387-B2 Text: (US-20130094704-A1 OR EP-2227784-B1 OR US-RE47609-E OR WO-2009084995-A1 OR EP-2227784-A1 OR AU-2020261370-A1 OR CA-3136127-A1 OR JP-2022530039-A OR EP-3959684-A1 OR CN-113710159-A OR CN-110443792-A OR EP-2227784-A4 OR JP-2001511372-A OR CA-3134745-A1 OR US-20220180487-A1 OR WO-2020219619-A1 OR EP-3959683-A1 OR AU-2020263381-A1 OR EP-0993269-A2 OR JP-2022530040-A).did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L54	836509	(G06T7/11 or A61B6/032 or A61B6/037 or A61B6/463 or A61B6/466 or A61B6/481 or A61B6/505 or A61B6/507 or A61B6/5205 or A61B6/5241 or A61B6/5247 or A61K51/0455 or G06F18/214 or G06V20/64 or G06V20/695 or G06V20/698 or G06V30/2504 or G16H30/20 or G16H30/40 or G16H50/20 or G16H50/30 or G16H50/50 or G06V2201/031 or G06V2201/033 or G06T2207/10104 or	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM

		G06T2207/10108 or G06T2207/20084).cpc.					
L55	274	((("RICHTER") near3 ("Jens")) OR (("JOHNSSON") near3 ("Kerstin")) OR (("GJERTSSON") near3 ("Erik")) OR (("ANAND") near3 ("Aseem"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/10/04 05:40 PM
L56	8554	uptak$3 near3 radio$	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/10/04 05:40 PM
L57	1365613	cancer$ OR tumor OR tuomor	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/10/04 05:40 PM
L58	296	hotspot near3 index	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/10/04 05:40 PM
L59	8	3 AND 4 AND 5	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/10/04 05:40 PM
L60	93	("7450747" | "7751605" | "7935055" | "7970194" | "8199985" | "8211401" | "8467856" | "8538166" | "8705887" | "8778305" | "8855387" | "8962799" | "9002081" | "9466133" | "9710915" | "9721340" | "10058393" | "10223610" | "10311971" | "10330763" | "10339653" | "10340044" | "10340046" | "RE47609" | "10492723" | "10600184" | "10665346" | "10748652" | "10762993" | "10818386" | "10943681" | "10973486" | "11011257" | "11321844" | "11386988" | "11424035" | "20030215120" | "20050281381" | "20060062425" | "20060064396" | "20060078183" | "20070081712" | "20070081713" |	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/10/04 05:40 PM

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		OR WO-2020219620-A1 OR CA-3136127-A1 OR AU-2020261370-A1 OR EP-3959684-A1 OR US-20230148980-A1 OR CN-113710159-A OR JP-2022530039-A OR TW-202105407-A OR JP-WO2020219620-A5 OR EP-2227784-A1 OR CN-113272859-A OR US-20220005586-A1 OR US-11721428-B2 OR TW-202040518-A OR US-20210335480-A1 OR US-11386988-B2 OR US-10973486-B2 OR US-11321844-B2 OR US-20210334974-A1).did.	HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L62	14	"20130094704"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L63	20	("8538166" | "8705887" | "20060062425" | "20070081712").pn. OR ("8855387").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/10/04 05:40 PM
L64	34	(Artificial Intelligence) More like doc: US-8855387-B2 Text: (US-20130094704-A1 OR EP-2227784-B1 OR US-RE47609-E OR WO-2009084995-A1 OR EP-2227784-A1 OR AU-2020261370-A1 OR CA-3136127-A1 OR JP-2022530039-A OR EP-3959684-A1 OR CN-113710159-A OR CN-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO;	ADJ	ON	ON	2023/10/04 05:40 PM

		110443792-A OR EP-2227784-A4 OR JP-2001511372-A OR CA-3134745-A1 OR US-20220180487-A1 OR WO-2020219619-A1 OR EP-3959683-A1 OR AU-2020263381-A1 OR EP-0993269-A2 OR JP-2022530040-A).did.	JPO; DERWENT; IBM_TDB)				
L65	1	20220079451a	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L66	6	"20220079451"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L67	0	"20140114187"7	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT;	ADJ	ON	ON	2023/10/04 05:40 PM

			IBM_TDB)				
L68	15	"20140114187"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L69	60332	third near3 optical near2 (fiber OR waveguide)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L70	809903	arrange$ near5 fibers	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L71	17138	27 AND 28	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV,	ADJ	ON	ON	2023/10/04 05:40 PM

			MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L72	301093	(center OR between) SAME 28	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L73	8836	27 AND 30	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
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L75	0	32 AND 31	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/10/04 05:40 PM
L76	49479	(A61B5/0095 OR A61B8/54 OR G01N21/1702 OR	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/10/04 05:40 PM

		G02B6/02076 OR A61B6/5252 OR G02B2006/12097 OR G02B2006/12107 OR G02B2006/12138 OR A61B8/08 OR A61B8/4416 OR A61B8/4444 OR A61B8/4488 OR A61B8/4494 OR A61B6/502 OR A61B6/4417 OR A61B6/00 OR A61B8/4483 OR G03B42/06 OR A61B5/055 OR G02B6/122 OR G02B6/124).cpc.					
L77	29	31 AND 34	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/10/04 05:40 PM
L78	1	"10670804".pn.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/10/04 05:40 PM
L79	109695	bundle near3 optical near2 (fiber OR waveguide)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L80	11914	ultraso$ AND 37	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L81	1472	34 AND 38	(US-PGPUB; USPAT; USOCR; FIT (AP, AT,	ADJ	ON	ON	2023/10/04 05:40 PM

			AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L82	1629	ultraso$ SAME 37	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L83	436	34 AND 40	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L84	113	34 AND 40	(US-PGPUB; USPAT; DERWENT)	ADJ	ON	ON	2023/10/04 05:40 PM

PE2E SEARCH - Search History (Interference)

There are no Interference searches to show.

Bibliographic Data

Application No: 18/127,991

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /JOSEPH M SANTOS RODRIGUEZ/ (Examiner's Signature) /J.S./ (Initials)

Title: SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
03/29/2023	600	3793	2010358-0284
RULE			

APPLICANTS

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Erik Konrad Gjertsson, Lund, SWEDEN

Aseem Undvall Anand, Queens, NY, UNITED STATES

CONTINUING DATA

This application is a DIV of 16734599 01/06/2020 PAT 11657508

16734599 has PRO of 62934305 11/12/2019

16734599 has PRO of 62907158 09/27/2019

16734599 has PRO of 62870210 07/03/2019

16734599 has PRO of 62863608 06/19/2019

16734599 has PRO of 62837941 04/24/2019

16734599 has PRO of 62789155 01/07/2019

FOREIGN APPLICATIONS

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NOTICE OF ALLOWANCE AND FEE(S) DUE

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EXAMINER
SANTOS RODRIGUEZ, JOSEPH M

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/127,991	03/29/2023	Jens Filip Andreas Richter	2010358-0284	4023

TITLE OF INVENTION: SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	01/16/2024

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 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted 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. 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 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. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

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

24280 7590 10/13/2023
CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

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.
18/127,991	03/29/2023	Jens Filip Andreas Richter	2010358-0284	4023

TITLE OF INVENTION: SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	01/16/2024

EXAMINER	ART UNIT	CLASS-SUBCLASS
SANTOS RODRIGUEZ, JOSEPH M	3793	600-425000

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/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

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

1 _____
2 _____
3 _____

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

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document 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)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via Patent Center or 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

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

❑ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

❑ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

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

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

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.
18/127,991	03/29/2023	Jens Filip Andreas Richter	2010358-0284	4023

24280 7590 10/13/2023

CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

EXAMINER	
SANTOS RODRIGUEZ, JOSEPH M	
ART UNIT	PAPER NUMBER
3793	

DATE MAILED: 10/13/2023

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. 18/127,991	Applicant(s) Richter et al.	
	Examiner JOSEPH M SANTOS RODRIGUEZ	Art Unit 3793	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 the claims filed 06/26/2023.
   ☐ 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 See Continuation Sheet . 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 _____.

/JOSEPH M SANTOS RODRIGUEZ/
Primary Examiner, Art Unit 3793

Continuation of 3. The allowed claim(s) is/are: 44-52,102-110 and 117-130

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.

EXAMINER'S COMMENTS

1. Claims 44-52, 102-110, 117-130 are allowed.

Allowable subject matter:

The closes prior art is **Hamadeh et al. (US 8,855,387)** which An aspect of the present invention relates to a detection system for automatic detection of bone cancer metastases from a set of isotope bone scan images of a patients skeleton, the system comprising a shape identifier unit for identifying anatomical structures of the skeleton pictured in the set of bone scan images, forming an annotated set of images, a hotspot detection unit for detecting areas of high intensity in the annotated set of images based on information from the shape identifier regarding the anatomical structures corresponding to different portions of the skeleton of the images, a hotspot feature extraction unit for extracting a set of hotspot features for each hot spot detected by the hotspot detection unit ,a first artificial neural network unit arranged to calculate a likelihood for each hot spot of the hotspot set being a metastasis based on the set of hotspot features extracted by the hotspot feature extraction unit, a patient feature extraction unit arranged to extract a set of patient features based on the hotspots

detected by the hotspot detection unit and on the likelihood outputs from the first artificial neural network unit, and a second artificial neural network unit arranged to calculate a likelihood that the patient has one or more cancer metastases, based on the set of patient features extracted by the patient feature extraction unit.

However Hameda **fails to teach** a cancerous lesion automatically identification method for (d) receiving, by the processor, a 3D functional image of the subject obtained using a functional imaging modality; (e) identifying, within the 3D functional image, one or more 3D volume(s), each corresponding to an identified target VOI, using the 3D segmentation map; and(f) automatically detecting, by the processor, within at least a portion of the one or more 3D volumes identified within the 3D functional image, one or more hotspots determined to represent lesions based on intensities of voxels within the 3D functional image

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOSEPH M SANTOS RODRIGUEZ whose telephone number is (571)270-7782. The examiner can normally be reached Monday-Friday 8:30am to 5:30pm.

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, Ashley Buran can be reached on 571-270-5284. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/JOSEPH M SANTOS RODRIGUEZ/
Primary Examiner, Art Unit 3793

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.
18/127,991	03/29 2023	Jens Filip Andreas Richter	2010358-0284	4023

24280 7590 10/25/2023
CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

EXAMINER	
SANTOS RODRIGUEZ, JOSEPH M	

ART UNIT	PAPER NUMBER
3793	

NOTIFICATION DATE	DELIVERY MODE
10/25/2023	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):

choatepatentdepartment@choate.com
patentdocket@choate.com

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

Application No. : 18127991
Applicant : Richter
Filing Date : 03/29/2023
Date Mailed : 10/25/2023

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Notice of Allowance Mailed

This application has been accorded an Allowance Date and is being prepared for issuance. The application, however, is incomplete for the reasons below.

Applicant is given two (2) months from the mail date of this Notice within which to respond. This time period for reply is extendable under 37 CFR 1.136(a) for only TWO additional MONTHS.

The informalities requiring correction are indicated in the attachment(s). If the informality pertains to the abstract, specification (including claims) or drawings, the informality must be corrected with an amendment in compliance with 37 CFR 1.121 (or, if the application is a reissue application, 37 CFR 1.173). Such an amendment may be filed after payment of the issue fee if limited to correction of informalities noted herein. See Waiver of 37 CFR 1.312 for Documents Required by the Office of Patent Publication, 1280 Off. Gaz. Patent Office 918 (March 23, 2004). In addition, if the informality is not corrected until after payment of the issue fee, for purposes of 35 U.S.C. 154(b)(1)(iv), "all outstanding requirements" will be considered to have been satisfied when the informality has been corrected. A failure to respond within the above-identified time period will result in the application being ABANDONED.

See attachment(s).

A copy of this notice MUST be returned with the reply. Please address response to "Mail Stop Issue Fee, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450".

/Quang Nguyen/
Publication Branch
Office of Data Management
(571) 272-4200

Application No. 18127991

SPECIFICATION REFERS TO ITS OWN PAGE/PARAGRAPH NUMBER(S) AND/OR SPECIFICATION REFERS TO NONEXISTENT CLAIM(S)

[X] The patent will be printed in numbered columns with intercolumnar line numbers and without paragraph numbers. Any reference(s) within the applicant-filed specification to its own page number(s) or paragraph number(s) will have no meaning in the printed patent.

In response to this notice, the applicant either should file an amendment to the specification that removes the reference(s) to the page number(s) or paragraph number(s) or should submit a letter stating that the patent specification should be printed with the reference(s) to the page number(s) or paragraph number(s).

See Page(s)/Paragraph(s) Pages 14, 21, 33-34, 40, or paragraphs [0039, 0062, 0097, 0120].

[ ] The specification refers by number to one or more claims that are not present in the allowed application – that is, the claim number(s) mentioned in the specification are higher than the total number of allowed claims.

In response to this notice, the applicant either should file an amendment to the specification that removes the reference(s) to the nonexistent claim(s) or should submit a letter stating that the patent specification should be printed with the reference(s) to the nonexistent claim(s).

See Page(s)/Paragraph(s) .

PTO/SB/30EFS (01-22)
Approved for use through 05/31/2024. 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.

REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	18/127,991	Filing Date	2023-03-29	Docket Number (if applicable)	2010358-0284	Art Unit	3793
First Named Inventor	Jens Filip Andreas Richter			Examiner Name	JOSEPH M SANTOS RODRIGUEZ		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

- ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____
- ☐ Other _____

☒ Enclosed

- ☒ Amendment/Reply
- ☒ Information Disclosure Statement (IDS)
- ☐ Affidavit(s)/ Declaration(s)
- ☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____ (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

☒ **The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**
The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No 031721

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

Applicant Signature

PTO/SB/30EFS (01-22)
Approved for use through 05/31/2024. 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.

Signature of Registered U.S. Patent Practitioner			
Signature	/Ronen Adato/	Date (YYYY-MM-DD)	2023-10-30
Name	Ronen Adato	Registration Number	76,341

This collection of information is required by 37 CFR 1.114. 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 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.

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

Privacy Act Statement

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

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

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

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.

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.
18/127,991	03/29 2023	Jens Filip Andreas Richter	2010358-0284	4023

24280 7590 10/25/2023
CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

EXAMINER	
SANTOS RODRIGUEZ, JOSEPH M	

ART UNIT	PAPER NUMBER
3793	

NOTIFICATION DATE	DELIVERY MODE
10/25/2023	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):

choatepatentdepartment@choate.com
patentdocket@choate.com

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

Application No. : 18127991
Applicant : Richter
Filing Date : 03/29/2023
Date Mailed : 10/25/2023

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Notice of Allowance Mailed

This application has been accorded an Allowance Date and is being prepared for issuance. The application, however, is incomplete for the reasons below.

Applicant is given two (2) months from the mail date of this Notice within which to respond. This time period for reply is extendable under 37 CFR 1.136(a) for only TWO additional MONTHS.

The informalities requiring correction are indicated in the attachment(s). If the informality pertains to the abstract, specification (including claims) or drawings, the informality must be corrected with an amendment in compliance with 37 CFR 1.121 (or, if the application is a reissue application, 37 CFR 1.173). Such an amendment may be filed after payment of the issue fee if limited to correction of informalities noted herein. See Waiver of 37 CFR 1.312 for Documents Required by the Office of Patent Publication, 1280 Off. Gaz. Patent Office 918 (March 23, 2004). In addition, if the informality is not corrected until after payment of the issue fee, for purposes of 35 U.S.C. 154(b)(1)(iv), "all outstanding requirements" will be considered to have been satisfied when the informality has been corrected. A failure to respond within the above-identified time period will result in the application being ABANDONED.

See attachment(s).

A copy of this notice MUST be returned with the reply. Please address response to "Mail Stop Issue Fee, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450".

/Quang Nguyen/
Publication Branch
Office of Data Management
(571) 272-4200

Application No. 18127991

SPECIFICATION REFERS TO ITS OWN PAGE/PARAGRAPH NUMBER(S) AND/OR SPECIFICATION REFERS TO NONEXISTENT CLAIM(S)

[X] The patent will be printed in numbered columns with intercolumnar line numbers and without paragraph numbers. Any reference(s) within the applicant-filed specification to its own page number(s) or paragraph number(s) will have no meaning in the printed patent.

In response to this notice, the applicant either should file an amendment to the specification that removes the reference(s) to the page number(s) or paragraph number(s) or should submit a letter stating that the patent specification should be printed with the reference(s) to the page number(s) or paragraph number(s).

See Page(s)/Paragraph(s) Pages 14, 21, 33-34, 40, or paragraphs [0039, 0062, 0097, 0120].

[ ] The specification refers by number to one or more claims that are not present in the allowed application – that is, the claim number(s) mentioned in the specification are higher than the total number of allowed claims.

In response to this notice, the applicant either should file an amendment to the specification that removes the reference(s) to the nonexistent claim(s) or should submit a letter stating that the patent specification should be printed with the reference(s) to the nonexistent claim(s).

See Page(s)/Paragraph(s) .

Electronic Patent Application Fee Transmittal

Application Number:	18127991
Filing Date:	29-Mar-2023
Title of Invention:	SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION
First Named Inventor/Applicant Name:	Jens Filip Andreas Richter
Filer:	Ronen Adato/Kimberly Chrisom
Attorney Docket Number:	2010358-0284

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

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

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
RCE- 1ST REQUEST	1801	1	1360	1360
		Total in USD ($)		**1360**

Electronic Acknowledgement Receipt

EFS ID:	48775484
Application Number:	18127991
International Application Number:	
Confirmation Number:	4023
Title of Invention:	SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION
First Named Inventor/Applicant Name:	Jens Filip Andreas Richter
Customer Number:	24280
Filer:	Ronen Adato/Kimberly Chrisom
Filer Authorized By:	Ronen Adato
Attorney Docket Number:	2010358-0284
Receipt Date:	30-OCT-2023
Filing Date:	29-MAR-2023
Time Stamp:	11:03:17
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1360
RAM confirmation Number	E20230TB03416802
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	Foreign Reference	2023-09-29_CN107644421A.pdf	2271760 c20afe47724076ce7d480e670a168ab52d8c6d84	no	29
Warnings:					
Information:					
2	Foreign Reference	2023-07-10_CN1200520A.pdf	1023776 b055809083d6c886fd886076460b59a0ec7356d6	no	34
Warnings:					
Information:					
3	Foreign Reference	2023-10-05_JP2011067594A.pdf	1227610 04585d4fd6e591ec723d487c9da900e4fc47c8fc	no	46
Warnings:					
Information:					
4	Foreign Reference	2023-10-25_JP2014006130A.pdf	576523 e7c6e0410227a3b0572588ddb3cb24d648ece016	no	28
Warnings:					
Information:					
5	Foreign Reference	2023-09-29_TW201201847A.pdf	1658163 9fd5b552bea64bc740ebe662a506ac66885992af	no	29
Warnings:					
Information:					
6	Foreign Reference	2023-09-29_WO2011095580A1.pdf	1173366 849a47cb66dae7ed992a6145222e297e114202a8	no	22
Warnings:					
Information:					

7	Foreign Reference	2023-09-29_WO2018014475A1.pdf	2996396 0bc1231d11398e1e04c057cc8510b8ead48d8062	no	55
Warnings:					
Information:					
8	Foreign Reference	2023-10-05_WO2019005722A1.pdf	5896372 104f100e810ee2778f0b2ba0ab51677778af46ad	no	76
Warnings:					
Information:					
9	Non Patent Literature	GAFITA_ETAL_2022.PDF	523178 58ff366a285cc803ceb6f690e29bf941049b7f0f	no	8
Warnings:					
Information:					
10	Non Patent Literature	GUAN_ETAL_2006.pdf	540844 beddcf688ac1140142fb202d50342c41dfa7c392	no	4
Warnings:					
Information:					
11	Non Patent Literature	KAWAKAMI_ETAL_2011.PDF	7185249 398a430382c1c6929a11a9579e9a3e3673fb3637	no	32
Warnings:					
Information:					
12	Non Patent Literature	KAWAKAMI_2013.PDF	3632154 5ba5f8b9aec36acc6c41ad44d5a845e49ffaafda	no	13
Warnings:					
Information:					
13	Non Patent Literature	NOGI_ETAL_2012.PDF	1404402 5b0ab936c5a62b9836bf710c60bb2422ac491ff0	no	11
Warnings:					
Information:					

14	Non Patent Literature	PARTIN_ETAL_1997.pdf	2731884 3e4a4cee93712376204085a04d2102aa985272fa	no	7
Warnings:					
Information:					
15	Non Patent Literature	2023-09-22_PARTIN_ETAL_1993.pdf	1632351 9bb3f9c735228cfc03de01b9a56c07ce10747261	no	5
Warnings:					
Information:					
16	Non Patent Literature	2023-09-22_POULAKIS_ETAL_2004.pdf	2057470 46b5e74e111ff86f17f7801ea5d0ca16085322d5	no	8
Warnings:					
Information:					
17	Non Patent Literature	SEIFERT_ETAL_2018.PDF	7947829 97b313163e95acbb252e275a0594ca60714aa73e	no	9
Warnings:					
Information:					
18	Non Patent Literature	FDA_2018.PDF	360713 959fa51bb4b81e9a9c58b81239efc85ef0fb68a8	no	21
Warnings:					
Information:					
19	Transmittal Letter	Information_Disclosure_Statement.pdf	19068 9103ad7c74647ceebb3e714571308e197c279b09	no	2
Warnings:					
Information:					
20	Information Disclosure Statement (IDS) Form (SB08)	IDS_Citation_by_Applicant_20_References.pdf	36368 a21461ded033cc501de94fcf6e7387707347321f	no	2
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					

21		2023-10-30_Response_to_Notice_to_Correct_Application_Papers.pdf	28251 81b72e8979ec12f8dd6705c086f99b6ff737bab7	yes	4

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Amendment Submitted/Entered with Filing of Continued Prosecution Application (CPA)/Request for Continued Examination(RCE)	1	1
Specification	2	3
Applicant Arguments/Remarks Made in an Amendment	4	4

Warnings:

Information:

22	Request for Continued Examination (RCE)	2023-10-30_RCE_Transmittal_EFS.pdf	1667155 8279403b8a0fa3ea633ba5a6aec38142ee3d7760	no	3

Warnings:

Information:

23	Miscellaneous Incoming Letter	2023-10-25_Notice_to_File_Corrected_Application_Papers.pdf	106377 c86573b6f32ac101c20a9597653c84fb8a492937	no	3

Warnings:

Information:

24	Fee Worksheet (SB06)	fee-info.pdf	38433 5606b3c5a7bad6f09b2aad38f6c63c44b6f7d5fb	no	2

Warnings:

Information:

Total Files Size (in bytes):	46735692

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.

Docket No.: 2010358-0284
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
EXINI Diagnostics AB

Application No.: 18/127,991 | Confirmation No.: 4023

Filed: March 29, 2023 | Art Unit: 3793

For: SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION | Examiner: Joseph M. Santos Rodriguez

INFORMATION DISCLOSURE STATEMENT

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

Dear Commissioner:

Pursuant to 37 C.F.R. § 1.56, 1.97 and 1.98, the attention of the Patent and Trademark Office is hereby directed to the references listed on the attached PTO/SB/08. It is respectfully requested that the information be expressly considered during the prosecution of this application, and that the references be made of record therein and appear among the "References Cited" on any patent to issue therefrom.

This Information Disclosure Statement, pursuant to 37 C.F.R. § 1.114(c), accompanies the Request for Continued Examination (37 C.F.R. § 1.114) submitted herewith.

In accordance with 37 C.F.R. § 1.98(a)(2)(ii), Applicant has not submitted copies of the U.S. patent and the U.S. patent application. Applicant submits herewith copies of foreign patents and non-patent literature in accordance with 37 C.F.R. § 1.98(a)(2).

In accordance with 37 C.F.R. § 1.97(g), the filing of this Information Disclosure Statement shall not be construed to mean that a search has been made or that no other material information as defined in 37 C.F.R. § 1.56(a) exists. In accordance with 37 C.F.R. § 1.97(h), the filing of this Information Disclosure Statement shall not be construed to be an admission that any patent, publication or other information referred to therein is "prior art" for this invention unless specifically designated as such.

It is submitted that the Information Disclosure Statement is in compliance with 37 C.F.R. § 1.98 and the Examiner is respectfully requested to consider the listed references.

Dated: October 30, 2023

Respectfully submitted,

Electronic signature: /Ronen Adato/
Ronen Adato, PhD, JD
Registration No.: 76,341
CHOATE, HALL & STEWART LLP
Two International Place
Boston, Massachusetts 02110
(617) 248-4814
Attorney for Applicant

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 2

Complete if Known	
Application Number	18/127,991
Filing Date	March 29, 2023
First Named Inventor	Jens Filip Andreas Richter
Art Unit	3793
Examiner Name	Jospeh M. Santos Rodriguez
Attorney Docket Number	2010358-0284

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (*if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Additional Information
	A1*	US-8,995,736-B2	03-31-2015	Kaufman et al.	
	A2*	US-11,721,428-B2	08-08-2023	Brynolfsson et al.	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3]-Number[4]-Kind Code[5] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Additional Information	T[6]
	B1	CN-107644421-A	01-30-2018	Shanghai United Imaging Healthcare Co Ltd	English abstract included, also published in English as WO2018/014475.	
	B2	CN-1200520-A	12-02-1998	Lijie Computer Co., Ltd	English abstract and machine translation included.	√
	B3	JP-2011-067594-A	04-07-2011	Fujifilm Corp	English abstract and machine translation included.	√
	B4	JP-2014-006130-A	01-16-2014	Fujifilm Ri Pharma Co Ltd	English abstract included, also published as JP6170284.	
	B5	TW-201201847-A	01-16-2012	Bayer Schering Pharma AG	English abstract included, also published in English as WO2011/095580.	
	B6	WO-2011/095580-A1	08-11-2011	Bayer Schering Pharma AG	Corresponds to TW201201847.	
	B7	WO-2018/014475-A1	01-25-2018	Shanghai United Imaging Healthcare Co., Ltd	Corresponds to CN107644421.	
	B8	WO-2019/005722-A1	01-03-2019	Univ New York State Res Found		

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. * CITE NO.: Those application(s) which are marked with an single asterisk (*) next to the Cite No. are not supplied (under 37 CFR 1.98(a)(2)(iii)) because that application was filed after June 30, 2003 or is available in the IFW. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

Examiner Signature		Date Considered	

11653106

Substitute for form 1449/PTO				Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				**Application Number**	18/127,991
				Filing Date	March 29, 2023
				First Named Inventor	Jens Filip Andreas Richter
(Use as many sheets as necessary)				Art Unit	3793
				Examiner Name	Jospeh M. Santos Rodriguez
Sheet	2	of	2	Attorney Docket Number	2010358-0284

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No.[1]	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, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
	C1	GAFITA, A. et al., Novel Framework for Treatment Response Evaluation Using PSMA PET/CT in Patients with Metastatic Castration-Resistant Prostate Cancer (RECIP 1.0): An International Multicenter Study, J. Nucl. Med., 63(11):1651-1658 (2022).	
	C2	GUAN, H. et al., Automatic Hot Spot Detection and Segmentation in Whole Body FDG-PET Images, IEEE International Conference on Image Processing, 4 pages, (2006).	
	C3	KAWAKAMI, K. et al., Introduction of bone scintigraphy diagnosis support software "BONENAVI" (TOPICS), Journal of Nuclear Medicine (Japanese), 63:41-51 (2011).	√
	C4	KAWAKAMI, K., Evaluation of bone metastasis by bone scintigraphy diagnostic support software BONENAVI, Communication of the Imaging Group of the JSRT, 36(1):74-77 (2013).	√
	C5	NOGI, S. et al., Metastatic bone tumor quantified by computer-assisted diagnosis system of bone scintigraphy, Nuclear Medicine in Clinic, 45(3):35-37 (2012).	√
	C6	PARTIN, A.W. et al., Combination of prostate-specific antigen, clinical stage, and Gleason score to predict pathological stage of localized prostate cancer. A multi-institutional update, JAMA, 277(18):1445-1451 (1997).	
	C7	PARTIN, A.W. et al., The use of prostate specific antigen, clinical stage and Gleason score to predict pathological stage in men with localized prostate cancer, J. Urol., 150(1):110-114 (1993).	
	C8	POULAKIS, V. et al., Preoperative neural network using combined magnetic resonance imaging variables, prostate specific antigen, and Gleason score to predict prostate cancer recurrence after radical prostatectomy, Eur. Urol., 46(5):571-578 (2004).	
	C9	SEIFERT, R. et al., Second Version of the Prostate Cancer Molecular Imaging Standardized Evaluation Framework Including Response Evaluation for Clinical Trials (PROMISE V2), Eur. Urol., 83(5):405-412 (2023).	
	C10	US FOOD AND DRUG ADMINISTRATION, Clinical Trial Endpoints for the Approval of Cancer Drugs and Biologics, 21 pages, (2018).	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1]Applicant's unique citation designation number (optional). [2]Applicant is to place a check mark here if English language Translation is attached.

Examiner Signature		Date Considered	

11653106

Docket No.: 2010358-0284
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
EXINI Diagnostics AB

Application No.: 18/127,991 | Confirmation No.: 4023

Filed: March 29, 2023 | Art Unit: 3793

For: SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION | Examiner: Joseph M Santos Rodriguez

RESPONSE TO NOTICE TO FILE CORRECTED APPLICATION PAPERS – NOTICE OF ALLOWANCE MAILED

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

Dear Commissioner:

This submission is responsive to the Notice to File Corrected Application Papers mailed October 25, 2023 (the "Notice"). The deadline for responding to the Notice is December 25, 2023. Applicant therefore submits that the present response is timely filed on October 30, 2023.

This response accompanies a Request for Continued Examination (RCE) and Information Disclosure Statement (IDS).

In response to the Notice, Applicant submits herewith an amendment to the specification in compliance with 37 C.F.R. § 1.121. The amendment is made solely to remove references within the specification to its own paragraph numbers as requested by the Notice and is fully supported by the specification as originally filed. No new matter is added.

- Amendments to the specification begin on pg. **2**; and
- Remarks begin on pg. **4**.

AMENDMENTS TO THE SPECIFICATION

Applicant respectfully requests amendment to the specification by the following changes, to remove references within the specification to its own paragraph numbers. The amendments are fully supported by the specification as filed. No new matter is added.

Please amend paragraph [0039] on page 14 of the specification as follows:

In certain embodiments, step (i) comprises using a combination of two or more techniques for identification of hotspots in different sub-sets of the one or more 3D volumes identified within the 3D functional image [e.g., using a first filtering approach (e.g., as in ~~paragraph [0038]~~paragraphs above) for a first sub-set of the one or more 3D volumes and using a second filtering approach for a second sub-set; e.g., using thresholding approach (e.g., as ~~paragraph [0037]~~paragraphs above) for a first sub-set of the one or more 3D volumes and using a filtering approach (e.g., as ~~paragraph [0038]~~paragraphs above) for a second sub-set of the one or more 3D volumes].

Please amend paragraph [0062] on page 21 of the specification as follows:

In certain embodiments, the target tissue regions comprise one or more bone regions, each corresponding to a specific bone [e.g., where the target tissue regions comprise at least a portion of (e.g., up to all) the bones listed in paragraphs ~~[0058] or [0059]~~above] and one or more soft tissue regions, each corresponding to a specific soft-tissue region [e.g., where the target tissue regions comprise at least a portion of (e.g., up to all) the soft-tissue regions listed in paragraphs ~~[0060] or [0061]~~above].

Please amend paragraph [0097] on pages 33-34 of the specification as follows:

In certain embodiments, at step (i), the instructions cause the processor to use a combination of two or more techniques for identification of hotspots in different sub-sets of the one or more 3D volumes identified within the 3D functional image [e.g., using a first filtering

approach (e.g., as in paragraphs ~~[0096]~~above) for a first sub-set of the one or more 3D volumes and using a second filtering approach for a second sub-set; e.g., using thresholding approach (e.g., as in paragraphs ~~[0095]~~above) for a first sub-set of the one or more 3D volumes and using a filtering approach (e.g., as in paragraphs ~~[0096]~~above) for a second sub-set of the one or more 3D volumes].

Please amend paragraph [0120] on page 40 of the specification as follows:

In certain embodiments, the target tissue regions comprise one or more bone regions, each corresponding to a specific bone [e.g., where the target tissue regions comprise at least a portion of (e.g., up to all) the bones listed in paragraphs ~~[0116] or [0117]~~above] and one or more soft tissue regions, each corresponding to a specific soft-tissue region [e.g., where the target tissue regions comprise at least a portion of (e.g., up to all) the soft-tissue regions listed in paragraphs ~~[0118] or [0119]~~above].

REMARKS

Amendment to the Specification

Applicant amends the specification as reflected in the amendment to the specification above to address informalities identified in the Notice. The amendments are made solely to remove references within the specification to its own paragraph numbers. The amendments are fully supported by the specification as originally filed. No new matter is added.

Conclusion

Applicant thanks the Examiner for their time in consideration of this case. If a telephone conversation would help to clarify any issues or expedite prosecution of this case, Applicant invites the Examiner to contact the undersigned at (617) 248-4814. It is Applicant's understanding all fees due in connection with this submission are being paid herewith. However, if additional fees are due, or if any overpayment has been made, the Director is hereby authorized to charge any deficiency in the fees necessary for the processing of the present papers to our Deposit-Account No. 03-1721, under Attorney Docket No. 2010358-0284.

Dated: October 30, 2023

Respectfully submitted,

Electronic signature: /Ronen Adato/
Ronen Adato, PhD
Registration No.: 76,341
CHOATE, HALL & STEWART LLP
Two International Place
Boston, Massachusetts 02110
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Attorney for Applicant

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/127,991	Richter et al.
	Examiner	**Art Unit**
	JOSEPH M SANTOS RODRIGUEZ	3793

CPC						
Symbol					**Type**	**Version**
G06T	/	7	/	11	F	2017-01-01
G16H	/	50	/	50	I	2018-01-01
G16H	/	30	/	20	I	2018-01-01
G16H	/	50	/	30	I	2018-01-01
G16H	/	50	/	20	I	2018-01-01
G16H	/	30	/	40	I	2018-01-01
A61B	/	6	/	032	I	2013-01-01
A61B	/	6	/	037	I	2013-01-01
A61B	/	6	/	463	I	2013-01-01
A61B	/	6	/	466	I	2013-01-01
A61B	/	6	/	481	I	2013-01-01
A61B	/	6	/	505	I	2013-01-01
A61B	/	6	/	507	I	2013-01-01
A61B	/	6	/	5205	I	2013-01-01
A61B	/	6	/	5241	I	2013-01-01
A61B	/	6	/	5247	I	2013-01-01
A61K	/	51	/	0455	I	2013-01-01
G06V	/	20	/	64	I	2022-01-01
G06V	/	20	/	695	I	2022-01-01
G06V	/	20	/	698	I	2022-01-01
G06V	/	30	/	2504	I	2022-01-01
G06F	/	18	/	214	I	2023-01-01
G06V	/	2201	/	031	A	2022-01-01
G06V	/	2201	/	033	A	2022-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	32	
/JOSEPH M SANTOS RODRIGUEZ/ Primary Examiner, Art Unit 3793	04 November 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	44	1

U.S. Patent and Trademark Office

Part of Paper No.: 20231104

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/127,991	Richter et al.
	Examiner	**Art Unit**
	JOSEPH M SANTOS RODRIGUEZ	3793

INTERNATIONAL CLASSIFICATION					
CLAIMED					
G06T	/	7	/	00	
NON-CLAIMED					
	/		/		

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	32	
/JOSEPH M SANTOS RODRIGUEZ/ Primary Examiner, Art Unit 3793	04 November 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	44	1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/127,991	Richter et al.
	Examiner	**Art Unit**
	JOSEPH M SANTOS RODRIGUEZ	3793

☑ 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

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	32	
/JOSEPH M SANTOS RODRIGUEZ/ Primary Examiner, Art Unit 3793	04 November 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	44	1

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/127,991	Richter et al.
	Examiner	Art Unit
	JOSEPH M SANTOS RODRIGUEZ	3793

CPC - Searched*		
Symbol	Date	Examiner
G06T7/11	10/04/2023	

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
see search	10/04/2023	JS
see search IDS	11/04/2023	JS

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
G16H50	20	10/04/2023	JS

/JOSEPH M SANTOS RODRIGUEZ/ Primary Examiner, Art Unit 3793	

Used in Lieu of PTO/SB/08A/B
(Based on PTO 10-07 version)

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 2

Complete if Known	
Application Number	18/127,991
Filing Date	March 29, 2023
First Named Inventor	Jens Filip Andreas Richter
Art Unit	3793
Examiner Name	Jospeh M. Santos Rodriguez
Attorney Docket Number	2010358-0284

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (*if known*)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Additional Information
	A1*	US-8,995,736-B2	03-31-2015	Kaufman et al.	
	A2*	US-11,721,428-B2	08-08-2023	Brynolfsson et al.	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3]-Number[4]-Kind Code[5] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Additional Information	T[6]
	B1	CN-107644421-A	01-30-2018	Shanghai United Imaging Healthcare Co Ltd	English abstract included, also published in English as WO2018/014475.	
	B2	CN-1200520-A	12-02-1998	Lijie Computer Co., Ltd	English abstract and machine translation included.	√
	B3	JP-2011-067594-A	04-07-2011	Fujifilm Corp	English abstract and machine translation included.	√
	B4	JP-2014-006130-A	01-16-2014	Fujifilm Ri Pharma Co Ltd	English abstract included, also published as JP6170284.	
	B5	TW-201201847-A	01-16-2012	Bayer Schering Pharma AG	English abstract included, also published in English as WO2011/095580.	
	B6	WO-2011/095580-A1	08-11-2011	Bayer Schering Pharma AG	Corresponds to TW201201847.	
	B7	WO-2018/014475-A1	01-25-2018	Shanghai United Imaging Healthcare Co., Ltd	Corresponds to CN107644421.	
	B8	WO-2019/005722-A1	01-03-2019	Univ New York State Res Found		

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. * CITE NO.: Those application(s) which are marked with an single asterisk (*) next to the Cite No. are not supplied (under 37 CFR 1.98(a)(2)(iii)) because that application was filed after June 30, 2003 or is available in the IFW. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

Examiner Signature		Date Considered	

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /J.M.S/

Used in Lieu of PTO/SB/08A/B
(Based on PTO 10-07 version)

Substitute for form 1449/PTO **INFORMATION DISCLOSURE STATEMENT BY APPLICANT** *(Use as many sheets as necessary)*				***Complete if Known***	
				Application Number	18/127,991
				Filing Date	March 29, 2023
				First Named Inventor	Jens Filip Andreas Richter
				Art Unit	3793
				Examiner Name	Jospeh M. Santos Rodriguez
Sheet	2	of	2	Attorney Docket Number	2010358-0284

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No.[1]	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, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
	C1	GAFITA, A. et al., Novel Framework for Treatment Response Evaluation Using PSMA PET/CT in Patients with Metastatic Castration-Resistant Prostate Cancer (RECIP 1.0): An International Multicenter Study, J. Nucl. Med., 63(11):1651-1658 (2022).	
	C2	GUAN, H. et al., Automatic Hot Spot Detection and Segmentation in Whole Body FDG-PET Images, IEEE International Conference on Image Processing, 4 pages, (2006).	
	C3	KAWAKAMI, K. et al., Introduction of bone scintigraphy diagnosis support software "BONENAVI" (TOPICS), Journal of Nuclear Medicine (Japanese), 63:41-51 (2011).	√
	C4	KAWAKAMI, K., Evaluation of bone metastasis by bone scintigraphy diagnostic support software BONENAVI, Communication of the Imaging Group of the JSRT, 36(1):74-77 (2013).	√
	C5	NOGI, S. et al., Metastatic bone tumor quantified by computer-assisted diagnosis system of bone scintigraphy, Nuclear Medicine in Clinic, 45(3):35-37 (2012).	√
	C6	PARTIN, A.W. et al., Combination of prostate-specific antigen, clinical stage, and Gleason score to predict pathological stage of localized prostate cancer. A multi-institutional update, JAMA, 277(18):1445-1451 (1997).	
	C7	PARTIN, A.W. et al., The use of prostate specific antigen, clinical stage and Gleason score to predict pathological stage in men with localized prostate cancer, J. Urol., 150(1):110-114 (1993).	
	C8	POULAKIS, V. et al., Preoperative neural network using combined magnetic resonance imaging variables, prostate specific antigen, and Gleason score to predict prostate cancer recurrence after radical prostatectomy, Eur. Urol., 46(5):571-578 (2004).	
	C9	SEIFERT, R. et al., Second Version of the Prostate Cancer Molecular Imaging Standardized Evaluation Framework Including Response Evaluation for Clinical Trials (PROMISE V2), Eur. Urol., 83(5):405-412 (2023).	
	C10	US FOOD AND DRUG ADMINISTRATION, Clinical Trial Endpoints for the Approval of Cancer Drugs and Biologics, 21 pages, (2018).	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1]Applicant's unique citation designation number (optional). [2]Applicant is to place a check mark here if English language Translation is attached.

Examiner Signature	/JOSEPH M SANTOS RODRIGUEZ/	Date Considered	11/04/2023

11653106

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /J.M.S/

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	693661	(G06T7/11 or A61B6/032 or A61B6/037 or A61B6/463 or A61B6/466 or A61B6/481 or A61B6/505 or A61B6/507 or A61B6/5205 or A61B6/5241 or A61B6/5247 or A61K51/0455 or G06F18/214 or G06V20/64 or G06V20/695 or G06V20/698 or G06V30/2504 or G16H30/20 or G16H30/40 or G16H50/20 or G16H50/30 or G16H50/50 or G06V2201/031 or G06V2201/033 or G06T2207/10104 or G06T2207/10108 or G06T2207/20084).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/01/28 11:51 AM
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		USOC).dbnm.					
L19	32	(Artificial Intelligence) More like doc: US-11534125-B2 Text: (US-20200337658-A1 OR WO-2020219620-A1 OR CA-3136127-A1 OR AU-2020261370-A1 OR EP-3959684-A1 OR CN-113710159-A OR JP-2022530039-A OR TW-202105407-A OR EP-2227784-B1 OR US-RE47609-E OR US-8855387-B2 OR US-20130094704-A1 OR WO-2009084995-A1 OR EP-2227784-A1 OR US-20200245960-A1 OR CN-113272859-A OR TW-202040518-A OR JP-2022048246-A OR CA-3134745-A1 OR US-20210335480-A1).did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/01/28 01:06 PM
L20	11	"20130094704"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/01/28 01:06 PM
L21	17	("8538166" | "8705887" | "20060062425" | "20070081712").pn. OR ("8855387").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/01/28 01:06 PM
L22	35	(Artificial Intelligence) More like doc: US-8855387-B2 Text: (US-20130094704-A1 OR EP-2227784-B1 OR US-RE47609-E OR WO-2009084995-A1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV,	ADJ	ON	ON	2023/01/28 01:06 PM

		OR EP-2227784-A1 OR US-9002081-B2 OR US-20140105471-A1 OR EP-2227784-A4 OR CA-3134745-A1 OR US-20220180487-A1 OR WO-2020219619-A1 OR AU-2020263381-A1 OR EP-3959683-A1 OR US-7295691-B2 OR JP-2022530040-A OR CN-113748443-A OR US-20030215120-A1 OR US-7397475-B2 OR JP-2014006130-A OR JP-2017198697-A).did.	MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L23	1	20220079451a	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/02/02 11:34 AM
L24	6	"20220079451"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/02/02 11:34 AM
L25	0	"20140114187"7	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV,	ADJ	ON	ON	2023/02/02 11:44 AM

			MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L26	14	"20140114187"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/02/02 11:45 AM
L27	57761	third near3 optical near2 (fiber OR waveguide)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/02/02 11:56 AM
L28	784657	arrange$ near5 fibers	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/02/02 11:56 AM
L29	16408	27 AND 28	(US-PGPUB; USPAT;	ADJ	ON	ON	2023/02/02

			USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				11:56 AM
L30	292249	(center OR between) SAME 28	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/02/02 11:57 AM
L31	8459	27 AND 30	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/02/02 11:57 AM
L32	12	("6839496" | "7206259" | "20060018595" | "20060126435" | "20070123776" | "20070291275" | "20080043243" | "20080204859" | "20100087732").pn. OR ("9949717").urpn. AND (PGPB | USPT |	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/02/02 11:57 AM

		USOC).dbnm.					
L33	0	32 AND 31	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/02/02 11:58 AM
L34	47246	(A61B5/0095 OR A61B8/54 OR G01N21/1702 OR G02B6/02076 OR A61B6/5252 OR G02B2006/12097 OR G02B2006/12107 OR G02B2006/12138 OR A61B8/08 OR A61B8/4416 OR A61B8/4444 OR A61B8/4488 OR A61B8/4494 OR A61B6/502 OR A61B6/4417 OR A61B6/00 OR A61B8/4483 OR G03B42/06 OR A61B5/055 OR G02B6/122 OR G02B6/124).cpc.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/02/02 11:58 AM
L35	29	31 AND 34	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/02/02 11:58 AM
L36	1	"10670804".pn.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/02/02 12:01 PM
L37	106803	bundle near3 optical near2 (fiber OR waveguide)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/02/02 12:05 PM
L38	11491	ultraso$ AND 37	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH,	ADJ	ON	ON	2023/02/02 12:05 PM

			TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L39	1414	34 AND 38	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/02/02 12:05 PM
L40	1579	ultraso$ SAME 37	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/02/02 12:06 PM
L41	411	34 AND 40	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/02/02 12:06 PM
L42	104	34 AND 40	(US-PGPUB; USPAT; DERWENT)	ADJ	ON	ON	2023/02/02 12:06 PM
L43	836509	(G06T7/11 or A61B6/032 or	(US-PGPUB; USPAT; USOCR; FIT (AU, AP,	ADJ	ON	ON	2023/10/04 05:40 PM

		A61B6/037 or A61B6/463 or A61B6/466 or A61B6/481 or A61B6/505 or A61B6/507 or A61B6/5205 or A61B6/5241 or A61B6/5247 or A61K51/0455 or G06F18/214 or G06V20/64 or G06V20/695 or G06V20/698 or G06V30/2504 or G16H30/20 or G16H30/40 or G16H50/20 or G16H50/30 or G16H50/50 or G06V2201/031 or G06V2201/033 or G06T2207/10104 or G06T2207/10108 or G06T2207/20084).cpc.	AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L44	274	((("RICHTER") near3 ("Jens")) OR (("JOHNSSON") near3 ("Kerstin")) OR (("GJERTSSON") near3 ("Erik")) OR (("ANAND") near3 ("Aseem"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/10/04 05:40 PM
L45	8554	uptak$3 near3 radio$	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/10/04 05:40 PM
L46	1365613	cancer$ OR tumor OR tuomor	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/10/04 05:40 PM
L47	296	hotspot near3 index	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/10/04 05:40 PM
L48	8	3 AND 4 AND 5	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/10/04 05:40 PM
L49	93	("7450747" | "7751605" | "7935055" | "7970194" | "8199985" | "8211401" | "8467856" | "8538166" | "8705887" | "8778305" | "8855387" | "8962799" | "9002081" | "9466133" | "9710915" | "9721340" | "10058393" | "10223610" | "10311971" | "10330763" |	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/10/04 05:40 PM

		"10339653" | "10340044" | "10340046" | "RE47609" | "10492723" | "10600184" | "10665346" | "10748652" | "10762993" | "10818386" | "10943681" | "10973486" | "11011257" | "11321844" | "11386988" | "11424035" | "20030215120" | "20050281381" | "20060062425" | "20060064396" | "20060078183" | "20070081712" | "20070081713" | "20070100225" | "20070115204" | "20080027315" | "20090309874" | "20100215581" | "20100266170" | "20100322488" | "20110063288" | "20110255763" | "20120123253" | "20130038707" | "20130094704" | "20130129168" | "20130211231" | "20130281841" | "20150110716" | "20150331995" | "20160203263" | "20160335395" | "20170083682" | "20180144828" | "20180259608" | "20180360402" | "20190038239" | "20190105009" | "20190209116" | "20190388049" | "20200027559" | "20200051238" | "20200074634" | "20200085382" | "20200126666" | "20200170604" | "20200193594" | "20200193603" |				

		"20200245960" | "20200315455" | "20200342600" | "20200352518" | "20200357117" | "20200357118" | "20200357521" | "20210032206" | "20210082547" | "20210093249" | "20210183485" | "20210233633" | "20210334974" | "20210335480").pn. OR ("11534125").urpn. AND (PGPB | USPT | USOC).dbnm.					
L50	31	(Artificial Intelligence) More like doc: US-11534125-B2 Text: (US-20200337658-A1 OR WO-2020219620-A1 OR CA-3136127-A1 OR AU-2020261370-A1 OR EP-3959684-A1 OR US-20230148980-A1 OR CN-113710159-A OR JP-2022530039-A OR TW-202105407-A OR JP-WO2020219620-A5 OR EP-2227784-A1 OR CN-113272859-A OR US-20220005586-A1 OR US-11721428-B2 OR TW-202040518-A OR US-20210335480-A1 OR US-11386988-B2 OR US-10973486-B2 OR US-11321844-B2 OR US-20210334974-A1).did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L51	14	"20130094704"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO;	ADJ	ON	ON	2023/10/04 05:40 PM

			JPO; DERWENT; IBM_TDB)				
L52	20	("8538166" | "8705887" | "20060062425" | "20070081712").pn. OR ("8855387").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/10/04 05:40 PM
L53	34	(Artificial Intelligence) More like doc: US-8855387-B2 Text: (US-20130094704-A1 OR EP-2227784-B1 OR US-RE47609-E OR WO-2009084995-A1 OR EP-2227784-A1 OR AU-2020261370-A1 OR CA-3136127-A1 OR JP-2022530039-A OR EP-3959684-A1 OR CN-113710159-A OR CN-110443792-A OR EP-2227784-A4 OR JP-2001511372-A OR CA-3134745-A1 OR US-20220180487-A1 OR WO-2020219619-A1 OR EP-3959683-A1 OR AU-2020263381-A1 OR EP-0993269-A2 OR JP-2022530040-A).did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L54	836509	(G06T7/11 or A61B6/032 or A61B6/037 or A61B6/463 or A61B6/466 or A61B6/481 or A61B6/505 or A61B6/507 or A61B6/5205 or A61B6/5241 or A61B6/5247 or A61K51/0455 or G06F18/214 or G06V20/64 or G06V20/695 or G06V20/698 or G06V30/2504 or G16H30/20 or G16H30/40 or G16H50/20 or G16H50/30 or G16H50/50 or G06V2201/031 or G06V2201/033 or G06T2207/10104 or	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM

		G06T2207/10108 or G06T2207/20084).cpc.					
L55	274	((("RICHTER") near3 ("Jens")) OR (("JOHNSSON") near3 ("Kerstin")) OR (("GJERTSSON") near3 ("Erik")) OR (("ANAND") near3 ("Aseem"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/10/04 05:40 PM
L56	8554	uptak$3 near3 radio$	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/10/04 05:40 PM
L57	1365613	cancer$ OR tumor OR tuomor	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/10/04 05:40 PM
L58	296	hotspot near3 index	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/10/04 05:40 PM
L59	8	3 AND 4 AND 5	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/10/04 05:40 PM
L60	93	("7450747" | "7751605" | "7935055" | "7970194" | "8199985" | "8211401" | "8467856" | "8538166" | "8705887" | "8778305" | "8855387" | "8962799" | "9002081" | "9466133" | "9710915" | "9721340" | "10058393" | "10223610" | "10311971" | "10330763" | "10339653" | "10340044" | "10340046" | "RE47609" | "10492723" | "10600184" | "10665346" | "10748652" | "10762993" | "10818386" | "10943681" | "10973486" | "11011257" | "11321844" | "11386988" | "11424035" | "20030215120" | "20050281381" | "20060062425" | "20060064396" | "20060078183" | "20070081712" | "20070081713" |	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/10/04 05:40 PM

		"20070100225" | "20070115204" | "20080027315" | "20090309874" | "20100215581" | "20100266170" | "20100322488" | "20110063288" | "20110255763" | "20120123253" | "20130038707" | "20130094704" | "20130129168" | "20130211231" | "20130281841" | "20150110716" | "20150331995" | "20160203263" | "20160335395" | "20170083682" | "20180144828" | "20180259608" | "20180360402" | "20190038239" | "20190105009" | "20190209116" | "20190388049" | "20200027559" | "20200051238" | "20200074634" | "20200085382" | "20200126666" | "20200170604" | "20200193594" | "20200193603" | "20200245960" | "20200315455" | "20200342600" | "20200352518" | "20200357117" | "20200357118" | "20200357521" | "20210032206" | "20210082547" | "20210093249" | "20210183485" | "20210233633" | "20210334974" | "20210335480").pn. OR ("11534125").urpn. AND (PGPB | USPT | USOC).dbnm.					
L61	31	(Artificial Intelligence) More like doc: US-11534125-B2 Text: (US-20200337658-A1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB,	ADJ	ON	ON	2023/10/04 05:40 PM

		OR WO-2020219620-A1 OR CA-3136127-A1 OR AU-2020261370-A1 OR EP-3959684-A1 OR US-20230148980-A1 OR CN-113710159-A OR JP-2022530039-A OR TW-202105407-A OR JP-WO2020219620-A5 OR EP-2227784-A1 OR CN-113272859-A OR US-20220005586-A1 OR US-11721428-B2 OR TW-202040518-A OR US-20210335480-A1 OR US-11386988-B2 OR US-10973486-B2 OR US-11321844-B2 OR US-20210334974-A1).did.	HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L62	14	"20130094704"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L63	20	("8538166" | "8705887" | "20060062425" | "20070081712").pn. OR ("8855387").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/10/04 05:40 PM
L64	34	(Artificial Intelligence) More like doc: US-8855387-B2 Text: (US-20130094704-A1 OR EP-2227784-B1 OR US-RE47609-E OR WO-2009084995-A1 OR EP-2227784-A1 OR AU-2020261370-A1 OR CA-3136127-A1 OR JP-2022530039-A OR EP-3959684-A1 OR CN-113710159-A OR CN-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO;	ADJ	ON	ON	2023/10/04 05:40 PM

		110443792-A OR EP-2227784-A4 OR JP-2001511372-A OR CA-3134745-A1 OR US-20220180487-A1 OR WO-2020219619-A1 OR EP-3959683-A1 OR AU-2020263381-A1 OR EP-0993269-A2 OR JP-2022530040-A).did.	JPO; DERWENT; IBM_TDB)				
L65	1	20220079451a	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L66	6	"20220079451"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L67	0	"20140114187"7	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT;	ADJ	ON	ON	2023/10/04 05:40 PM

			IBM_TDB)				
L68	15	"20140114187"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L69	60332	third near3 optical near2 (fiber OR waveguide)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L70	809903	arrange$ near5 fibers	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L71	17138	27 AND 28	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV,	ADJ	ON	ON	2023/10/04 05:40 PM

			MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L72	301093	(center OR between) SAME 28	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L73	8836	27 AND 30	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L74	12	("6839496" | "7206259" | "20060018595" | "20060126435" | "20070123776" | "20070291275" | "20080043243" | "20080204859" | "20100087732").pn. OR ("9949717").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/10/04 05:40 PM
L75	0	32 AND 31	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/10/04 05:40 PM
L76	49479	(A61B5/0095 OR A61B8/54 OR G01N21/1702 OR	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/10/04 05:40 PM

		G02B6/02076 OR A61B6/5252 OR G02B2006/12097 OR G02B2006/12107 OR G02B2006/12138 OR A61B8/08 OR A61B8/4416 OR A61B8/4444 OR A61B8/4488 OR A61B8/4494 OR A61B6/502 OR A61B6/4417 OR A61B6/00 OR A61B8/4483 OR G03B42/06 OR A61B5/055 OR G02B6/122 OR G02B6/124).cpc.					
L77	29	31 AND 34	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/10/04 05:40 PM
L78	1	"10670804".pn.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/10/04 05:40 PM
L79	109695	bundle near3 optical near2 (fiber OR waveguide)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L80	11914	ultraso$ AND 37	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L81	1472	34 AND 38	(US-PGPUB; USPAT; USOCR; FIT (AP, AT,	ADJ	ON	ON	2023/10/04 05:40 PM

			AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L82	1629	ultraso$ SAME 37	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L83	436	34 AND 40	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/04 05:40 PM
L84	113	34 AND 40	(US-PGPUB; USPAT; DERWENT)	ADJ	ON	ON	2023/10/04 05:40 PM
L85	2951	(maltese OR quad) near3 antenna$	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO,	ADJ	ON	ON	2023/10/11 09:30 AM

			MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L86	1325977	a61b5/$.cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/11 09:33 AM
L87	76	85 AND 86	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/11 09:33 AM
L88	7042	taper$ near2 antenn$	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/11 09:34 AM
L89	0	88 AND 87	(US-PGPUB; USPAT; USOCR; FIT (AU, AP,	ADJ	ON	ON	2023/10/11 09:34 AM

			AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L90	7044	taper$ near2 anten$	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/11 09:34 AM
L91	0	87 AND 90	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/11 09:34 AM
L92	9	"20110313288"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE,	ADJ	ON	ON	2023/10/11 09:37 AM

			SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L93	1	("2016/0354177").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/10/11 09:43 AM
L94	56	("5361070" | "5573012" | "5764162" | "5766208" | "5853366" | "5879357" | "6144300" | "6226548" | "6233479" | "6363940" | "6492933" | "6496717" | "6575991" | "6725083" | "6914552" | "7174201" | "7569065" | "7881030" | "8052708" | "9136690" | "9713437" | "20030004411" | "20030018246" | "20030088186" | "20030192557" | "20050036945" | "20050059884" | "20050096589" | "20050163336" | "20060025795" | "20060256981" | "20060258933" | "20070038014" | "20070093726" | "20070100666" | "20070135711" | "20070195929" | "20070243225" | "20080027313" | "20080071169" | "20080086046" | "20080200802" | "20080269601" | "20080281190" | "20090015832" | "20090157068" | "20090216115" | "20090248014" | "20090281422" | "20090299174" | "20100234792" | "20110080678" | "20140309522").pn. OR ("10610326").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/10/11 09:44 AM
L95	2	"20070123776"	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/10/12 11:09 AM
L96	2	"20170123776"	(US-PGPUB; USPAT;	ADJ	ON	ON	2023/10/12

			USOCR)				11:09 AM
L97	2	"20070123776"	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/10/12 11:12 AM
L98	125929	peristal$.ti,ab,clm.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/13 02:24 PM
L99	44950524	(movement OR constriction OR relaxation OR displacement OR shift)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/13 02:25 PM
L100	6586357	(ultraso$ OR doppler)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/13 02:25 PM
L101	5737	98 AND 99 AND 100	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA,	ADJ	ON	ON	2023/10/13 02:25 PM

			EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L102	1207	(movement OR constriction OR relaxation OR displacement OR shift) near15 endometri$	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/13 02:26 PM
L103	29	102 AND 100 AND 98	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/13 02:26 PM
L104	13279	peristal$ SAME (ultraso$ OR doppler)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO;	ADJ	ON	ON	2023/10/13 02:29 PM

			JPO; DERWENT; IBM_TDB)				
L105	7081	(movement OR constriction OR relaxation OR displacement OR shift) near15 (endometri$ OR uteru$)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/13 02:30 PM
L106	72	104 AND 105	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/13 02:30 PM
L107	2	"11534132".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/10/19 04:50 PM
L108	845214	(G06T7/11 or A61B6/032 or A61B6/037 or A61B6/463 or A61B6/466 or A61B6/481 or A61B6/505 or	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS,	ADJ	ON	ON	2023/11/04 04:39 PM

		A61B6/507 or A61B6/5205 or A61B6/5241 or A61B6/5247 or A61K51/0455 or G06F18/214 or G06V20/64 or G06V20/695 or G06V20/698 or G06V30/2504 or G16H30/20 or G16H30/40 or G16H50/20 or G16H50/30 or G16H50/50 or G06V2201/031 or G06V2201/033 or G06T2207/10104 or G06T2207/10108 or G06T2207/20084).cpc.	IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L109	276	((("RICHTER") near3 ("Jens")) OR (("JOHNSSON") near3 ("Kerstin")) OR (("GJERTSSON") near3 ("Erik")) OR (("ANAND") near3 ("Aseem"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/11/04 04:39 PM
L110	8584	uptak$3 near3 radio$	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/11/04 04:39 PM
L111	1373587	cancer$ OR tumor OR tuomor	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/11/04 04:39 PM
L112	300	hotspot near3 index	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/11/04 04:39 PM
L113	10	3 AND 4 AND 5	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/11/04 04:39 PM
L114	93	("7450747" | "7751605" | "7935055" | "7970194" | "8199985" | "8211401" | "8467856" | "8538166" | "8705887" | "8778305" | "8855387" | "8962799" | "9002081" | "9466133" | "9710915" | "9721340" | "10058393" | "10223610" | "10311971" | "10330763" | "10339653" | "10340044" | "10340046" | "RE47609" | "10492723" |	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM

		"10600184" | "10665346" | "10748652" | "10762993" | "10818386" | "10943681" | "10973486" | "11011257" | "11321844" | "11386988" | "11424035" | "20030215120" | "20050281381" | "20060062425" | "20060064396" | "20060078183" | "20070081712" | "20070081713" | "20070100225" | "20070115204" | "20080027315" | "20090309874" | "20100215581" | "20100266170" | "20100322488" | "20110063288" | "20110255763" | "20120123253" | "20130038707" | "20130094704" | "20130129168" | "20130211231" | "20130281841" | "20150110716" | "20150331995" | "20160203263" | "20160335395" | "20170083682" | "20180144828" | "20180259608" | "20180360402" | "20190038239" | "20190105009" | "20190209116" | "20190388049" | "20200027559" | "20200051238" | "20200074634" | "20200085382" | "20200126666" | "20200170604" | "20200193594" | "20200193603" | "20200245960" | "20200315455" | "20200342600" | "20200352518" | "20200357117" |				

		"20200357118" | "20200357521" | "20210032206" | "20210082547" | "20210093249" | "20210183485" | "20210233633" | "20210334974" | "20210335480").pn. OR ("11534125").urpn. AND (PGPB | USPT | USOC).dbnm.					
L115	33	(Artificial Intelligence) More like doc: US-11534125-B2 Text: (US-20200337658-A1 OR WO-2020219620-A1 OR CA-3136127-A1 OR AU-2020261370-A1 OR EP-3959684-A1 OR US-20230148980-A1 OR CN-113710159-A OR JP-2022530039-A OR TW-202105407-A OR EP-2227784-B1 OR US-RE47609-E OR US-8855387-B2 OR US-20130094704-A1 OR WO-2009084995-A1 OR EP-2227784-A1 OR CN-113272859-A OR TW-202040518-A OR US-10973486-B2 OR WO-2019136349-A2 OR EP-3738097-A2).did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L116	14	"20130094704"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L117	20	("8538166" | "8705887" | "20060062425" | "20070081712").pn. OR ("8855387").urpn. AND	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM

		(PGPB | USPT | USOC).dbnm.					
L118	37	(Artificial Intelligence) More like doc: US-8855387-B2 Text: (US-20130094704-A1 OR EP-2227784-B1 OR US-RE47609-E OR WO-2009084995-A1 OR EP-2227784-A1 OR US-11534125-B2 OR CN-113710159-A OR CA-3134745-A1 OR US-20220180487-A1 OR AU-2020263381-A1 OR EP-3959683-A1 OR WO-2020219619-A1 OR US-7295691-B2 OR JP-2022530040-A OR CN-113748443-A OR US-20030215120-A1 OR JP-2014006130-A OR JP-2017198697-A OR US-20080031507-A1 OR US-7796795-B2).did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L119	845214	(G06T7/11 or A61B6/032 or A61B6/037 or A61B6/463 or A61B6/466 or A61B6/481 or A61B6/505 or A61B6/507 or A61B6/5205 or A61B6/5241 or A61B6/5247 or A61K51/0455 or G06F18/214 or G06V20/64 or G06V20/695 or G06V20/698 or G06V30/2504 or G16H30/20 or G16H30/40 or G16H50/20 or G16H50/30 or G16H50/50 or G06V2201/031 or G06V2201/033 or G06T2207/10104 or G06T2207/10108 or G06T2207/20084).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L120	276	((("RICHTER") near3 ("Jens")) OR (("JOHNSSON") near3	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/11/04 04:39 PM

		("Kerstin")) OR (("GJERTSSON") near3 ("Erik")) OR (("ANAND") near3 ("Aseem"))).INV.					
L121	8584	uptak$3 near3 radio$	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/11/04 04:39 PM
L122	1373587	cancer$ OR tumor OR tuomor	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/11/04 04:39 PM
L123	300	hotspot near3 index	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/11/04 04:39 PM
L124	10	3 AND 4 AND 5	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/11/04 04:39 PM
L125	93	("7450747" | "7751605" | "7935055" | "7970194" | "8199985" | "8211401" | "8467856" | "8538166" | "8705887" | "8778305" | "8855387" | "8962799" | "9002081" | "9466133" | "9710915" | "9721340" | "10058393" | "10223610" | "10311971" | "10330763" | "10339653" | "10340044" | "10340046" | "RE47609" | "10492723" | "10600184" | "10665346" | "10748652" | "10762993" | "10818386" | "10943681" | "10973486" | "11011257" | "11321844" | "11386988" | "11424035" | "20030215120" | "20050281381" | "20060062425" | "20060064396" | "20060078183" | "20070081712" | "20070081713" | "20070100225" | "20070115204" | "20080027315" | "20090309874" | "20100215581" |	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM

		"20100266170" | "20100322488" | "20110063288" | "20110255763" | "20120123253" | "20130038707" | "20130094704" | "20130129168" | "20130211231" | "20130281841" | "20150110716" | "20150331995" | "20160203263" | "20160335395" | "20170083682" | "20180144828" | "20180259608" | "20180360402" | "20190038239" | "20190105009" | "20190209116" | "20190388049" | "20200027559" | "20200051238" | "20200074634" | "20200085382" | "20200126666" | "20200170604" | "20200193594" | "20200193603" | "20200245960" | "20200315455" | "20200342600" | "20200352518" | "20200357117" | "20200357118" | "20200357521" | "20210032206" | "20210082547" | "20210093249" | "20210183485" | "20210233633" | "20210334974" | "20210335480").pn. OR ("11534125").urpn. AND (PGPB | USPT | USOC).dbnm.					
L126	33	(Artificial Intelligence) More like doc: US-11534125-B2 Text: (US-20200337658-A1 OR WO-2020219620-A1 OR CA-3136127-A1 OR AU-2020261370-A1 OR EP-3959684-A1 OR US-20230148980-A1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO,	ADJ	ON	ON	2023/11/04 04:39 PM

		OR CN-113710159-A OR JP-2022530039-A OR TW-202105407-A OR EP-2227784-B1 OR US-RE47609-E OR US-8855387-B2 OR US-20130094704-A1 OR WO-2009084995-A1 OR EP-2227784-A1 OR CN-113272859-A OR TW-202040518-A OR US-10973486-B2 OR WO-2019136349-A2 OR EP-3738097-A2).did.	RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L127	14	"20130094704"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L128	20	("8538166" | "8705887" | "20060062425" | "20070081712").pn. OR ("8855387").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM
L129	37	(Artificial Intelligence) More like doc: US-8855387-B2 Text: (US-20130094704-A1 OR EP-2227784-B1 OR US-RE47609-E OR WO-2009084995-A1 OR EP-2227784-A1 OR US-11534125-B2 OR CN-113710159-A OR CA-3134745-A1 OR US-20220180487-A1 OR AU-2020263381-A1 OR EP-3959683-A1 OR WO-2020219619-A1 OR US-7295691-B2 OR JP-2022530040-A OR CN-113748443-A OR US-20030215120-A1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM

		OR JP-2014006130-A OR JP-2017198697-A OR US-20080031507-A1 OR US-7796795-B2).did.					
L130	1	20220079451a	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L131	6	"20220079451"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L132	0	"20140114187"7	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L133	16	"20140114187"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU,	ADJ	ON	ON	2023/11/04 04:39 PM

			CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L134	60545	third near3 optical near2 (fiber OR waveguide)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L135	812061	arrange$ near5 fibers	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L136	17200	27 AND 28	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA,	ADJ	ON	ON	2023/11/04 04:39 PM

			VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L137	302011	(center OR between) SAME 28	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L138	8866	27 AND 30	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L139	12	("6839496" | "7206259" | "20060018595" | "20060126435" | "20070123776" | "20070291275" | "20080043243" | "20080204859" | "20100087732").pn. OR ("9949717").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM
L140	0	32 AND 31	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM
L141	49801	(A61B5/0095 OR A61B8/54 OR G01N21/1702 OR G02B6/02076 OR A61B6/5252 OR G02B2006/12097 OR G02B2006/12107 OR G02B2006/12138 OR	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM

		A61B8/08 OR A61B8/4416 OR A61B8/4444 OR A61B8/4488 OR A61B8/4494 OR A61B6/502 OR A61B6/4417 OR A61B6/00 OR A61B8/4483 OR G03B42/06 OR A61B5/055 OR G02B6/122 OR G02B6/124).cpc.					
L142	29	31 AND 34	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM
L143	1	"10670804".pn.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM
L144	109952	bundle near3 optical near2 (fiber OR waveguide)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L145	11937	ultraso$ AND 37	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L146	1473	34 AND 38	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS,	ADJ	ON	ON	2023/11/04 04:39 PM

			IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L147	1631	ultraso$ SAME 37	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L148	436	34 AND 40	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L149	113	34 AND 40	(US-PGPUB; USPAT; DERWENT)	ADJ	ON	ON	2023/11/04 04:39 PM
L150	845214	(G06T7/11 or A61B6/032 or A61B6/037 or A61B6/463 or A61B6/466 or A61B6/481 or A61B6/505 or A61B6/507 or A61B6/5205 or A61B6/5241 or A61B6/5247 or A61K51/0455 or G06F18/214 or G06V20/64 or	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO;	ADJ	ON	ON	2023/11/04 04:39 PM

		G06V20/695 or G06V20/698 or G06V30/2504 or G16H30/20 or G16H30/40 or G16H50/20 or G16H50/30 or G16H50/50 or G06V2201/031 or G06V2201/033 or G06T2207/10104 or G06T2207/10108 or G06T2207/20084).cpc.	JPO; DERWENT; IBM_TDB)				
L151	276	((("RICHTER") near3 ("Jens")) OR (("JOHNSSON") near3 ("Kerstin")) OR (("GJERTSSON") near3 ("Erik")) OR (("ANAND") near3 ("Aseem"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/11/04 04:39 PM
L152	8584	uptak$3 near3 radio$	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/11/04 04:39 PM
L153	1373587	cancer$ OR tumor OR tuomor	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/11/04 04:39 PM
L154	300	hotspot near3 index	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/11/04 04:39 PM
L155	10	3 AND 4 AND 5	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/11/04 04:39 PM
L156	93	("7450747" | "7751605" | "7935055" | "7970194" | "8199985" | "8211401" | "8467856" | "8538166" | "8705887" | "8778305" | "8855387" | "8962799" | "9002081" | "9466133" | "9710915" | "9721340" | "10058393" | "10223610" | "10311971" | "10330763" | "10339653" | "10340044" | "10340046" | "RE47609" | "10492723" | "10600184" | "10665346" | "10748652" | "10762993" | "10818386" | "10943681" | "10973486" |	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM

		"11011257" | "11321844" | "11386988" | "11424035" | "20030215120" | "20050281381" | "20060062425" | "20060064396" | "20060078183" | "20070081712" | "20070081713" | "20070100225" | "20070115204" | "20080027315" | "20090309874" | "20100215581" | "20100266170" | "20100322488" | "20110063288" | "20110255763" | "20120123253" | "20130038707" | "20130094704" | "20130129168" | "20130211231" | "20130281841" | "20150110716" | "20150331995" | "20160203263" | "20160335395" | "20170083682" | "20180144828" | "20180259608" | "20180360402" | "20190038239" | "20190105009" | "20190209116" | "20190388049" | "20200027559" | "20200051238" | "20200074634" | "20200085382" | "20200126666" | "20200170604" | "20200193594" | "20200193603" | "20200245960" | "20200315455" | "20200342600" | "20200352518" | "20200357117" | "20200357118" | "20200357521" | "20210032206" | "20210082547" | "20210093249" | "20210183485" | "20210233633" |					

		"20210334974" | "20210335480").pn. OR ("11534125").urpn. AND (PGPB | USPT | USOC).dbnm.					
L157	31	(Artificial Intelligence) More like doc: US-11534125-B2 Text: (US-20200337658-A1 OR WO-2020219620-A1 OR CA-3136127-A1 OR AU-2020261370-A1 OR EP-3959684-A1 OR US-20230148980-A1 OR CN-113710159-A OR JP-2022530039-A OR TW-202105407-A OR JP-WO2020219620-A5 OR EP-2227784-A1 OR CN-113272859-A OR US-20220005586-A1 OR US-11721428-B2 OR TW-202040518-A OR US-20210335480-A1 OR US-11386988-B2 OR US-10973486-B2 OR US-11321844-B2 OR US-20210334974-A1).did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L158	14	"20130094704"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L159	20	("8538166" | "8705887" | "20060062425" | "20070081712").pn. OR ("8855387").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM
L160	34	(Artificial Intelligence) More like doc: US-8855387-B2	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY,	ADJ	ON	ON	2023/11/04 04:39 PM

		Text: (US-20130094704-A1 OR EP-2227784-B1 OR US-RE47609-E OR WO-2009084995-A1 OR EP-2227784-A1 OR AU-2020261370-A1 OR CA-3136127-A1 OR JP-2022530039-A OR EP-3959684-A1 OR CN-113710159-A OR CN-110443792-A OR EP-2227784-A4 OR JP-2001511372-A OR CA-3134745-A1 OR US-20220180487-A1 OR WO-2020219619-A1 OR EP-3959683-A1 OR AU-2020263381-A1 OR EP-0993269-A2 OR JP-2022530040-A).did.	CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L161	845214	(G06T7/11 or A61B6/032 or A61B6/037 or A61B6/463 or A61B6/466 or A61B6/481 or A61B6/505 or A61B6/507 or A61B6/5205 or A61B6/5241 or A61B6/5247 or A61K51/0455 or G06F18/214 or G06V20/64 or G06V20/695 or G06V20/698 or G06V30/2504 or G16H30/20 or G16H30/40 or G16H50/20 or G16H50/30 or G16H50/50 or G06V2201/031 or G06V2201/033 or G06T2207/10104 or G06T2207/10108 or G06T2207/20084).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L162	276	((("RICHTER") near3 ("Jens")) OR (("JOHNSSON") near3 ("Kerstin")) OR (("GJERTSSON") near3 ("Erik")) OR (("ANAND") near3 ("Aseem"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/11/04 04:39 PM
L163	8584	uptak$3 near3 radio$	(US-PGPUB; USPAT; USOCR; EPO; JPO;	ADJ	ON	ON	2023/11/04 04:39 PM

			DERWENT)				
L164	1373587	cancer$ OR tumor OR tuomor	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/11/04 04:39 PM
L165	300	hotspot near3 index	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/11/04 04:39 PM
L166	10	3 AND 4 AND 5	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	ADJ	ON	ON	2023/11/04 04:39 PM
L167	93	("7450747" | "7751605" | "7935055" | "7970194" | "8199985" | "8211401" | "8467856" | "8538166" | "8705887" | "8778305" | "8855387" | "8962799" | "9002081" | "9466133" | "9710915" | "9721340" | "10058393" | "10223610" | "10311971" | "10330763" | "10339653" | "10340044" | "10340046" | "RE47609" | "10492723" | "10600184" | "10665346" | "10748652" | "10762993" | "10818386" | "10943681" | "10973486" | "11011257" | "11321844" | "11386988" | "11424035" | "20030215120" | "20050281381" | "20060062425" | "20060064396" | "20060078183" | "20070081712" | "20070081713" | "20070100225" | "20070115204" | "20080027315" | "20090309874" | "20100215581" | "20100266170" | "20100322488" | "20110063288" | "20110255763" | "20120123253" | "20130038707" | "20130094704" |	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM

		"20130129168" | "20130211231" | "20130281841" | "20150110716" | "20150331995" | "20160203263" | "20160335395" | "20170083682" | "20180144828" | "20180259608" | "20180360402" | "20190038239" | "20190105009" | "20190209116" | "20190388049" | "20200027559" | "20200051238" | "20200074634" | "20200085382" | "20200126666" | "20200170604" | "20200193594" | "20200193603" | "20200245960" | "20200315455" | "20200342600" | "20200352518" | "20200357117" | "20200357118" | "20200357521" | "20210032206" | "20210082547" | "20210093249" | "20210183485" | "20210233633" | "20210334974" | "20210335480").pn. OR ("11534125").urpn. AND (PGPB | USPT | USOC).dbnm.					
L168	31	(Artificial Intelligence) More like doc: US-11534125-B2 Text: (US-20200337658-A1 OR WO-2020219620-A1 OR CA-3136127-A1 OR AU-2020261370-A1 OR EP-3959684-A1 OR US-20230148980-A1 OR CN-113710159-A OR JP-2022530039-A OR TW-202105407-A OR JP-WO2020219620-A5 OR EP-2227784-A1 OR CN-113272859-A OR	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM

		US-20220005586-A1 OR US-11721428-B2 OR TW-202040518-A OR US-20210335480-A1 OR US-11386988-B2 OR US-10973486-B2 OR US-11321844-B2 OR US-20210334974-A1).did.					
L169	14	"20130094704"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L170	20	("8538166" | "8705887" | "20060062425" | "20070081712").pn. OR ("8855387").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM
L171	34	(Artificial Intelligence) More like doc: US-8855387-B2 Text: (US-20130094704-A1 OR EP-2227784-B1 OR US-RE47609-E OR WO-2009084995-A1 OR EP-2227784-A1 OR AU-2020261370-A1 OR CA-3136127-A1 OR JP-2022530039-A OR EP-3959684-A1 OR CN-113710159-A OR CN-110443792-A OR EP-2227784-A4 OR JP-2001511372-A OR CA-3134745-A1 OR US-20220180487-A1 OR WO-2020219619-A1 OR EP-3959683-A1 OR AU-2020263381-A1 OR EP-0993269-A2 OR JP-2022530040-A).did.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L172	1	20220079451a	(US-PGPUB; USPAT;	ADJ	ON	ON	2023/11/04

			USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				04:39 PM
L173	6	"20220079451"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L174	0	"20140114187"7	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L175	16	"20140114187"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO,	ADJ	ON	ON	2023/11/04 04:39 PM

			NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L176	60545	third near3 optical near2 (fiber OR waveguide)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L177	812061	arrange$ near5 fibers	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L178	17200	27 AND 28	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L179	302011	(center OR between) SAME 28	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY,	ADJ	ON	ON	2023/11/04 04:39 PM

			CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L180	8866	27 AND 30	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L181	12	("6839496" | "7206259" | "20060018595" | "20060126435" | "20070123776" | "20070291275" | "20080043243" | "20080204859" | "20100087732").pn. OR ("9949717").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM
L182	0	32 AND 31	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM
L183	49801	(A61B5/0095 OR A61B8/54 OR G01N21/1702 OR G02B6/02076 OR A61B6/5252 OR G02B2006/12097 OR G02B2006/12107 OR G02B2006/12138 OR A61B8/08 OR A61B8/4416 OR A61B8/4444 OR A61B8/4488 OR A61B8/4494 OR A61B6/502 OR A61B6/4417 OR	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM

		A61B6/00 OR A61B8/4483 OR G03B42/06 OR A61B5/055 OR G02B6/122 OR G02B6/124).cpc.					
L184	29	31 AND 34	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM
L185	1	"10670804".pn.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM
L186	109952	bundle near3 optical near2 (fiber OR waveguide)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L187	11937	ultraso$ AND 37	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L188	1473	34 AND 38	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO;	ADJ	ON	ON	2023/11/04 04:39 PM

			JPO; DERWENT; IBM_TDB)				
L189	1631	ultraso$ SAME 37	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L190	436	34 AND 40	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L191	113	34 AND 40	(US-PGPUB; USPAT; DERWENT)	ADJ	ON	ON	2023/11/04 04:39 PM
L192	2954	(maltese OR quad) near3 antenna$	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L193	1331457	a61b5/$.cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU,	ADJ	ON	ON	2023/11/04 04:39 PM

			CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L194	76	85 AND 86	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L195	7078	taper$ near2 antenn$	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L196	0	88 AND 87	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA,	ADJ	ON	ON	2023/11/04 04:39 PM

			VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L197	7080	taper$ near2 anten$	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L198	0	87 AND 90	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L199	10	"20110313288"	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L200	1	("2016/0354177").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM
L201	56	("5361070" | "5573012" | "5764162" | "5766208"	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM

		| "5853366" | "5879357" | "6144300" | "6226548" | "6233479" | "6363940" | "6492933" | "6496717" | "6575991" | "6725083" | "6914552" | "7174201" | "7569065" | "7881030" | "8052708" | "9136690" | "9713437" | "20030004411" | "20030018246" | "20030088186" | "20030192557" | "20050036945" | "20050059884" | "20050096589" | "20050163336" | "20060025795" | "20060256981" | "20060258933" | "20070038014" | "20070093726" | "20070100666" | "20070135711" | "20070195929" | "20070243225" | "20080027313" | "20080071169" | "20080086046" | "20080200802" | "20080269601" | "20080281190" | "20090015832" | "20090157068" | "20090216115" | "20090248014" | "20090281422" | "20090299174" | "20100234792" | "20110080678" | "20140309522").pn. OR ("10610326").urpn. AND (PGPB | USPT | USOC).dbnm.					
L202	2	"20070123776"	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM
L203	2	"20170123776"	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM
L204	2	"20070123776"	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:39 PM
L205	126652	peristal$.ti,ab,clm.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS,	ADJ	ON	ON	2023/11/04 04:39 PM

			IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L206	45130010	(movement OR constriction OR relaxation OR displacement OR shift)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L207	6621562	(ultraso$ OR doppler)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L208	5767	98 AND 99 AND 100	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM

L209	1211	(movement OR constriction OR relaxation OR displacement OR shift) near15 endometri$	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L210	30	102 AND 100 AND 98	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L211	13355	peristal$ SAME (ultraso$ OR doppler)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L212	7106	(movement OR constriction OR relaxation OR displacement OR shift) near15 (endometri$ OR uteru$)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL,	ADJ	ON	ON	2023/11/04 04:39 PM

			NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L213	73	104 AND 105	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L214	2	"11534132".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L215	10	"2011095580"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:39 PM
L216	16	"2018014475"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP,	ADJ	ON	ON	2023/11/04 04:40 PM

			AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L217	30	"2019005722"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:40 PM
L218	2	"8995736".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	ADJ	ON	ON	2023/11/04 04:40 PM
L219	5	("6697538" | "8204315" | "20080285830" | "20090027382").pn. OR ("8995736").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:40 PM
L220	1	"11721428".pn.	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:40 PM
L221	93	("7450747" | "7751605" | "7935055" | "7970194"	(US-PGPUB; USPAT; USOCR)	ADJ	ON	ON	2023/11/04 04:41 PM

		| "8199985" | "8211401" | "8467856" | "8538166" | "8705887" | "8778305" | "8855387" | "8962799" | "9002081" | "9466133" | "9710915" | "9721340" | "10058393" | "10223610" | "10311971" | "10330763" | "10339653" | "10340044" | "10340046" | "RE47609" | "10492723" | "10600184" | "10665346" | "10748652" | "10762993" | "10818386" | "10943681" | "10973486" | "11011257" | "11321844" | "11386988" | "11424035" | "20030215120" | "20050281381" | "20060062425" | "20060064396" | "20060078183" | "20070081712" | "20070081713" | "20070100225" | "20070115204" | "20080027315" | "20090309874" | "20100215581" | "20100266170" | "20100322488" | "20110063288" | "20110255763" | "20120123253" | "20130038707" | "20130094704" | "20130129168" | "20130211231" | "20130281841" | "20150110716" | "20150331995" | "20160203263" | "20160335395" | "20170083682" | "20180144828" | "20180259608" | "20180360402" | "20190038239" | "20190105009" |					

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PE2E SEARCH - Search History (Interference)

There are no Interference searches to show.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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NOTICE OF ALLOWANCE AND FEE(S) DUE

24280 7590 11/21/2023

CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

EXAMINER	
SANTOS RODRIGUEZ, JOSEPH M	
ART UNIT	**PAPER NUMBER**
3793	

DATE MAILED: 11/21/2023

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/127,991	03/29/2023	Jens Filip Andreas Richter	2010358-0284	4023

TITLE OF INVENTION: SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	02/21/2024

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 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted 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. 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 the USPTO patent electronic filing system.

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 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. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

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

24280 7590 11/21/2023
CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

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 the USPTO patent electronic filing system 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.
18/127,991	03/29/2023	Jens Filip Andreas Richter	2010358-0284	4023

TITLE OF INVENTION: SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	02/21/2024

EXAMINER	ART UNIT	CLASS-SUBCLASS
SANTOS RODRIGUEZ, JOSEPH M	3793	600-425000

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/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

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

1 _____
2 _____
3 _____

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

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document 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)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via the USPTO patent electronic filing system ❑ 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

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

❑ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

❑ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

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

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/127,991	03/29/2023	Jens Filip Andreas Richter	2010358-0284	4023

24280 7590 11/21/2023

CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

EXAMINER	
SANTOS RODRIGUEZ, JOSEPH M	
ART UNIT	PAPER NUMBER
3793	

DATE MAILED: 11/21/2023

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. 18/127,991	Applicant(s) Richter et al.	
	Examiner JOSEPH M SANTOS RODRIGUEZ	Art Unit 3793	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 the IDS filed 10/30/2023.
   ☐ 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 See Continuation Sheet . 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 _____.

/JOSEPH M SANTOS RODRIGUEZ/
Primary Examiner, Art Unit 3793

Continuation of 3. The allowed claim(s) is/are: 44-52,102-110 and 117-130

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.

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after allowance or after an Office action under *Ex Parte Quayle*, 25 USPQ 74, 453 O.G. 213 (Comm'r Pat. 1935). Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, prosecution in this application has been reopened pursuant to 37 CFR 1.114. Applicant's submission filed on 10/30/2023 has been entered.

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.

EXAMINER'S COMMENTS

1. Claims 44-52, 102-110, 117-130 are allowed.

2. The IDS filed 10/30/2023 has been reviewed.

Allowable subject matter:

The closes prior art is **Hamadeh et al. (US 8,855,387)** which An aspect of the present invention relates to a detection system for automatic detection of bone cancer metastases from a set of isotope bone scan images of a patients skeleton, the system comprising a shape identifier unit for identifying anatomical structures of the skeleton pictured in the set of bone scan images, forming an annotated set of images, a hotspot detection unit for detecting areas of high intensity in the annotated set of images based on information from the shape identifier regarding the anatomical structures corresponding to different portions of the skeleton of the images, a hotspot feature extraction unit for extracting a set of hotspot features for each hot spot detected by the hotspot detection unit ,a first artificial neural network unit arranged to calculate a likelihood for each hot spot of the hotspot set being a metastasis based on the set of hotspot features extracted by the hotspot feature extraction unit, a patient feature extraction unit arranged to extract a set of patient features based on the hotspots detected by the hotspot detection unit and on the likelihood outputs from the first artificial neural network unit, and a second artificial neural network unit arranged to calculate a likelihood that the patient has one or more cancer metastases, based on the set of patient features extracted by the patient feature extraction unit.

However Hameda **fails to teach** a cancerous lesion automatically identification method for (d) receiving, by the processor, a 3D functional image of the subject obtained using a functional imaging modality; (e) identifying, within the 3D functional image, one or more 3D volume(s), each corresponding to an identified target VOI, using

the 3D segmentation map; and(f) automatically detecting, by the processor, within at least a portion of the one or more 3D volumes identified within the 3D functional image, one or more hotspots determined to represent lesions based on intensities of voxels within the 3D functional image

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOSEPH M SANTOS RODRIGUEZ whose telephone number is (571)270-7782. The examiner can normally be reached Monday-Friday 8:30am to 5:30pm.

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, Ashley Buran can be reached on 571-270-5284. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For

additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/JOSEPH M SANTOS RODRIGUEZ/
Primary Examiner, Art Unit 3793

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.
18/127,991	03/29/2023	Jens Filip Andreas Richter	2010358-0284	4023

24280 7590 12/08/2023

CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

EXAMINER	
SANTOS RODRIGUEZ, JOSEPH M	

ART UNIT	PAPER NUMBER
3793	

NOTIFICATION DATE	DELIVERY MODE
12/08/2023	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):

choatepatentdepartment@choate.com
patentdocket@choate.com

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

Application No. : 18127991
Applicant : Richter
Filing Date : 03/29/2023
Date Mailed : 12/08/2023

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Notice of Allowance Mailed

This application has been accorded an Allowance Date and is being prepared for issuance. The application, however, is incomplete for the reasons below.

Applicant is given two (2) months from the mail date of this Notice within which to respond. This time period for reply is extendable under 37 CFR 1.136(a) for only TWO additional MONTHS.

The informalities requiring correction are indicated in the attachment(s). If the informality pertains to the abstract, specification (including claims) or drawings, the informality must be corrected with an amendment in compliance with 37 CFR 1.121 (or, if the application is a reissue application, 37 CFR 1.173). Such an amendment may be filed after payment of the issue fee if limited to correction of informalities noted herein. See Waiver of 37 CFR 1.312 for Documents Required by the Office of Patent Publication, 1280 Off. Gaz. Patent Office 918 (March 23, 2004). In addition, if the informality is not corrected until after payment of the issue fee, for purposes of 35 U.S.C. 154(b)(1)(iv), "all outstanding requirements" will be considered to have been satisfied when the informality has been corrected. A failure to respond within the above-identified time period will result in the application being ABANDONED.

See attachment(s).

A copy of this notice MUST be returned with the reply. Please address response to "Mail Stop Issue Fee, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450".

/Quang Nguyen/
Publication Branch
Office of Data Management
(571) 272-4200

IDENTIFICATION OF DRAWING DEFICIENCIES

- [ ] There is a hole or the image thereof within the illustration. FIG(s)
- [ ] The illustration is penetrated or traversed by a solid or broken line that is not intended to be part of the drawing, such as a dark line caused by a flaw in the copying process. FIG(s)
- [ ] An ink stamp or the image thereof obscures part of the illustration. FIG(s)
- [ ] The drawing is marred by black smudges, obliterations, or fax/copier marks (for example, speckles or dots in a substantial portion of the drawing). FIG(s)
- [ ] Figure numbers are duplicated or missing. FIG(s)
- [ ] Drawing sheet or figure is missing. FIG(s)
- [ ] Numbers, letters, or reference characters in the drawing have been crossed out or are illegibly handwritten. FIG(s)
- [ ] The character of the lines, numbers, and letters is poor. FIG(s)
- [ ] The drawing's background shows that the original drawing was made on graph paper or other paper with a pattern or decoration. FIG(s)
- [ ] The FIG. number label is placed in a location that causes the drawing to be read upside down. FIG(s)
- [X] Data, a reference number, or part of the drawing is truncated or missing, or a lead line has no reference number. FIG(s) 4, 19
- [ ] The drawing and/or the FIG. label contain(s) foreign language. FIG(s)
- [ ] This utility application contains a photograph of a view that is capable of being illustrated as a line drawing. FIG(s)
- [ ] A petition under 37 CFR 1.84(a)(2) to accept color drawings has been granted, but the brief description of the drawings in the specification does not contain (or has not been amended to contain) the paragraph required by 37 CFR 1.84(a)(2)(iii).
- [ ] This reissue application contains added and/or amended drawings that are not labeled as “New” or “Amended” or “Canceled” as required by 37 CFR 1.173(b)(3). FIG(s)
- [ ] This Design reissue application contains a drawing that is labeled as “Canceled” but is not surrounded by brackets, or a drawing that is surrounded by brackets but is not labeled as “Canceled.” See 37 CFR 1.173(b)(3). FIG(s)
- [ ] OTHER:
- [ ] COMMENTS:

DocCode - SCORE

SCORE Placeholder Sheet for IFW Content

Application Number: 18127991 Document Date: 01/31/2024

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

Since this was an electronic submission, there is no physical artifact folder, no artifact folder is recorded in PALM, and no paper documents or physical media exist. The TIFF images in the IFW record were created from the original documents that are stored in SCORE.

- Drawing

At the time of document entry (noted above):

- USPTO employees may access SCORE content via DAV or via the SCORE web page.
- External customers may access SCORE content via PAIR using the Supplemental Content tab.

Form Revision Date: March 1, 2019

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/127,991	**01/31/2024 09:24:36 PM Z ET**	**2010358-0284**

Title of Invention

SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	4023	FILED BY	Kimberly Chrisom
PATENT CENTER #	64162973	FILING DATE	03/29/2023
CUSTOMER #	24280	FIRST NAMED INVENTOR	Jens Filip Andreas Richter
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Ronen Adato

Documents

TOTAL DOCUMENTS: 10

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
2024-01-31 Petition to Accept Color Drawings.pdf		2	A petition from Applicant to accept Color Drawings or Color Photographs	17 KB
2024-01-31 Replacement Figures just 4 and 19.pdf		2	Drawings-other than black and white line drawings	592 KB
2023-12-08 Copy of Notice to File Corrected Application Papers.pdf		3	Miscellaneous Incoming Letter	116 KB
2024-01-31 Amendment After Allowance.pdf		5	-	31 KB
2024-01-31 Amendment After Allowance-A.NA.pdf	(1-1)	1	Amendment after Notice of Allowance (Rule 312)	17 KB
2024-01-31 Amendment	(2-2)	1	Specification	17 KB

After Allowance-SPEC.pdf				
2024-01-31 Amendment After Allowance-DRW.NONBW.pdf	(3-3)	1	Drawings-other than black and white line drawings	17 KB
2024-01-31 Amendment After Allowance-REM.pdf	(4-5)	2	Applicant Arguments/Remarks Made in an Amendment	25 KB
2024-01-31 Issue Fee Transmittal.pdf		1	Issue Fee Payment (PTO-85B)	37 KB
2024-01-31 Comments on Statement of Reasons for Allowance.pdf		2	Miscellaneous Incoming Letter	18 KB
2024-01-31_Response_to_NTFCAP.pdf		2	Supplemental Response or Supplemental Amendment	19 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
2024-01-31 Petition to Accept Color Drawings.pdf	DD62A98C0190EC10128C2BBED0711191A74FC53515BC7CA48D9C6D3577B197A061C2E1AEED6F9E05FE31EF6E4377941B5E497195C089386F68D01BCE5E66AA59
2024-01-31 Replacement Figures just 4 and 19.pdf	CA6E6FCF32373034E732CE37BA01233B0FBE0DCED4A69341CDF399992D282A0C4D3CE734B38362C73B4DE443A81159ED3097FFCCB313307537DF7E9A5F6679F8
2023-12-08 Copy of Notice to File Corrected Application Papers.pdf	1C24D029AAD1D31DB8847569F8E0F4CC47A03A14E2FC2BF2751E0929DC91D3401253E34BA300189431E5241C55DAA3DBF2BDC637712A22478C2917D3D97CDEAF
2024-01-31 Amendment After Allowance.pdf	244D8B94FEAAE7A3D6387FBBF3E7348A3B7DFDE9625C8C20E8C595867A07F73FBBA1C2115FAB7DE54D2AAB7D7C82D783F506DFA79D306D24BF01594FD1A2B2F7
2024-01-31 Amendment After Allowance-A.NA.pdf	07EF3A10FAE428DAE703143B4400146EE64EDF2DA351C4023314E4F99C70A67B9A7A4C471112F0AF791E0378F8CF236BB76449387C1C34CFA50497155CA9DDDB
2024-01-31 Amendment After Allowance-SPEC.pdf	66A6D28A22DE9029E2900A5A8F565D3B1EAF1CAA2BB3F7D8A93DEE54C44B1B3F82D889077459FE727B5DC5A8DEECF7845D1CE3AAB2C657C754915B4AA7EC2448
2024-01-31 Amendment After Allowance-DRW.NONBW.pdf	FC8897E63999B180A3060976B8DF08EC29F5E8FFEED7788F4D6BDF0CDB1191770E6D0D80383B1FD9198643C0D5BE407A9BD2614904295180FC330FA45FBC7C1E

2024-01-31 Amendment After Allowance-REM.pdf	BEE3C666F4B7080E56290C78312A03FB8812A1CDB92114E43B890507B42233C19AEFC23072B6A6BDE57F961C58DBBAC46667A0AA7F78AAD2BC5A33B3AFE4776A
2024-01-31 Issue Fee Transmittal.pdf	AA8C6950E1447D54403B10FE24FABFDD3B5CE0C9B9872835554F6230ADB6DC767A715179EECD4E1B04237F578D1B63BB72D5A75DC1B4924E773618356263B380
2024-01-31 Comments on Statement of Reasons for Allowance.pdf	B2CA9E1E2443A068BE181DB26FF403C6CEA6C43FC82159BB6E3CD1C876B0F820DC8E1F3D080CB5E192625BD13E8320B989823EAD3B0B89A37A3CB9793A6E5BDF
2024-01-31_Response_to_NTFCAP.pdf	E30579AE8D1902E78BD4B181FF09B92C912C0D4C550ED13DEECF10A728FFD392094FC68DE59A70D8585BBD16B6AEE226BB187D7BFE5558D9B60CD1DEDA5F9BEB

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 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.

Docket No.: 2010358-0284
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
EXINI Diagnostics AB

Application No.: 18/127,991 | Confirmation No.: 4023

Filed: March 29, 2023 | Art Unit: 3797

For: SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION | Examiner: JOSEPH M SANTOS RODRIGUEZ

COMMENTS ON STATEMENT OF REASONS FOR ALLOWANCE UNDER 37 C.F.R. § 1.104(e)

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

Dear Commissioner:

Applicant has received the Examiner's Statement of Reasons for Allowance with the November 21, 2023 Notice of Allowance and Allowability regarding the above-identified application. Entry of the Statement into the record should not be construed as any agreement with or acquiescence in the reasoning stated by the Examiner. Each of the claims stands on its own merits and is patentable at least because of the combination it recites, taken as a whole, and not necessarily because of the presence or absence of any one particular limitation.

The Examiner's Statement was not prepared by Applicant and only contains the Examiner's stated positions in one or more reasons for allowability. Thus, any interpretation with respect to the Examiner's Statement of Reasons for Allowance should not be imputed to the Applicant.

11788681v1

Furthermore, Applicant does not necessarily agree with or acquiesce in any other characterization of any claim term or rejection of any claim that the Examiner may have made during the pendency of the present patent application.

Dated: January 31, 2024

Respectfully submitted,

/Ronen Adato/
Ronen Adato, PhD, JD
Registration No.: 76,341
CHOATE, HALL & STEWART LLP
Two International Place
Boston, Massachusetts 02110
(617) 248-4814
Attorney for Applicant

11788681v1

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/127,991	**01/31/2024 09:24:36 PM Z ET**	**2010358-0284**

Title of Invention

SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	4023	FILED BY	Kimberly Chrisom
PATENT CENTER #	64162973	AUTHORIZED BY	Ronen Adato
CUSTOMER #	24280	FILING DATE	03/29/2023
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Jens Filip Andreas Richter

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 3001	**E20241UL25115350**	**Sylvia Sanchez**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1501	UTILITY ISSUE FEE	1200.00	1	1200.00
1464	PETITIONS REQUIRING THE PETITION FEE SET FORTH IN 37 CFR 1.17(H) (GROUP III)	140.00	1	140.00
			TOTAL AMOUNT:	**$1,340.00**

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 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.

Docket No.: 2010358-0284
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
EXINI Diagnostics AB

Application No.: 18/127,991 | Confirmation No.: 4023

Filed: March 29, 2023 | Art Unit: 3797

For: SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION | Examiner: JOSEPH M SANTOS RODRIGUEZ

RESPONSE TO NOTICE TO FILE CORRECTED APPLICATION PAPERS – NOTICE OF ALLOWANCE MAILED

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

Dear Commissioner:

This submission is responsive to the Notice to File Corrected Application Papers mailed December 8, 2023 (hereinafter, the "Notice," a copy of which is provided herewith). The deadline for responding to the Notice is February 8, 2024. Applicant therefore submits that the present Response is timely filed on January 30, 2024.

In response to the Notice, Applicant submits herewith an Amendment After Allowance under 37 C.F.R. § 1.312 along with two (2) Replacement Sheets of Drawing, in compliance with 37 C.F.R. § 1.121.

The amendments are solely to address informalities in the drawing in view of the Notice. In particular, FIG. 4 on the replacement sheet 4 is amended to adjust positioning of reference numerals "404" and "406" to further clarify their correspondence to certain elements of FIG. 4 and FIG. 19 is amended to provide the right-most plot with a right-hand border, to clarify it is not truncated.

It is Applicant's belief that all fees due in connection with this response are being paid. If, however, Applicant's understanding is incorrect, the Director is hereby authorized to charge any deficiency in the fees necessary for the processing of this response to our Deposit Account No. 03-1721, referencing order no. 2010358-0284. Applicant respectfully requests that a notice be issued explaining any such discrepancy.

Dated: January 31, 2024

Respectfully submitted,

Electronic signature: /Ronen Adato/
Ronen Adato, PhD, JD
Registration No.: 76,341
CHOATE, HALL & STEWART LLP
Two International Place
Boston, Massachusetts 02110
(617) 248-4814
Attorney for Applicant

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.
18/127,991	03/29/2023	Jens Filip Andreas Richter	2010358-0284	4023

24280 7590 12/08/2023

CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

EXAMINER	
SANTOS RODRIGUEZ, JOSEPH M	

ART UNIT	PAPER NUMBER
3793	

NOTIFICATION DATE	DELIVERY MODE
12/08/2023	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):

choatepatentdepartment@choate.com
patentdocket@choate.com

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

Application No. : 18127991
Applicant : Richter
Filing Date : 03/29/2023
Date Mailed : 12/08/2023

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Notice of Allowance Mailed

This application has been accorded an Allowance Date and is being prepared for issuance. The application, however, is incomplete for the reasons below.

Applicant is given two (2) months from the mail date of this Notice within which to respond. This time period for reply is extendable under 37 CFR 1.136(a) for only TWO additional MONTHS.

The informalities requiring correction are indicated in the attachment(s). If the informality pertains to the abstract, specification (including claims) or drawings, the informality must be corrected with an amendment in compliance with 37 CFR 1.121 (or, if the application is a reissue application, 37 CFR 1.173). Such an amendment may be filed after payment of the issue fee if limited to correction of informalities noted herein. See Waiver of 37 CFR 1.312 for Documents Required by the Office of Patent Publication, 1280 Off. Gaz. Patent Office 918 (March 23, 2004). In addition, if the informality is not corrected until after payment of the issue fee, for purposes of 35 U.S.C. 154(b)(1)(iv), "all outstanding requirements" will be considered to have been satisfied when the informality has been corrected. A failure to respond within the above-identified time period will result in the application being ABANDONED.

See attachment(s).

A copy of this notice MUST be returned with the reply. Please address response to "Mail Stop Issue Fee, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450".

/Quang Nguyen/
Publication Branch
Office of Data Management
(571) 272-4200

IDENTIFICATION OF DRAWING DEFICIENCIES

- [ ] There is a hole or the image thereof within the illustration. FIG(s)
- [ ] The illustration is penetrated or traversed by a solid or broken line that is not intended to be part of the drawing, such as a dark line caused by a flaw in the copying process. FIG(s)
- [ ] An ink stamp or the image thereof obscures part of the illustration. FIG(s)
- [ ] The drawing is marred by black smudges, obliterations, or fax/copier marks (for example, speckles or dots in a substantial portion of the drawing). FIG(s)
- [ ] Figure numbers are duplicated or missing. FIG(s)
- [ ] Drawing sheet or figure is missing. FIG(s)
- [ ] Numbers, letters, or reference characters in the drawing have been crossed out or are illegibly handwritten. FIG(s)
- [ ] The character of the lines, numbers, and letters is poor. FIG(s)
- [ ] The drawing's background shows that the original drawing was made on graph paper or other paper with a pattern or decoration. FIG(s)
- [ ] The FIG. number label is placed in a location that causes the drawing to be read upside down. FIG(s)
- [X] Data, a reference number, or part of the drawing is truncated or missing, or a lead line has no reference number. FIG(s) 4, 19
- [ ] The drawing and/or the FIG. label contain(s) foreign language. FIG(s)
- [ ] This utility application contains a photograph of a view that is capable of being illustrated as a line drawing. FIG(s)
- [ ] A petition under 37 CFR 1.84(a)(2) to accept color drawings has been granted, but the brief description of the drawings in the specification does not contain (or has not been amended to contain) the paragraph required by 37 CFR 1.84(a)(2)(iii).
- [ ] This reissue application contains added and/or amended drawings that are not labeled as “New” or “Amended” or “Canceled” as required by 37 CFR 1.173(b)(3). FIG(s)
- [ ] This Design reissue application contains a drawing that is labeled as “Canceled” but is not surrounded by brackets, or a drawing that is surrounded by brackets but is not labeled as “Canceled.” See 37 CFR 1.173(b)(3). FIG(s)
- [ ] OTHER:
- [ ] COMMENTS:

Docket No.: 2010358-0284
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
EXINI Diagnostics AB

Application No.: 18/127,991 | Confirmation No.: 4023

Filed: March 29, 2023 | Art Unit: 3797

For: SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION | Examiner: JOSEPH M SANTOS RODRIGUEZ

PETITION FOR SUBMISSION OF COLOR FORMAL DRAWINGS AND REQUEST TO ACCEPT COLOR DRAWING

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

Dear Commissioner:

Applicant hereby requests that the drawing sheets in the present application be accepted as formal drawings in this case in accordance with 37 C.F.R. 1.84(a)(2). The color drawings correspond to images of biological tissue with annotations in color that facilitates understanding of the subject matter of the above-referenced patent application. The multiple (duplicate) sets of drawing sheets are believed to be unnecessary in view of electronic filing. Should the Examiner have any questions, s/he is cordially invited to call the undersigned at the telephone number listed below.

Filed concurrently herewith is the requisite fee as set forth in 37 C.F.R. § 1.17(h) for filing this Petition for Submission of Color Formal Drawings under 37 C.F.R. § 1.84(a)(2) and a Preliminary Amendment amending the specification to include the requisite paragraph in the Brief Description of the Drawings as set forth in 37 C.F.R. § 1.84(a)(2).

Dated: January 31, 2024

Respectfully submitted,

By: /Ronen Adato/
Ronen Adato, PhD
Registration No.: 76,341
CHOATE, HALL & STEWART LLP
Two International Place
Boston, Massachusetts 02110
(617) 248-4814
Attorney For Applicant

PART B–FEE(S) TRANSMITTAL

Complete and send this form, together with the applicable fee(s), by mail or fax, or via the USPTO patent electronic filing system.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 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 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. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

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

24280 7590 11/21/2023

CHOATE, HALL & STEWART LLP
Two International Place
Boston, Massachusetts 02110

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 the USPTO patent electronic filing system 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
18/127,991	03/29/2023	Jens Filip Andreas Richter	2010358-0284	4023

TITLE OF INVENTION: SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION

APPLN: TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1,200.00	$0.00	$0.00	$1,200.00	02/21/2024

EXAMINER	ART UNIT	CLASS-SUBCLASS
SANTOS RODRIGUEZ, JOESPH M.	3797	600-425000

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/AIA/47 or 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. Choate, Hall & Stewart LLP
2. William R. Haulbrook, PhD, JD
3. Ronen Adato, PhD, JD

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: EXINI Diagnostics AB

(B) RESIDENCE: (CITY and STATE or COUNTRY): Lund, SE

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)

4b. Method of Payment (*Please first reapply any previously paid fee shown above*):

☒ Electronic Payment via the USPTO patent electronic filing system ☐ 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. 03-1721

5. Change of Entity Status (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29. NOTE: Absent a valid Certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

☐ Applicant asserting small entity status. See 37 CFR 1.27. NOTE: If the application was previously under micro entity status, checking this box will be taken as a notification of loss of entitlement to micro entity status.

☐ Applicant changing to regular undiscounted fee status. NOTE: Checking this box will be taken as 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 /Ronen Adato/ Date January 31, 2024

Typed or printed name Ronen Adato, PhD, JD Registration No. 76,341

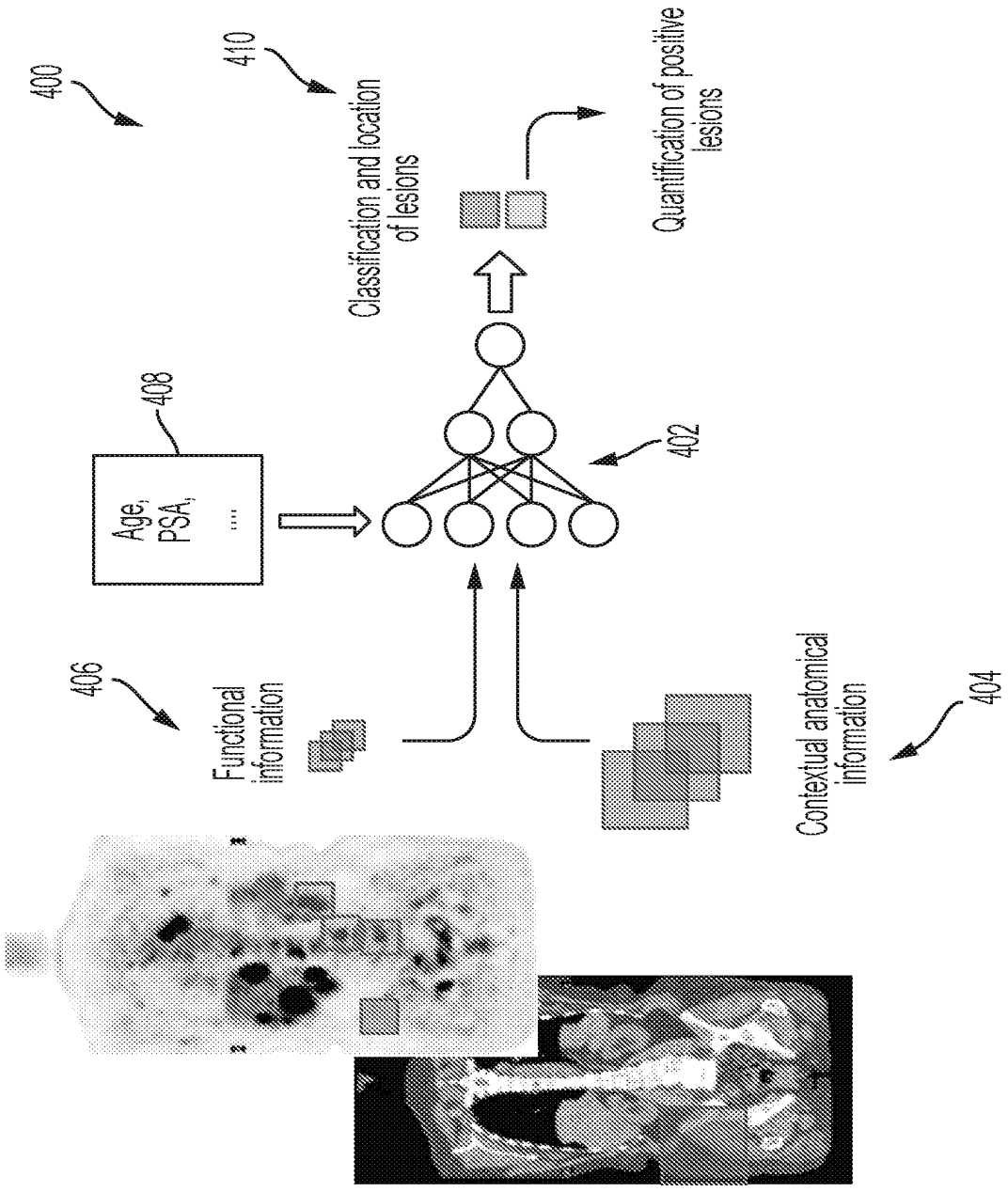

400
410
Classification and location of lesions
Quantification of positive lesions
408
Age, PSA, ...
402
406
Functional information
Contextual anatomical information
404

FIG. 4

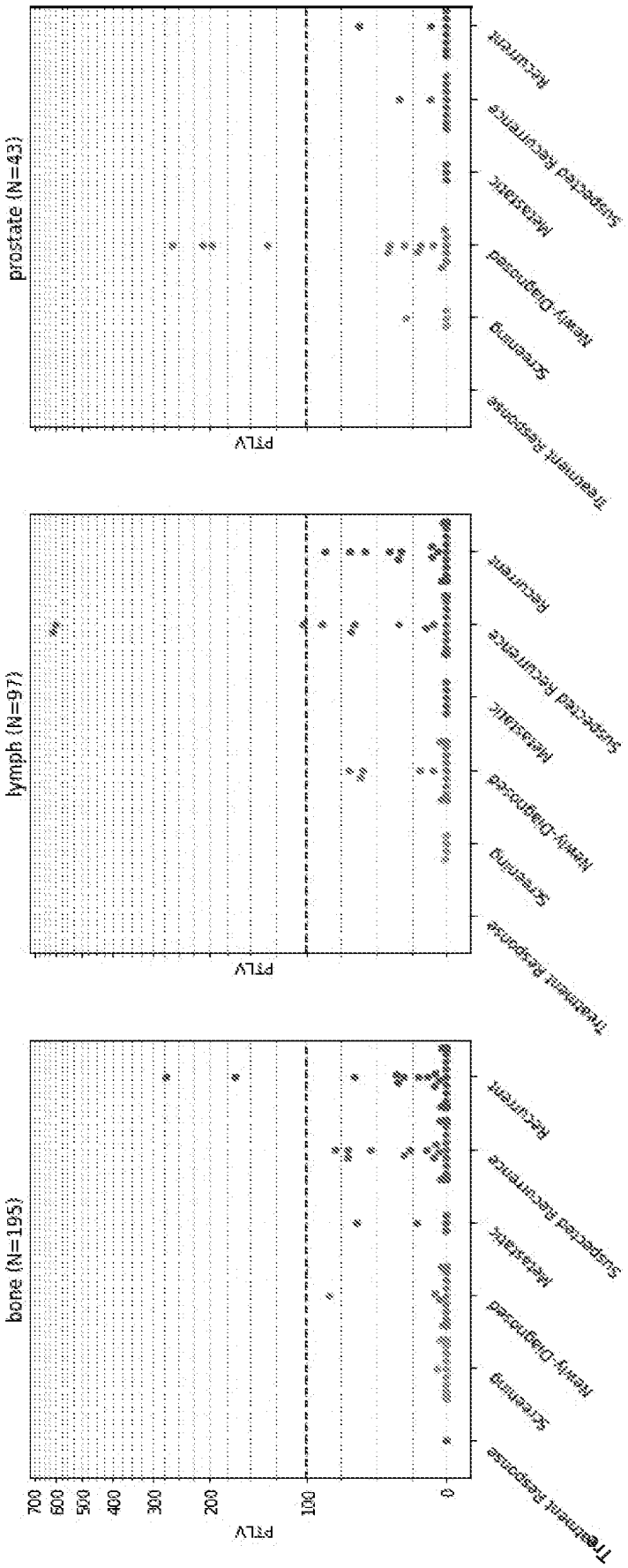

bone (N=195)
lymph (N=97)
prostate (N=43)
PSLV
700
600
500
400
300
200
100
0
Treatment Response
Screening
Newly-Diagnosed
Metastatic
Suspected Recurrence
Recurrent

FIG. 19

Docket No.: 2010358-0284
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
EXINI Diagnostics AB

Application No.: 18/127,991 | Confirmation No.: 4023

Filed: March 29, 2023 | Art Unit: 3797

For: SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION | Examiner: JOSEPH M SANTOS RODRIGUEZ

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

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

Dear Commissioner:

Prior to issuance of the patent, applicant respectfully requests entry of this amendment under 37 C.F.R. § 1.312 for the above-captioned patent application.

Amendment to the Specification begin on page **2** of this paper;

Amendments to the Drawing begin on page **3** of this paper; and

Remarks begin on page **4** of this paper.

11788670v4

AMENDMENTS TO THE SPECIFICATION

Please insert the following paragraph immediately following the heading "Brief Description of the Figures" and immediately before current paragraph [0137] on pg. 47:

[0137] The patent or application file contains at least one drawing executed in color. Copies of this patent or patent application publication with color drawing(s) will be provided by the Office upon request and payment of the necessary fee.

AMENDMENTS TO THE DRAWING

Please replace sheets 4 and 25 (corresponding to FIG. 4 and FIG. 19) of the current drawing on record with the two replacement sheets (corresponding to amended versions of sheets 4 and 25) of drawing submitted herewith. The replacement sheets are fully supported by the specification and original drawing as filed. No new matter is added.

REMARKS

Amendments to the Specification

The specification has been amended to reflect that that color drawings were filed with this application. The amendments to the specification are fully supported by the specification and drawings as originally filed. No new matter is added.

Amendment to the Drawing

With entry of this Amendment After Allowance, Applicant amends the drawing via submission of two replacement sheets of drawing, filed herewith. The amendments to the drawing are fully supported by the specification and drawing as originally filed, for example, original sheets 4 and 25 (corresponding to FIGs. 4 and 19) as filed and paragraph [0206] of the specification (e.g., which states, "As shown in FIG. 4, a machine learning module 402, such as a convolutional neural network (CNN), receives ***contextual anatomical information*** (e.g., a CT image or other anatomical imaging modality) ***404*** along with ***functional information*** (e.g., a functional image, such as a SPECT, PET, or other functional image obtained using a particular imaging probe) ***406***. [***emphasis added***]"). No new matter is added.

Amendments made via the present Amendment After Allowance are solely to address informalities in the drawing in view of the Notice to File Corrected Application Papers, dated December 8, 2023 and which were further discussed on January 22, 2024, with the USPTO (representative ID No. 1-848-726565 and agent for Applicant, Dr. Volodymyr Koman, Reg. No. 800,072). In particular, FIG. 4 is amended to adjust positioning of reference numerals "404" and "406" to further clarify their correspondence to certain elements of FIG. 4 and FIG. 19 is amended to provide the right-most plot with a right-hand border, to clarify that it is not truncated.

Accordingly, Applicant respectfully submits that the amendment does not necessitate further examination.

Applicant submits that the present amendment is timely filed with payment of the Issue Fee and, accordingly, is required only to comply with 37 C.F.R. § 1.312, which does not require the fee under 37 C.F.R. § 1.17(i) or a petition.

Conclusion

Applicant thanks the Examiner and Office for careful consideration of the present case. If a telephone conversation would help clarify any issues or expedite prosecution of the case, Applicant invites the Examiner to contact the undersigned at (617) 248-4814.

It is Applicant's understanding that all the necessary fees, if any, are being paid with this submission. However, if Applicant's understanding is incorrect, the Director is hereby authorized to charge any deficiency in the fees required for processing this Paper, or credit any overpayments, to our Deposit Account No. 03-1721, under Attorney Docket No. 2010358-0284.

Dated: January 31, 2024

Respectfully submitted,

Electronic signature: /Ronen Adato/
Ronen Adato, PhD, JD
Registration No.: 76,341
CHOATE, HALL & STEWART LLP
Two International Place
Boston, Massachusetts 02110
(617) 248-4814
Attorney For Applicant

11788670v4

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.
18/127,991	03/29/2023	Jens Filip Andreas Richter	2010358-0284	4023

24280 7590 02/08/2024

CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

EXAMINER	
SANTOS RODRIGUEZ, JOSEPH M	

ART UNIT	PAPER NUMBER
3797	

NOTIFICATION DATE	DELIVERY MODE
02/08/2024	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):

choatepatentdepartment@choate.com
patentdocket@choate.com

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Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

In re Application of: JENS RICHTER
Serial No.: 18127991
Filed: March 29, 2023
Docket: 2010358-0284
Title: SYSTEMS AND METHODS FOR PLATFORM AGNOSTIC WHOLE BODY IMAGE SEGMENTATION

DECISION ON PETITION UNDER 37 CFR 1.84(a)(2) TO ACCEPT COLOR DRAWINGS

This decision is in response to the petition under 37 CFR 1.84(a)(2) for acceptance of color drawings, filed 31 January 2024.

The petition is **GRANTED**.

REVIEW OF FACTS

Petitioner filed a petition requesting acceptance of color drawings on 31 January 2024.

REGULATION AND PRACTICE

37 CFR 1.84(a)(2) states in relevant part**:**

> "*Color.* Color drawings are permitted in design applications. Where a design application contains color drawings, the application must include the number of sets of color drawings required by paragraph (a)(2)(ii) of this section and the specification must contain the reference required by paragraph (a)(2)(iii) of this section. On rare occasions, color drawings may be necessary as the only practical medium by which to disclose the subject matter sought to be patented in a utility patent application. The color drawings must be of sufficient quality such that all details in the drawings are reproducible in black and white in the printed patent. Color drawings are not permitted in international applications (see PCT Rule 11.13). The Office will accept color drawings in utility patent applications only after granting a petition filed under this paragraph explaining why the color drawings are necessary. Any such petition must include the following:
>
> (i) The fee set forth in § 1.17(h);

(ii) One (1) set of the color drawings if submitted via the Office electronic filing system or three (3) sets of the color drawings if not submitted via the Office electronic filing system; and

(iii) An amendment to the specification (unless the specification contains or has been previously amended to contain) the following language as the first paragraph of the brief description of the drawings:

'The patent or application file contains at least one drawing executed in color. Copies of this patent or patent application publication with color drawing(s) will be provided by the Office upon request and payment of the necessary fee.'"

MPEP § 608.02(VIII) COLOR DRAWINGS OR COLOR PHOTOGRAPHS states in relevant part**:**

> It is anticipated that such a petition will be granted only when the U.S. Patent and Trademark Office has determined that a color drawing or color photograph is the only practical medium by which to disclose in a printed utility patent the subject matter to be patented.

ANALYSIS

Petitioner has satisfied all criteria identified in 37 CFR 1.84(a)(2) and MPEP § 608.02(VIII) above.

DECISION

For the above-stated reasons, the petition is **GRANTED**.

Petitioner is advised that this decision grants the petition to accept color drawing(s) or photograph(s) because the requirements of 37 CFR 1.84(a)(2) or (b)(2) have been met. The initial review undertaken for purposes of the petition did not identify new matter in the color drawing(s) or photograph(s). However, the grant of this petition should not be construed as a determination that should the color drawing(s) be entered the application would be free of statutory and/or formal defects. See MPEP § 608.02(VIII) and 608.02(b). The examiner is charged with determining whether applicant's nonprovisional application as amended to include the replacement drawings complies with all statutory requirements (e.g., enablement under 35 U.S.C. 112) and other applicable requirements (e.g., other formal requirements under 37 CFR 1.84). Further, the determination of whether a petition establishes a sufficient basis to accept color drawings or photographs is separate from the examiner's ultimate determination as to whether an amendment to the drawings should be entered (e.g., based on the prohibition under 35 U.S.C. 132 against introducing new matter). See MPEP § 608.04(a), 608.02(h), and 2163.06(I).

Any inquiry concerning this decision should be directed to Andrew Gilbert at (571) 272-7216.

/ANDREW M GILBERT/
Quality Assurance Specialist, TC 3700

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United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/127,991	03/29/2023	Jens Filip Andreas Richter	2010358-0284	4023

24280 7590 02/21/2024

CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

EXAMINER
SANTOS RODRIGUEZ, JOSEPH M

ART UNIT	PAPER NUMBER
3797	

NOTIFICATION DATE	DELIVERY MODE
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choatepatentdepartment@choate.com
patentdocket@choate.com

Response to Rule 312 Communication	Application No. 18/127,991	Applicant(s)
	Examiner	Art Unit

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

1. ☒ The amendment filed on *31 January 2024* under 37 CFR 1.312 has been considered, and has been:

   a) ☒ entered.

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

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

   d) ☐ disapproved. See explanation below.

   e) ☐ entered in part. See explanation below.

/C. Garner/

Publishing Division

Office of Data Management

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/127,991	03/26/2024	11941817	2010358-0284	4023

24280 7590 03/06/2024

CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

ISSUE NOTIFICATION

The projected patent number and issue date are specified above. The patent will issue electronically. The electronically issued patent is the official patent grant pursuant to 35 U.S.C. § 153. The patent may be accessed on or after the issue date through Patent Center at https://patentcenter.uspto.gov/. The patent will be available in both the public and the private sides of Patent Center. Further assistance in electronically accessing the patent, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-888-217-9197.

The USPTO is implementing electronic patent issuance with a transition period, during which period the USPTO will mail a ceremonial paper copy of the electronic patent grant to the correspondence address of record. Additional copies of the patent (i.e., certified and presentation copies) may be ordered for a fee from the USPTO's Certified Copy Center at https://certifiedcopycenter.uspto.gov/index.html. The Certified Copy Center may be reached at (800)972-6382.

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 0 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 Center (https://patentcenter.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 Patents Stakeholder Experience (OPSE), Stakeholder Support Division (SSD) at (571)-272-4200.

INVENTOR(s) (Please see PATENT CENTER site https://patentcenter.uspto.gov for additional inventors):

Jens Filip Andreas Richter, Lund, SWEDEN;
Kerstin Elsa Maria Johnsson, Lund, SWEDEN;
Erik Konrad Gjertsson, Lund, SWEDEN;
Aseem Undvall Anand, Queens, NY;

APPLICANT(s) (Please see PATENT CENTER site https://patentcenter.uspto.gov for additional applicants):

EXINI Diagnostics AB, Lund, SWEDEN;

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

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24280 7590 03/26/2024

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EXAMINER
SANTOS RODRIGUEZ, JOSEPH M

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choatepatentdepartment@choate.com
patentdocket@choate.com

APPLICATION NO.	ISSUE DATE	PATENT NO.
18/127,991	26-Mar-2024	11941817

CHOATE, HALL & STEWART LLP
TWO INTERNATIONAL PLACE
BOSTON, MA 02110

EGRANT NOTIFICATION

Your electronic patent grant (eGrant) is now available, which can be accessed via Patent Center at https://patentcenter.uspto.gov

The electronic patent grant is the official patent grant under 35 U.S.C. 153. For more information, please visit https://www.uspto.gov/electronicgrants

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SCORE Placeholder Sheet for IFW Content

Application Number: 18127991 Document Date: 03/26/2024

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

Since this was an electronic submission, there is no physical artifact folder, no artifact folder is recorded in PALM, and no paper documents or physical media exist. The TIFF images in the IFW record were created from the original documents that are stored in SCORE.

- Patent Grant with Color/Grayscale Drawings

At the time of document entry (noted above):

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