

973137

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UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

January 18, 2019

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APPLICATION NUMBER: 62/597,537

FILING DATE: December 12, 2017

RELATED PCT APPLICATION NUMBER: PCT/US18/65226

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS US62/597,537



Certified by

Michelle M. Lee

Under Secretary of Commerce
for Intellectual Property
and Director of the United States
Patent and Trademark Office

Doc Code: **TR.PROV**

Document Description: Provisional Cover Sheet (SB16)

PTO/SB/16 (11-08)

Approved for use through 05/31/2015. OMB 0651-0032

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Provisional Application for Patent Cover Sheet

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c)

Inventor(s)

Inventor 1

[Remove](#)

Given Name	Middle Name	Family Name	City	State	Country ;
Ahmed		El Kaffas	Palo Alto	CA	US

All Inventors Must Be Listed – Additional Inventor Information blocks may be generated within this form by selecting the **Add** button.

[Add](#)

Title of Invention

MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM ULTRASOUND RF SPECTRUMS

Attorney Docket Number (if applicable)

079633-00001PR00

Correspondence Address

Direct all correspondence to (select one):

☒ The address corresponding to Customer Number

☐ Firm or Individual Name

Customer Number

106303

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒ No.

Yes, the invention was made by an agency of the United States Government. The U.S. Government agency name is:

Yes, the invention was under a contract with an agency of the United States Government. The name of the U.S. Government agency and Government contract number are:

Entity Status**Applicant asserts small entity status under 37 CFR 1.27 or applicant certifies micro entity status under 37 CFR 1.29**

- ☒ Applicant asserts small entity status under 37 CFR 1.27
- ☐ Applicant certifies micro entity status under 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
- ☐ No

Warning

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

Signature

Please see 37 CFR 1.4(d) for the form of the signature.

Signature	Erik Birkeneder/		Date (YYYY-MM-DD)	2017-12-12
First Name	Erik	Last Name	Birkeneder	Registration Number (If appropriate)
				65299

This collection of information is required by 37 CFR 1.51. 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 8 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **This form can only be used when in conjunction with EFS-Web. If this form is mailed to the USPTO, it may cause delays in handling the provisional application.**

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.

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	079633-000001PR00
		Application Number	
Title of Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM ULTRASOUND RF SPECTRUMS		
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	
	Ahmed		El Kaffas			
Residence Information (Select One) • US Residency Non US Residency Active US Military Service						
City	Palo Alto	State/Province	CA	Country of Residence	US	
Mailing Address of Inventor:						
Address 1		458 Fernando Ave.				
Address 2						
City	Palo Alto	State/Province	CA			
Postal Code		Country	US			
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	106303		
Email Address	lapatentmb@nixonpeabody.com	Add Email	Remove Email

Application Information:

Title of the Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM ULTRASOUND RF SPECTRUMS		
Attorney Docket Number	079633-000001PR00	Small Entity Status Claimed	☒
Application Type	Provisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	7	Suggested Figure for Publication (if any)	

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	079633-000001PR00
		Application Number	
Title of Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM ULTRASOUND RF SPECTRUMS		

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	106303		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status		Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.			
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	079633-000001PR00
		Application Number	
Title of Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM ULTRASOUND RF SPECTRUMS		

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

Application Number	Country ⁱ	Filing Date (YYYY-MM-DD)	Access Code ⁱ (if applicable)

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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	079633-000001PR00
		Application Number	
Title of Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM ULTRASOUND RF SPECTRUMS		

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.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	079633-000001PR00
		Application Number	
Title of Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM ULTRASOUND RF SPECTRUMS		

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	Oncoustics Inc.	
Mailing Address Information For Applicant:		
Address 1	25 Capreol Crt. - 4005	
Address 2		
City	Toronto, Ontario	State/Province
Country	CA	Postal Code
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.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	079633-000001PR00
		Application Number	
Title of Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM ULTRASOUND RF SPECTRUMS		

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. ☒			
Organization Name			
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	/Erik Birkeneder/		Date (YYYY-MM-DD)	2017-12-12
First Name	Erik	Last Name	Birkeneder	Registration Number
				65299
Additional Signature may be generated within this form by selecting the Add button. Add				

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	079633-000001PR00
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Title of Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM ULTRASOUND RF SPECTRUMS		

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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.

MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM ULTRASOUND RF SPECTRUMS

FIELD

[0001] The present invention is directed to ultrasound for classification and identification of various physiological aspects of a living organism, including tissue and biomarker identification and classification.

BACKGROUND

[0002] The following description includes information that may be useful in understanding the present invention. It is not an admission that any of the information provided herein is prior art or relevant to the presently claimed invention, or that any publication specifically or implicitly referenced is prior art.

[0003] Ultrasound imaging is widely used in clinical diagnosis and image-guided interventions. However, the field is relatively behind other areas of quantitative image analysis, including MRI, CT and X-ray analysis. For instance, many of the quantitative analysis techniques process the data from B-mode, after the ultrasound has already been converted into two dimensional images and much additional RF data has been removed. In other cases, the ultrasound RF data is analyzed using regression and best-fit models/analysis that yield specific known features for quantitative analysis. At times, these features can be directly correlated to specific tissue properties.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] The accompanying drawings, which are incorporated in and constitute a part of this specification, exemplify the embodiments of the present invention and, together with the description, serve to explain and illustrate principles of the invention. The drawings are intended to illustrate major features of the exemplary embodiments in a diagrammatic manner. The drawings are not intended to depict every feature of actual embodiments nor relative dimensions of the depicted elements, and are not drawn to scale.

[0005] FIG. 1 depicts a perspective view of an overview of an ultrasound system;

[0006] FIG. 2 depicts a flowchart showing a prior art method of tissue classification;

[0007] FIG. 3 depicts an example of a flowchart showing a method for classification of tissue using machine learning analysis of ultrasound data;

[0008] FIG. 4A depicts an example image of a mouse tumor using the systems and methods disclosed herein to segment the image using k-means clustering;

[0009] FIG. 4B depicts the original ultrasound image that was processed for FIG. 4A;

[0010] FIG. 5 depicts a schematic diagram of an ultrasound image analysis process; and

[0011] FIG. 6 depicts a schematic diagram of an ultrasound image analysis process.

[0012] In the drawings, the same reference numbers and any acronyms identify elements or acts with the same or similar structure or functionality for ease of understanding and convenience. To easily identify the discussion of any particular element or act, the most significant digit or digits in a reference number refer to the Figure number in which that element is first introduced.

DETAILED DESCRIPTION

[0013] Unless defined otherwise, technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. Szycher's Dictionary of Medical Devices CRC Press, 1995, may provide useful guidance to many of the terms and phrases used herein. One skilled in the art will recognize many methods and materials similar or equivalent to those described herein, which could be used in the practice of the present invention. Indeed, the present invention is in no way limited to the methods and materials specifically described.

[0014] In some embodiments, properties such as dimensions, shapes, relative positions, and so forth, used to describe and claim certain embodiments of the invention are to be understood as being modified by the term "about."

[0015] Various examples of the invention will now be described. The following description provides specific details for a thorough understanding and enabling description of these examples. One skilled in the relevant art will understand, however, that the invention may be practiced without many of these details. Likewise, one skilled in the relevant art will also understand that the invention can include many other obvious features not described in detail herein. Additionally, some well-known structures or functions may not be shown or described in detail below, so as to avoid unnecessarily obscuring the relevant description.

[0016] The terminology used below is to be interpreted in its broadest reasonable manner, even though it is being used in conjunction with a detailed description of certain specific examples of the invention. Indeed, certain terms may even be emphasized below; however, any terminology intended to be interpreted in any restricted manner will be overtly and specifically defined as such in this Detailed Description section.

[0017] While this specification contains many specific implementation details, these should not be construed as limitations on the scope of any inventions or of what may be claimed, but rather as descriptions of features specific to particular implementations of particular inventions. Certain features that are described in this specification in the context of separate implementations can also be implemented in combination in a single implementation. Conversely, various features that are described in the context of a single implementation can also be implemented in multiple implementations separately or in any suitable subcombination. Moreover, although features may be described above as acting in certain combinations and even initially claimed as such, one or more features from a claimed combination can in some cases be excised from the combination, and the claimed combination may be directed to a subcombination or variation of a subcombination.

[0018] Similarly while operations may be depicted in the drawings in a particular order, this should not be understood as requiring that such operations be performed in the particular order shown or in sequential order, or that all illustrated operations be performed, to achieve desirable results. In certain circumstances, multitasking and parallel processing may be advantageous. Moreover, the separation of various system components in the implementations described above

should not be understood as requiring such separation in all implementations, and it should be understood that the described program components and systems can generally be integrated together in a single software product or packaged into multiple software products.

Overview

[0019] Conventional ultrasound spectroscopy uses ultrasound frequency spectrums from ultrasound RF data (raw sound signal as it returns into transducer) to extract specific, pre-defined quantitative parameters that can describe tissue state (e.g., information on the ultrasound scatter size, concentration and change in impedance in tissue).

[0020] In some conventional applications, systems extract sets of parameters to characterize and classify tissue from RF, or a frequency-domain RF (employing a Fourier or wavelet transform). This process takes the RF data and first normalizes it to a calibration spectrum (acquired separately) to remove the machine setting, some artifacts and some user dependencies. Next, it extracts parameters, which are correlated to different tissue pathologies. This is done by taking a certain segment of the spectrum (with an established bandwidth around the center frequency of the signal) and fitting it to a specific mathematical model or simple linear regression. However, the parameters and quality of fit are not ideal, and predetermined models and parameters usually miss valuable information degrading the accuracy and specificity of classification using these methods.

[0021] Another method using machine learning takes ultrasound *images* and trains machine learning models to recognize certain pathologies based on these conventionally qualitative images. Effectively, this system is used to automate the clinical process of a clinician analyzing images from the processed ultrasound data. However, conventional clinical images (e.g. two dimensional B-mode images) are heavily processed from the raw ultrasound data and though they appear good qualitatively, they lack information about tissue microstructure.

[0022] However, it has been discovered that using artificial intelligence/machine learning methods (“ML”) to analyze the ultrasound data as is – instead of conventional mathematical models or “fits” that parameterize the signal – provides for vastly increased accuracy and

specificity. Particularly, this allows for more accurate and specific classification and identification of tissue types and biomarkers related to tissue – including for disease states. Additionally, it has been discovered that applying the ML models to the raw data or the frequency spectrum data – rather than the images (e.g. B-mode) after processing – provides much more accurate results because the already heavily processed images have much of the important ultrasound data filtered out, including that which is useful for diagnosis and classification (e.g., a lot of the microstructure of tissue is lost when processing the data to form images).

[0023] In some examples, the entire spectrum of data or a specific subset of the spectrum can be used as a feature set to train an ML model to evaluate and classify tissues in ultrasound images for screening, diagnostics and treatment monitoring applications. The spectrum-based features as is, or normalized (using standard methods) can be used as is, or combined with conventional parameters from linear regression or mathematical models. The RF ultrasound data may be converted to a normalized power spectrum which may then be fed into a trained (supervised, unsupervised or deep learning method) ML model(s) to classify tissues for specific applications, or to find specific multi-parametric biomarkers, or to identify and apply previously unknown parameters of normal and pathological physiology. In other examples, the raw data before conversion to spectra, or the RF converted to other domains (i.e. Laplace transform, principal component analysis, etc.) may be input to ML learning algorithms.

Ultrasound System

[0024] Various conventional ultrasound systems may be utilized that include an ultrasound transducer and signal processing equipment. For instance, FIG. 1 illustrates an example of an ultrasound system that includes an ultrasound transducer 100, a signal processor 110, a mobile device 105, a network 160, display 150, server 170, and database 180.

[0025] In this example, a handheld ultrasound transducer 100 contained in a handheld case (e.g. ultrasound probe) is utilized. In other examples, a robotic arm transducer or other transducer 100 implementations may be utilized. In some examples, to focus the ultrasound beam, the

transducer 100 may use phased array techniques, shaping of the transducer 100 or utilize a physical lens.

[0026] In some examples, materials on the face of the transducer 100 enable the sound to be transmitted efficiently to the patient's body 105 (e.g. human, animal) by impedance matching. For instance, this may be a rubber or other coating. In addition, a water based gel may be utilized between the patient's skin and the ultrasound transducer case. The sound waves propagate through the patient 105 until they are reflected in places where the acoustic impedance changes in the patient's 105 body. The return of the sound wave is then detected by the transducer(s) 100, which is converted to a signal that is the RF data. The RF data can be pre-beamforming in or post-beamforming.

[0027] The ultrasound data output from the transducer 100 may be processed by a processing unit 110 or other associated processors and computing devices in various ways as disclosed herein. In some cases, after processing an image showing various identified tissues or other indicators may be displayed on a display 150. The ultrasound data may be processed fully or partially by electronics included within the transducer 100 casing, on a separate processing unit 110, or an electrically connected computing device. In other examples, the data can be fully or partially processed on a local or remote server 170 connected to the processing unit 110 and/or transducer through a network 160.

[0028] Processing and display of the ultrasound data may also take place fully or partially on an associated mobile device 105, or results of the processing may be sent to and displayed on a mobile device 105. An associated database 180 may store the ultrasound data, models utilized for processing the data, and information about various patients and testing 105. Additionally, a server 170 or separate servers 170 may process training data to form and/or update the models and store them on a database 180.

[0029] The system may connect to a variety of different ultrasound transducers 100 and/or signal processing units 110. This data maybe aggregated and analyzed by a server(s) 170 and may be stored on databases 180. The data from different processing units 110 could be utilized to

continually update and train a model for processing the data, based on different types of patients and ultrasound units (e.g., for different types of transducers 100). Accordingly, the RF signal can be at any stage before image formation pre-beamforming, pre-scan conversion, post beamforming, post-scan conversion, etc.

Ultrasound Data Processing Methods

[0030] Previously described ultrasound processing methods are illustrated in the flowchart of FIG. 2. For instance, most ultrasound systems include a driver that drives the ultrasound signal 200 sent to the transducer 100. Then, the transducer 100 vibrates and emits the ultrasound signals 205 that are directed toward a patient's 105 body. The transducer then detects the reflected signals 210, and outputs the ultrasound data or raw RF data 215. Then, in previously described systems, the raw ultrasound data is typically broken up into various windows 220. Then, the power spectral for each window 225 may be determined, and the spectrum normalized 230 to calibrate for certain hardware and parameters settings (to be independent to system and acquisition parameters properties). Then, the parameters maybe extracted 235 using line of best fit or other regression models. The system them would display a parametric map or average of the parameters throughout the image 240.

[0031] FIG. 3 illustrates an example of an ultrasound processing method according to the present disclosure. As illustrated, the steps through outputting of the raw ultrasound data from the transducer 215 are largely the same. However, as illustrated, once the raw ultrasound data is output from the transducer 100, the processing steps may follow a similar or different path, but then are ultimately process by a machine learning model 300. While FIG. 3 is one example, FIG. 6 illustrates another example of an ultrasound processing method.

[0032] In some examples, the same steps of breaking the data into windows 220, performing a power spectrum for each window 225, and normalizing the spectrum 230 may be the same. For instance, many applications use a Fourier transform to turn the raw ultrasound data into spectral data for further analysis. In other examples, the raw ultrasound data may be input directly into a machine learning model 300, or optionally may undergo initial filtering techniques and

transformations other than frequency processing and then may be fit into a machine learning model 300 without first converting the data into the frequency domain.

[0033] In some examples, the normalized power spectrums output for each window 225 may be used as a feature set 245 input into a machine learning model. The spectrum is typically discretized to be representative of the continuous spectrum to obtain the set of features. In some examples, different processing techniques may be utilize non-normalized or normalized spectrums, full spectrum or windows of spectrums 315, or in other examples the raw RF data may be input into the machine learning model or any other form of processed RF data. In some examples, different Fourier transform discretization 325 may be utilized to develop features.

[0034] In these examples, the machine learning model 300 utilized may be a model trained to find a specific type of tissue. For instance, a server 170 may constantly process new data to update and train the model to recognize, for instance, liver cancer based on a signature the model recognizes. The model may be different kinds of neural networks, deep learning neural networks, supervised or unsupervised models, or other suitable types of machine learning models.

EXAMPLES

[0035] The following examples are provided to better illustrate the claimed invention and are not intended to be interpreted as limiting the scope of the invention. To the extent that specific materials or steps are mentioned, it is merely for purposes of illustration and is not intended to limit the invention. One skilled in the art may develop equivalent means or reactants without the exercise of inventive capacity and without departing from the scope of the invention.

[0036] Several different modes of ultrasound are known. For instance, in A-mode (amplitude mode), a single transducer scans a line through the body with echoes plotted on screen as a function of depth. B-mode or 2D mode uses a linear array of transducers to simultaneously scan a plane through the body that case be viewed as a two dimensional image on screen.

[0037] FIG. 5 illustrates an example of an ultrasound transducer 100 aimed at a patient's body, that would penetrate into the body and potentially identify an abnormal, diseased, or other

types of tissue 585 in the liver for example. For instance, the transducer 100 may contain a linear array of transducers 100 as illustrated in FIG. 5. Each of the transducers 100 would emit or vibrate at a certain frequency (or multiple frequencies) and sound waves would enter the patient's body. For instance, the ultrasound transducers 100 may emit sound pulses with a Gaussian intensity curve (intensity v frequency) around a central frequency within the range of, for example, 1 – 5 megahertz. For instance, the transducer(s) 100 may emit an acoustic wave that it is centered around 2 megahertz, and includes frequencies around 2 megahertz with decreasing intensity to form a Gaussian curve around 2 megahertz.

[0038] When the emitted sound waves encounter various structures of the body that have different acoustic properties, portions of the sound waves get reflected back to the transducer 100 at the boundary between the structures. The greater the difference in the acoustic properties, the greater is the intensity or energy of the reflected waves. Additionally, structures of the body contribute to attenuation of the signal and scattering.

[0039] Then, once the reflected sound waves hit one or more transducer(s) the transducers will record the exact time of flight when the received wave is registered. Additionally, the intensity of the wave or pulse will be determined. Using the time of flight and the linear array of transducers 100, the system can reconstruct a two dimensional grid or data segments of ultrasound RF data that includes an array of frequencies, intensities and other data at each data segments 520. Generally, the array of frequencies can be converted into a power spectrum curve 530 that shows the returned intensity of the acoustic signal at various of frequencies. In some examples, the system will only record different sized bands of frequencies around the emission frequency or a frequency near the emission frequency. In some examples, the bands may be 4, 5, 6, 7, or 8 dB wide.

[0040] In the case of a linear array of transducers, the system may use beamforming or other techniques that utilize concepts of destructive and constructive interference to reconstruct the frequencies and intensities for each data segments of an ultrasound plane along each RF line. As discussed earlier, in some examples, the signals may be processed into a two dimensional array of data segments that represent different readings or data at each data segment, and in turn each

represent the reflected ultrasound signal at a certain location in the object (e.g., a portion of the liver if the transducer 100 is aimed at a patient's body).

[0041] In some examples, a reference will then be applied to each of the data segments 520 to normalize a reference tissue to the curve obtained from the object or patient. In other examples, the raw data output from the transducers will be processed by a machine learning model 300 to allow it to find the features. In some examples, a power spectrum 535 will be taken of each data segment 520. In some examples a larger window 510 or sliding window 510 or a bounding box 510 (as in a YOLO, "You Only Look Once," strategy) or anchor box 510 may be applied to a matrix of data segments to average or combine using other statistical techniques to provide a power spectrum 535 or other data set for each window 510.

[0042] Then, a machine learning algorithm 300 may be applied to the data set for each data segment 520, or each window 510. This may be used to classify the tissue represented in the window 510 or data segments 520. For instance, the system may classify the tissue in the window 510 as abnormal, cancerous, water, bone, or air. In some examples, the system may utilize the input of all of the data segments 520 or windows 510 to then classify each tissue, or classify larger portions of the tissue, such as a region of interest.

[0043] Then, once each data segment 520 or window 510 is classified, the system may display an image differentiating the tissues 310 by classification. The image could be displayed as a heatmap or other map similar to FIG. 4A, or could have numeric values, diagnosis, or other classification mapped to each section of tissue. In some examples, the system may output whether or not the tissue contains any cancerous cells after classifying each of the data segments 520 or windows 510.

Machine Learning Models

[0044] In some examples, the machine learning model 300 will be an unsupervised algorithm. In other examples, the machine learning model 300 will be supervised. The, machine learning model 300 may take a variety of forms. For instance, the system may utilize more basic machine learning tools including 1) decision trees ("DT"), (2) Bayesian networks ("BN"), (3)

artificial neural network (“ANN”), or (4) support vector machines (“SVM”). In other examples, deep learning algorithms or other more sophisticated machine learning algorithms, e.g., convolutional neural networks (“CNN”), or capsule networks (“CapsNet”) may be used.

[0045] DT programs are generally used because of their simplicity and ease of understanding. DT are classification graphs that match input data to questions asked at each consecutive step in a decision tree. The DT program moves down the “branches” of the tree based on the answers to the questions (e.g., First branch: Is the patient male? yes or no. Branch two: Is the patient having trouble urinating? yes or no, etc.).

[0046] Bayesian networks (“BN”) are based on likelihood something is true based on given independent variables and are modeled based on probabilistic relationships. BN are based purely on probabilistic relationships that determine the likelihood of one variable based on another or others. For example, BN can model the relationships between symptoms and diseases. Particularly, if a patient’s symptoms or biomarkers levels are known, a BN can be used to compute the probability that a patient has a particular disease. Thus, using an efficient BN algorithm, an inference can be made based on the input data. They are commonly used by the medical domain to represent reasoning under uncertain conditions for a wide range of applications, including disease diagnostics, genetic counseling, and emergency medical decision support system (MDSS) design.

[0047] Artificial neural networks (“ANN”) are computational models inspired by an animal's central nervous system. They map inputs to outputs through a network of nodes. However, unlike BN, in ANN the nodes do not necessarily represent any actual variable. Accordingly, ANN may have a hidden layer of nodes that are not represented by a known variable to an observer.

[0048] ANNs are capable of pattern recognition and have been used for the medical and diagnostics fields. Their computing methods make it easier to understand a complex and unclear process that might go on during diagnosis of an illness based on input data a variety of input data including symptoms. While still facing steep limitations, ANN has demonstrated to be suitable in

a clinical decision support system design and other biomedical applications, such as diagnosis of myocardial infarction, MDSS for leukemia management, and cancer detection.

[0049] Support vector machines (“SVM”) came about from a framework utilizing of machine learning statistics and vector spaces (linear algebra concept that signifies the number of dimensions in linear space) equipped with some kind of limit-related structure. In some cases, they may determine a new coordinate system that easily separates inputs into two classifications. For example, a SVM could identify a line that separates two sets of points originating from different classifications of events.

[0050] They have been applied practically and are theoretically well-founded, but can sometimes be difficult to understand. SVMs have been applied to a number of biological domains, such as MDSS for the diagnosis of tuberculosis infection, tumor classification, and biomarker discovery.

[0051] However, there is a relatively new type of machine learning algorithm that is capable of modeling very complex relationships that have a lot of variation that are called deep neural networks. Deep neural networks (DNN) have developed recently to tackle the problems of speech recognition.

[0052] In the IT industry fields, various architectures of DNN have been proposed to tackle the problems associated with algorithms such as ANN by many researchers during the last few decades. These types of DNN are CNN (Convolutional Neural Network), RBM (Restricted Boltzmann Machine), LSTM (Long Short Term Memory) etc. They are all based on the theory of ANN. They demonstrate a better performance by overcoming the back-propagation error diminishing problem associated with ANN.

[0053] In some examples, clustering based on k-means, or K-nearest neighbors approaches may be a useful machine learning model 300. In other examples, a K-means clustering methods may be used as machine learning models 300. In other examples, principle component analysis can be utilized to separate the data and classify the tissues.

Machine Learning – Training Data

[0054] Machine learning models 300 require training data to identify the features of interest that they are designed to detect. For instance, various methods may be utilized to form the machine learning models 300 including applying randomly assigned initial weights for the network and applying gradient descent using back propagation for deep learning algorithms. In other examples, a neural network with one or two hidden layers can be used without training using this technique.

[0055] In some examples, the machine learning models 300 will be trained using labeled data, or data that represents certain features, specific tissues, diagnosis, or stage of diagnosis of tissues. In other examples, the data will only be labeled with the outcome and the various relevant data may be input to train the machine learning algorithm.

[0056] For instance, to classify a tissue or window of tissue, various machine learning models 300 may be utilized that input various data disclosed herein. In some examples, the input data will be labeled by correlating by having a certified radiologist label the tissues, windows 510 or data segments 520 that include cancer data. Accordingly, the input to the machine learning algorithm for training data may be cancer boxes or non-cancerous. In other examples, it may include additional labels including water, tissue, bone, and air.

Computer & Hardware Implementation of Disclosure

[0057] It should initially be understood that the disclosure herein may be implemented with any type of hardware and/or software, and may be a pre-programmed general purpose computing device. For example, the system may be implemented using a server, a personal computer, a portable computer, a thin client, or any suitable device or devices. The disclosure and/or components thereof may be a single device at a single location, or multiple devices at a single, or multiple, locations that are connected together using any appropriate communication protocols over any communication medium such as electric cable, fiber optic cable, or in a wireless manner.

[0058] It should also be noted that the disclosure is illustrated and discussed herein as having a plurality of modules which perform particular functions. It should be understood that these modules are merely schematically illustrated based on their function for clarity purposes only, and do not necessarily represent specific hardware or software. In this regard, these modules may be hardware and/or software implemented to substantially perform the particular functions discussed. Moreover, the modules may be combined together within the disclosure, or divided into additional modules based on the particular function desired. Thus, the disclosure should not be construed to limit the present invention, but merely be understood to illustrate one example implementation thereof.

[0059] 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. In some implementations, a server transmits data (e.g., an HTML page) to a client device (e.g., for purposes of displaying data to and receiving user input from a user interacting with the client device). Data generated at the client device (e.g., a result of the user interaction) can be received from the client device at the server.

[0060] Implementations of the subject matter described in this specification 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 subject matter described in this specification, or any combination of one or more 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”) and a wide area network (“WAN”), an inter-network (e.g., the Internet), and peer-to-peer networks (e.g., ad hoc peer-to-peer networks).

[0061] Implementations of the subject matter and the operations described in this specification can be implemented in digital electronic circuitry, or in computer software, firmware, or hardware, including the structures disclosed in this specification and their structural equivalents, or in combinations of one or more of them. Implementations of the subject matter described in this specification can be implemented as one or more computer programs, i.e., one or more modules of computer program instructions, encoded on computer storage medium for execution by, or to control the operation of, data processing apparatus. Alternatively or in addition, the program instructions can be encoded on an artificially generated propagated signal, e.g., a machine-generated electrical, optical, or electromagnetic signal that is generated to encode information for transmission to suitable receiver apparatus for execution by a data processing apparatus. A computer storage medium can be, or be included in, a computer-readable storage device, a computer-readable storage substrate, a random or serial access memory array or device, or a combination of one or more of them. Moreover, while a computer storage medium is not a propagated signal, a computer storage medium can be a source or destination of computer program instructions encoded in an artificially generated propagated signal. The computer storage medium can also be, or be included in, one or more separate physical components or media (e.g., multiple CDs, disks, or other storage devices).

[0062] The operations described in this specification can be implemented as operations performed by a “data processing apparatus” on data stored on one or more computer-readable storage devices or received from other sources.

[0063] The term “data processing apparatus” encompasses all kinds of apparatus, devices, and machines for processing data, including by way of example a programmable processor, a computer, a system on a chip, or multiple ones, or combinations, of the foregoing. The apparatus can include special purpose logic circuitry, e.g., an FPGA (field programmable gate array) or an ASIC (application specific integrated circuit). The apparatus can also include, in addition to hardware, code that creates an execution environment for the computer program in question, e.g., code that constitutes processor firmware, a protocol stack, a database management system, an operating system, a cross-platform runtime environment, a virtual machine, or a combination of one or more of them. The apparatus and execution environment can realize various different

computing model infrastructures, such as web services, distributed computing and grid computing infrastructures.

[0064] A computer program (also known as a program, software, software application, script, or code) can be written in any form of programming language, including compiled or interpreted languages, declarative or procedural languages, and it can be deployed in any form, including as a stand-alone program or as a module, component, subroutine, object, or other unit suitable for use in a computing environment. A computer program may, but need not, correspond to a file in a file system. A program can be stored in a portion of a file that holds other programs or data (e.g., one or more scripts stored in a markup language document), in a single file dedicated to the program in question, or in multiple coordinated files (e.g., files that store one or more modules, sub-programs, or portions of code). A computer program can be deployed to be executed on one computer or on multiple computers that are located at one site or distributed across multiple sites and interconnected by a communication network.

[0065] The processes and logic flows described in this specification can be performed by one or more programmable processors executing one or more computer programs to perform actions by operating on input data and generating output. The processes and logic flows can also be performed by, and apparatus can also be implemented as, special purpose logic circuitry, e.g., an FPGA (field programmable gate array) or an ASIC (application-specific integrated circuit).

[0066] Processors suitable for the execution of a computer program include, by way of example, both general and special purpose microprocessors, and any one or more processors of any kind of digital computer. Generally, a processor will receive instructions and data from a read-only memory or a random access memory or both. The essential elements of a computer are a processor for performing actions in accordance with instructions and one or more memory devices for storing instructions and data. Generally, a computer will also include, or be operatively coupled to receive data from or transfer data to, or both, one or more mass storage devices for storing data, e.g., magnetic, magneto-optical disks, or optical disks. However, a computer need not have such devices. Moreover, a computer can be embedded in another device, e.g., a mobile telephone, a personal digital assistant (PDA), a mobile audio or video player, a

game console, a Global Positioning System (GPS) receiver, or a portable storage device (e.g., a universal serial bus (USB) flash drive), to name just a few. Devices suitable for storing computer program instructions and data include all forms of non-volatile memory, media and memory devices, including by way of example semiconductor memory devices, e.g., EPROM, EEPROM, and flash memory devices; magnetic disks, e.g., internal hard disks or removable disks; magneto-optical disks; and CD-ROM and DVD-ROM disks. The processor and the memory can be supplemented by, or incorporated in, special purpose logic circuitry.

CONCLUSION

[0067] The various methods and techniques described above provide a number of ways to carry out the invention. Of course, it is to be understood that not necessarily all objectives or advantages described can be achieved in accordance with any particular embodiment described herein. Thus, for example, those skilled in the art will recognize that the methods can be performed in a manner that achieves or optimizes one advantage or group of advantages as taught herein without necessarily achieving other objectives or advantages as taught or suggested herein. A variety of alternatives are mentioned herein. It is to be understood that some embodiments specifically include one, another, or several features, while others specifically exclude one, another, or several features, while still others mitigate a particular feature by inclusion of one, another, or several advantageous features.

[0068] Furthermore, the skilled artisan will recognize the applicability of various features from different embodiments. Similarly, the various elements, features and steps discussed above, as well as other known equivalents for each such element, feature or step, can be employed in various combinations by one of ordinary skill in this art to perform methods in accordance with the principles described herein. Among the various elements, features, and steps some will be specifically included and others specifically excluded in diverse embodiments.

[0069] Although the application has been disclosed in the context of certain embodiments and examples, it will be understood by those skilled in the art that the embodiments of the

application extend beyond the specifically disclosed embodiments to other alternative embodiments and/or uses and modifications and equivalents thereof.

[0070] In some embodiments, the terms “a” and “an” and “the” and similar references used in the context of describing a particular embodiment of the application (especially in the context of certain of the following claims) can be construed to cover both the singular and the plural. The recitation of ranges of values herein is merely intended to serve as a shorthand method of referring individually to each separate value falling within the range. Unless otherwise indicated herein, each individual value is incorporated into the specification as if it were individually recited herein. All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (for example, “such as”) provided with respect to certain embodiments herein is intended merely to better illuminate the application and does not pose a limitation on the scope of the application otherwise claimed. No language in the specification should be construed as indicating any non-claimed element essential to the practice of the application.

[0071] Certain embodiments of this application are described herein. Variations on those embodiments will become apparent to those of ordinary skill in the art upon reading the foregoing description. It is contemplated that skilled artisans can employ such variations as appropriate, and the application can be practiced otherwise than specifically described herein. Accordingly, many embodiments of this application include all modifications and equivalents of the subject matter recited in the claims appended hereto as permitted by applicable law. Moreover, any combination of the above-described elements in all possible variations thereof is encompassed by the application unless otherwise indicated herein or otherwise clearly contradicted by context.

[0072] Particular implementations of the subject matter have been described. Other implementations are within the scope of the following claims. In some cases, the actions recited in the claims can be performed in a different order and still achieve desirable results. In addition,

the processes depicted in the accompanying figures do not necessarily require the particular order shown, or sequential order, to achieve desirable results.

[0073] All patents, patent applications, publications of patent applications, and other material, such as articles, books, specifications, publications, documents, things, and/or the like, referenced herein are hereby incorporated herein by this reference in their entirety for all purposes, excepting any prosecution file history associated with same, any of same that is inconsistent with or in conflict with the present document, or any of same that may have a limiting effect as to the broadest scope of the claims now or later associated with the present document. By way of example, should there be any inconsistency or conflict between the description, definition, and/or the use of a term associated with any of the incorporated material and that associated with the present document, the description, definition, and/or the use of the term in the present document shall prevail.

[0074] In closing, it is to be understood that the embodiments of the application disclosed herein are illustrative of the principles of the embodiments of the application. Other modifications that can be employed can be within the scope of the application. Thus, by way of example, but not of limitation, alternative configurations of the embodiments of the application can be utilized in accordance with the teachings herein. Accordingly, embodiments of the present application are not limited to that precisely as shown and described.

CLAIMS

1. An ultrasound system comprising:

a transducer configured to output a set of ultrasound data;

a memory containing machine readable medium comprising machine executable code having stored thereon instructions;

a signal processing unit comprising one or more processors coupled to the memory, the one or more processors configured to execute the machine executable code to cause the one or more processors to:

receive the set of ultrasound data and partition the set of ultrasound data into a set of windows;

process the set of windows to determine a power spectrum for each of the windows;

process the power spectrum for each of the windows to determine a normalized power spectrum for each of the windows; and

process the normalized power spectrum for each of the windows with a machine learning model; and

display an image where each of the windows is displayed using a unique identifier based on the output of the machine learning model.

2. The ultrasound system of claim 1, wherein the machine learning model is a k-means model or a model from a deep learning network comprising but not limited to one or a combination to the algorithm types of CNN (Convolutional Neural Network), RBM (Restricted Boltzmann Machine), LSTM (Long Short Term Memory) or CapsNet (Capsule Networks).

3. The ultrasound system of claim 1, wherein the machine learning model is trained using ultrasound images labeled by a radiologist.

4. The ultrasound system of claim 1, wherein the machine learning model is an unsupervised model.

5. A method comprising:

receiving a set of ultrasound data output from at least one ultrasound transducer representing a tissue of a patient and partitioning the set of ultrasound data into a set of windows or bounding boxes;

processing the set of windows to determine a power spectrum for each of the windows;

processing the power spectrum for each of the windows with a machine learning model;
and

outputting a classification of the tissue.

6. The method of claim 5, wherein the classification is a cancer status of the tissue.

7. The method of claim 5, wherein the method further comprises processing the power spectrum for each of the windows to determine a normalized power spectrum for each of the windows.

8. The method of claim 5, wherein the power spectrum is taken using a continuous Fast Fourier Transform (FFT).

9. The method of claim 5, wherein the power spectrum is taken using a discrete FFT.

10. A method comprising:

receiving a set of ultrasound data output from at least one ultrasound transducer representing a tissue of a patient and partitioning the set of ultrasound data into a set of windows;

processing the set of windows with a machine learning model; and

outputting a classification of the tissue.

11. The method of claim 10, wherein the step of processing the set of windows with a machine learning model first comprises processing the set of windows to output a power spectrum for each of the windows.

12. The method of claim 10, wherein the step of processing the set of windows with a machine learning model first comprises processing the set of windows to output a time frequency domain processing technique.

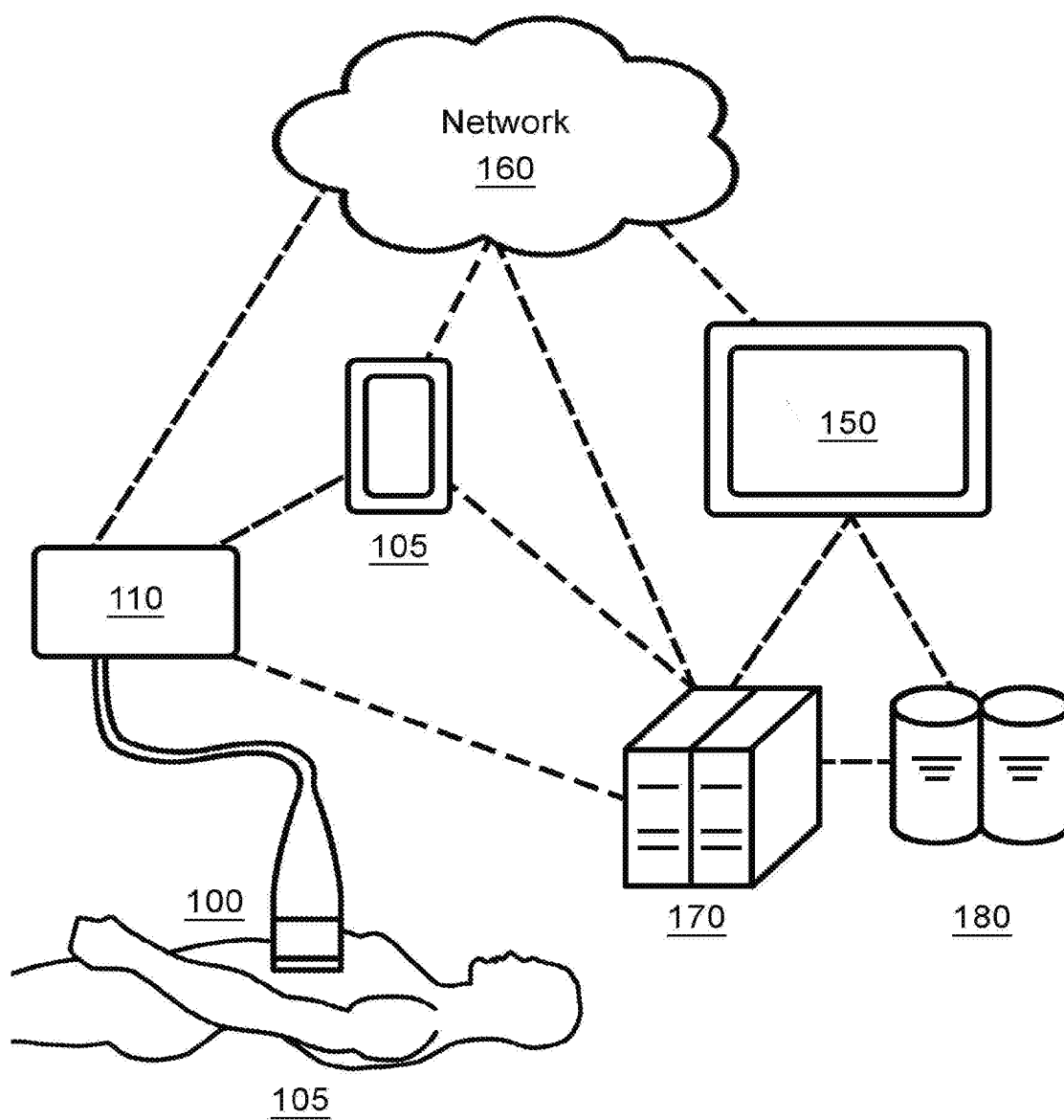


FIG. 1

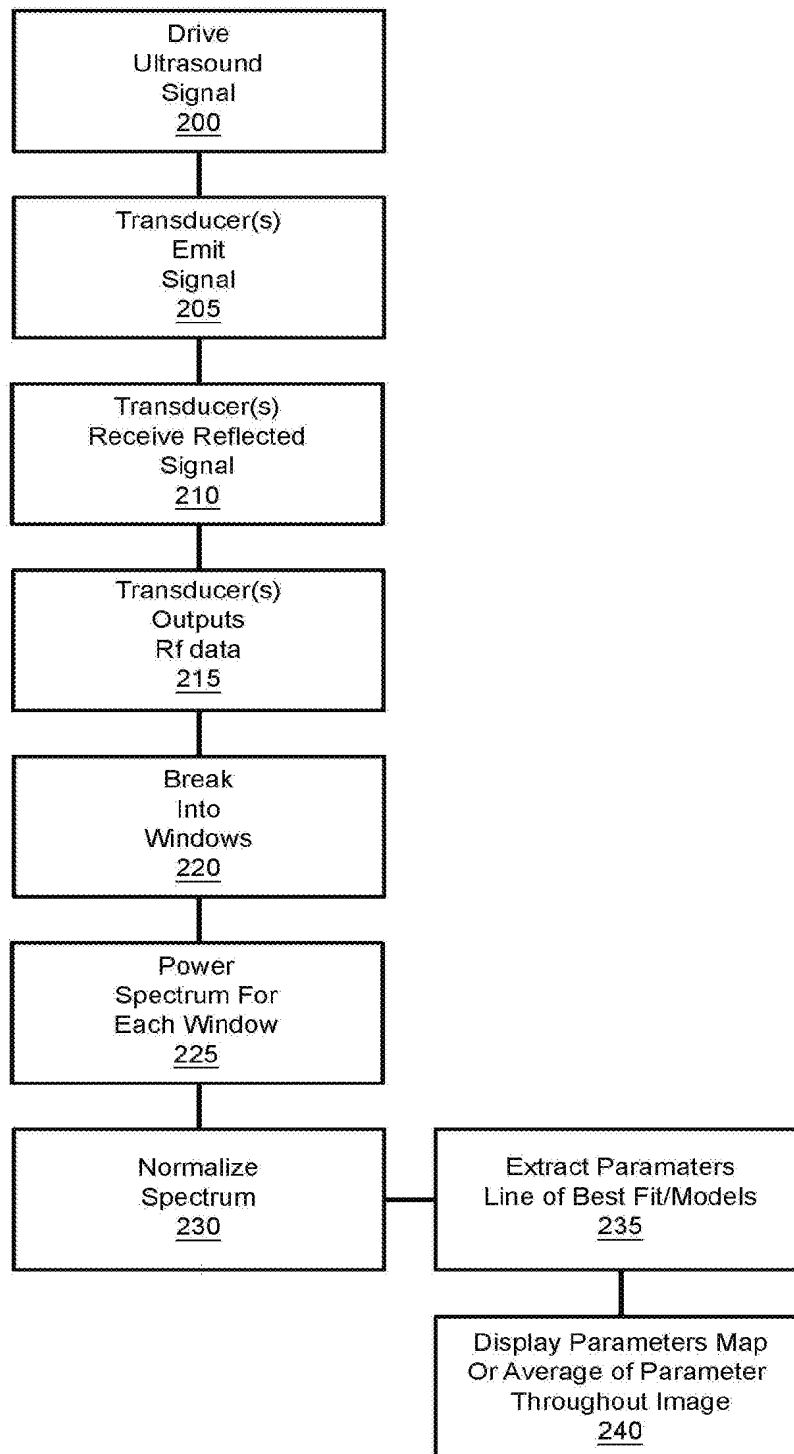


FIG. 2
(PRIOR ART)

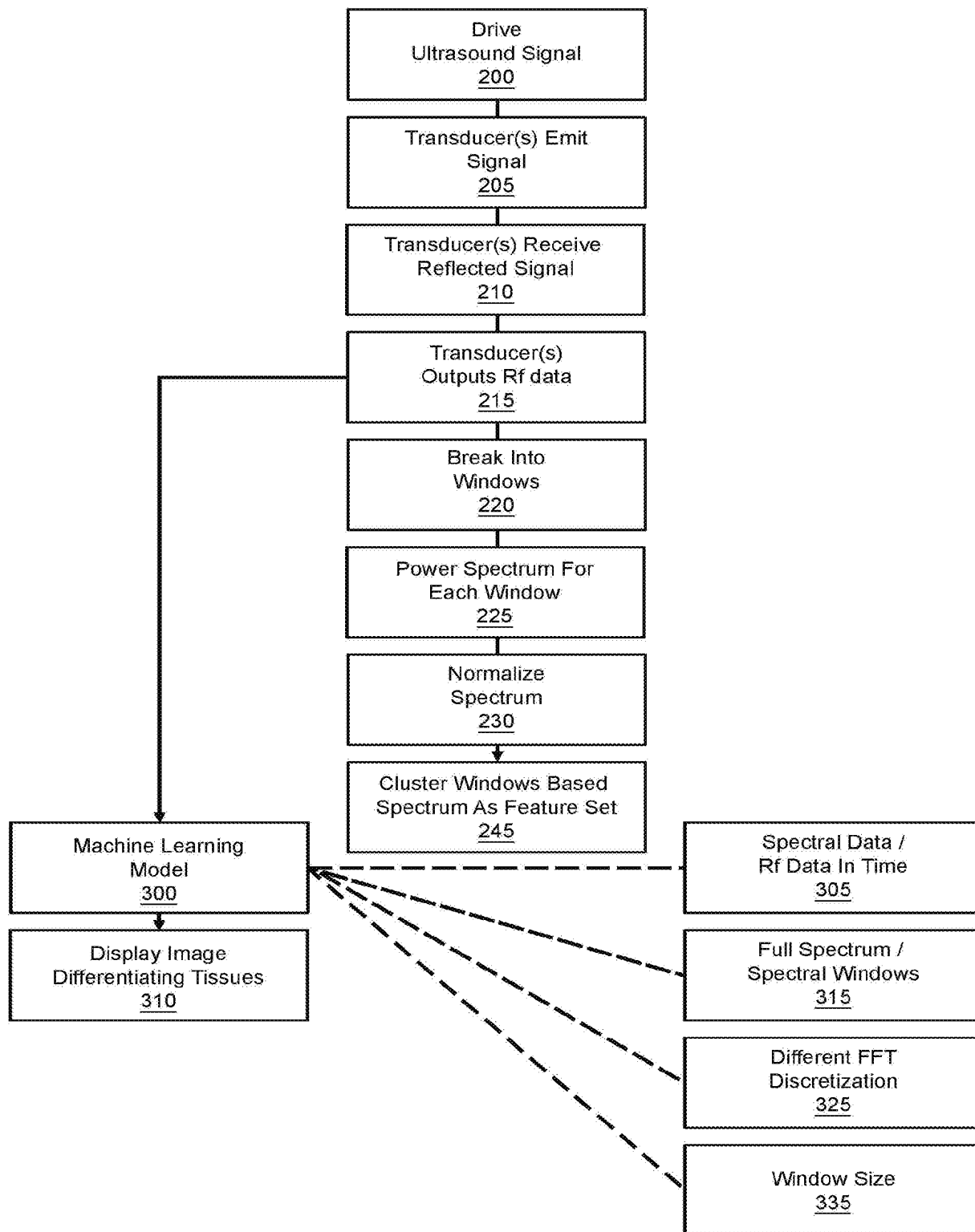


FIG. 3

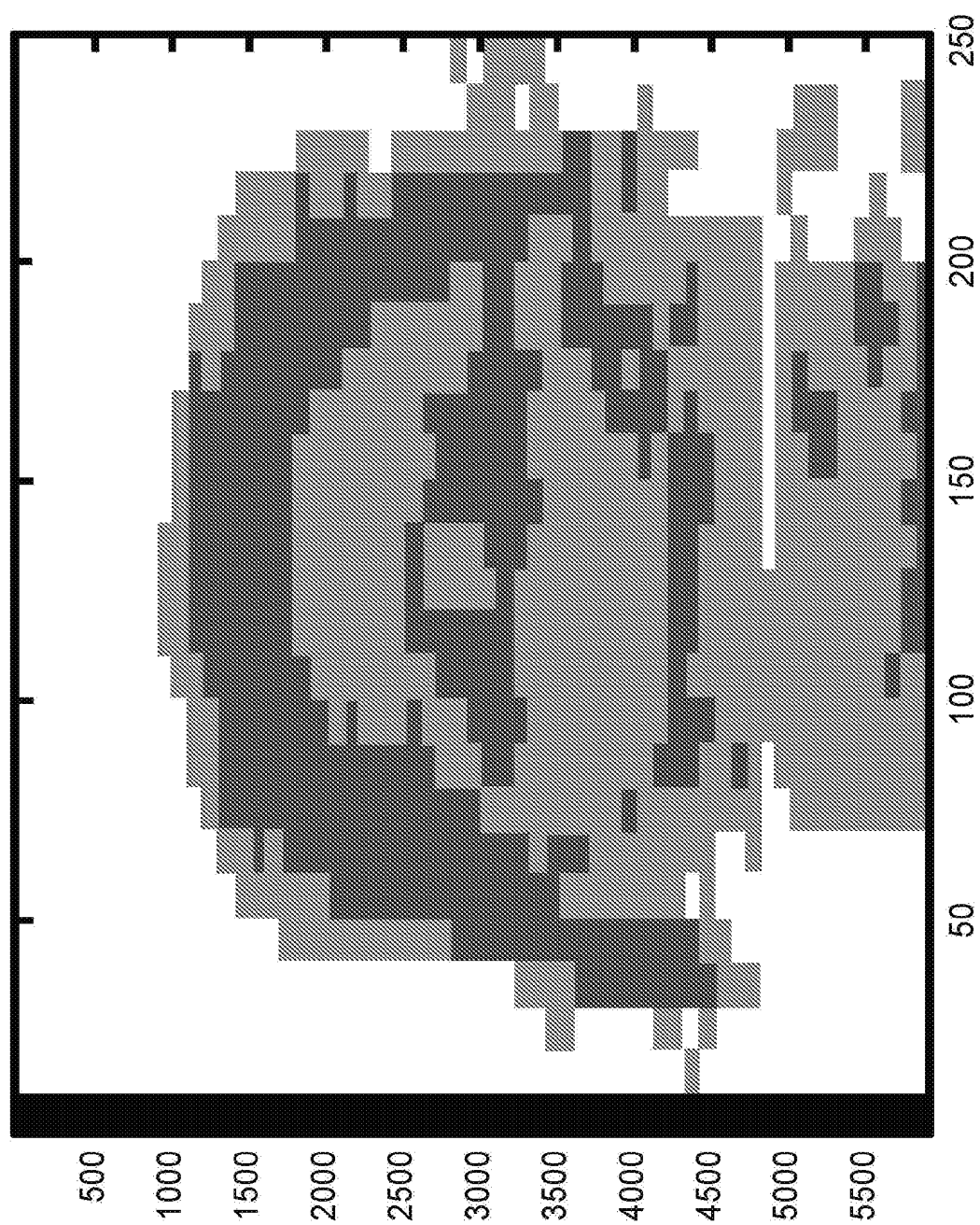


FIG. 4A

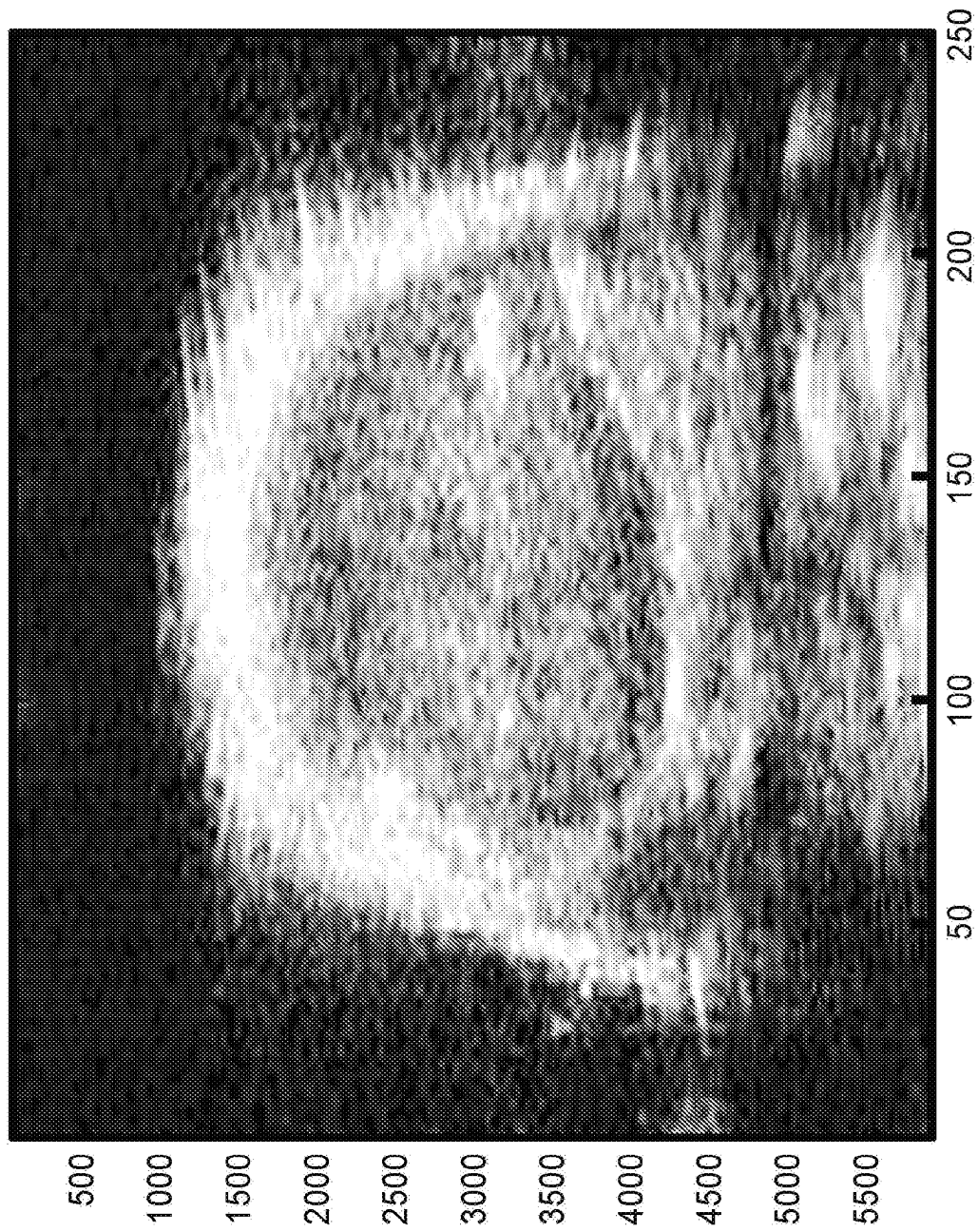


FIG. 4B

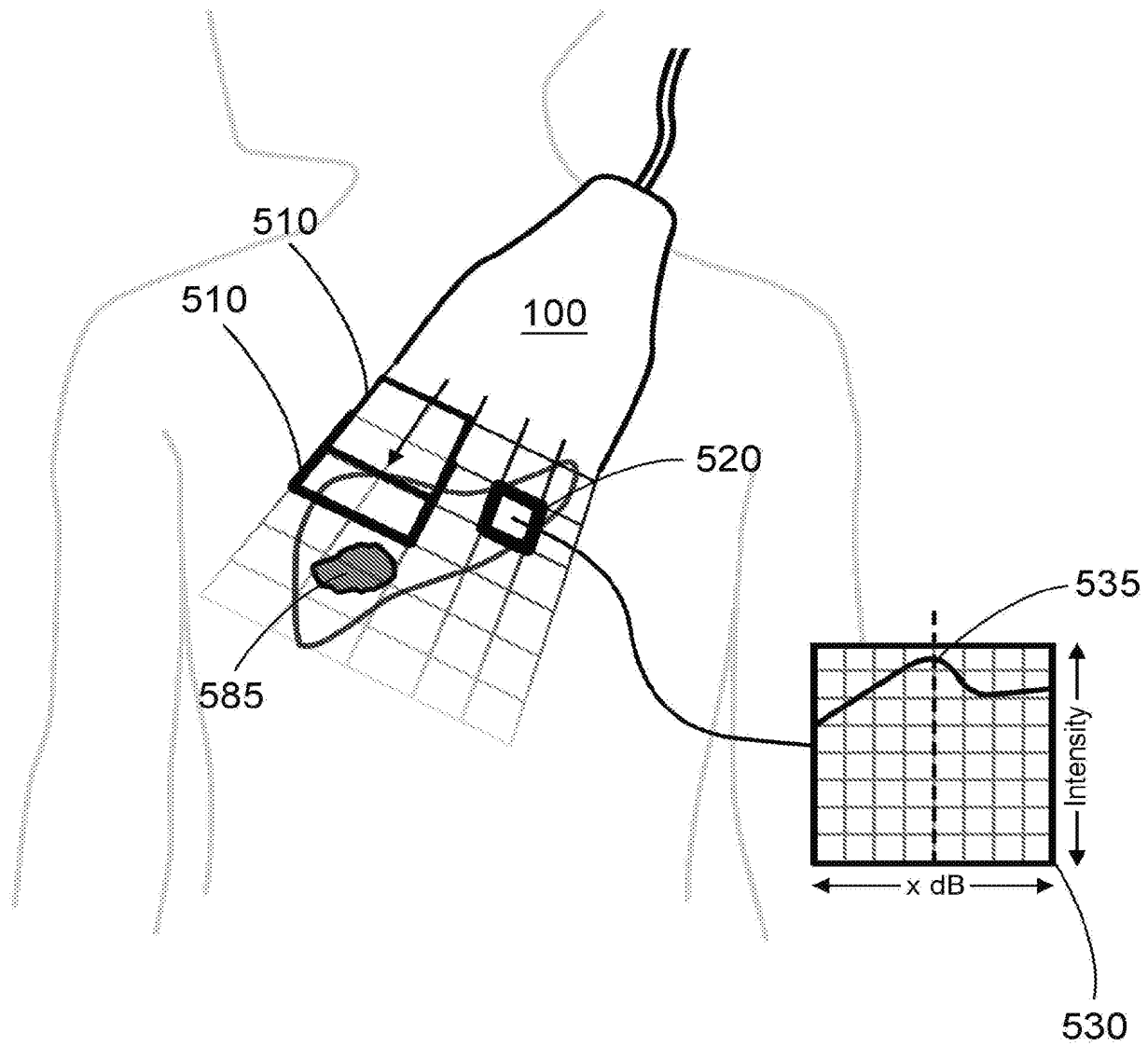


FIG. 5

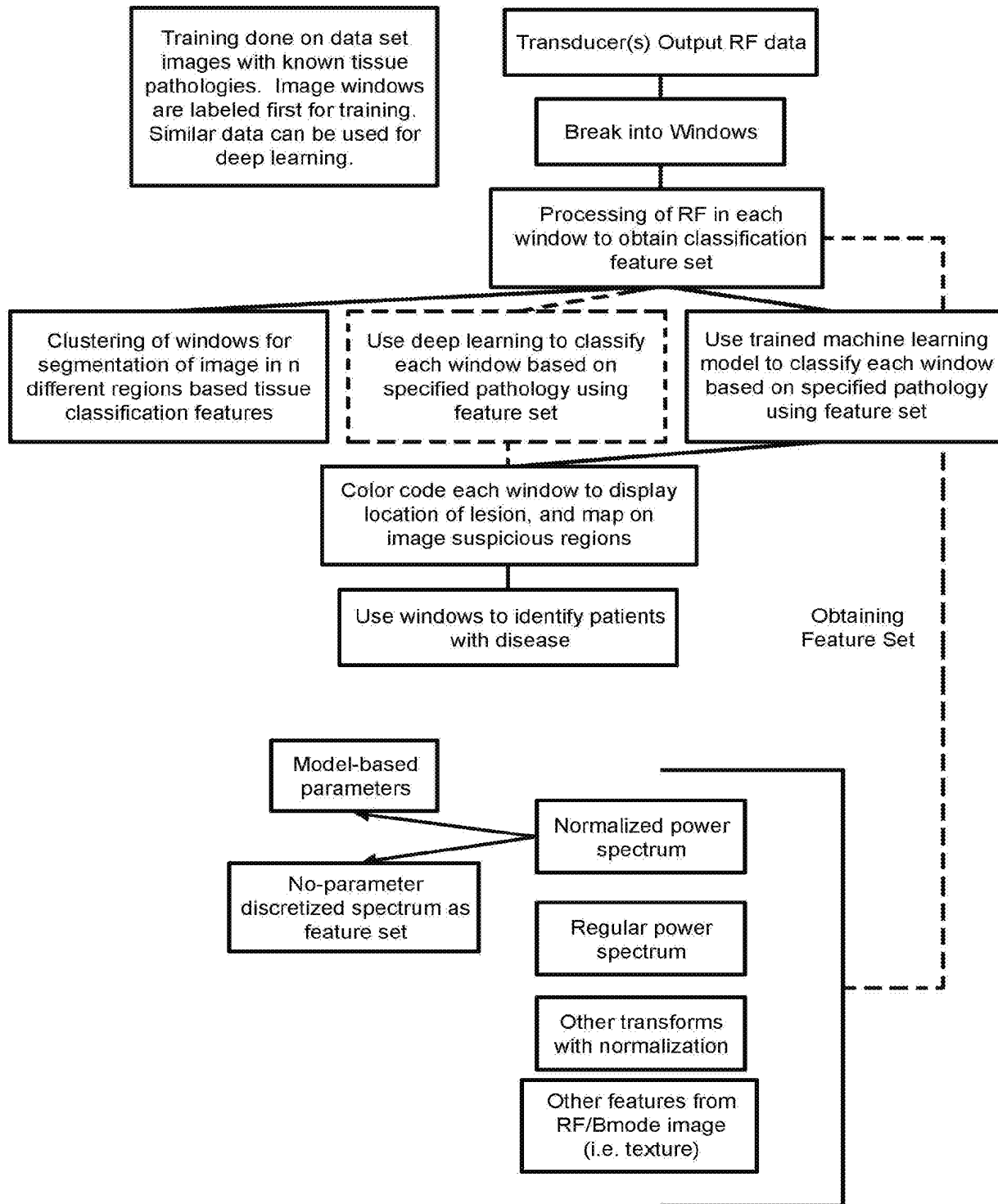


FIG. 6

Electronic Acknowledgement Receipt	
EFS ID:	31199104
Application Number:	62597537
International Application Number:	
Confirmation Number:	2679
Title of Invention:	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM ULTRASOUND RF SPECTRUMS
First Named Inventor/Applicant Name:	Ahmed El Kaffas
Customer Number:	106303
Filer:	Erik J. Birkeneder/Kathleen Dunn
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Attorney Docket Number:	079633-000001PR00
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RAM confirmation Number	121217INTEFSW00012719504166
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Authorized User	Kathleen Dunn
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File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Provisional Cover Sheet (SB16)	2017-12-12- ProvCS-079633-000001PR00. pdf	1477372	no	3
			5369f37af88f5b196b93d6919296ca3e623a31be		
Warnings:					
Information:					
2	Application Data Sheet	2017-12-12- ADS-079633-000001PR00.pdf	1793194	no	8
			ea2d11071df49ef4d84e2a0a8aa35c1301ffe5b3		
Warnings:					
Information:					
3		2017-12-12- ProvAppl-079633-000001PR00. pdf	167166	yes	22
			0dcea5bc59843c84e5e094aca812f4320884cd27		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Specification		1	19	
	Claims		20	22	
Warnings:					
Information:					
4	Drawings-only black and white line drawings	2017-12-12- ProvFigs-079633-000001PR00. pdf	3218423	no	7
			f4634fc17132b6363a4c0fc6e40ebd01ffb9fa83		
Warnings:					
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5	Fee Worksheet (SB06)	fee-info.pdf	30064	no	2
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DOCUMENT MADE AVAILABLE UNDER THE PATENT COOPERATION TREATY (PCT)

International application number:	PCT/US2018/065226
International filing date:	12 December 2018 (12.12.2018)
Document type:	Certified copy of priority document
Document details:	Country/Office: US
	Number: 62/597,537
	Filing date: 12 December 2017 (12.12.2017)
Date of receipt at the International Bureau:	19 January 2019 (19.01.2019)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a),(b) or (b-bis)

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

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PCT/US18/65226

International Application No.

12 December 2018 (12.12.2018)

International Filing Date

RO/US

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference
(if desired) (12 characters maximum) 079633-000001W00

Box No. I	TITLE OF INVENTION	
MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM ULTRASOUND RF SPECTRUMS		
Box No. II	APPLICANT	
☐ This person is also inventor		
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)		Telephone No.
ONCOUSTICS INC.		Facsimile No.
25 Capreol Crt. - 4005		Applicant's registration No. with the Office
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458 Fernando Ave.
Palto Alto, California 94306
UNITED STATES OF AMERICA

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☐ inventor only (If this check-box is marked, do not fill in below.)

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This person is:

- ☐ applicant only
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Filing date of earlier application <i>(day/month/year)</i>	Number of earlier application	Where earlier application is:		
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item (1) 12/12/2017	62/597,537	US		
item (2)				
item (3)				
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Furnishing the priority document(s): ☒ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) <i>(only if the earlier application(s) was filed with the receiving Office which, for the purposes of this international application, is the receiving Office)</i> identified above as: ☒ all items ☐ item (1) ☐ item (2) ☐ item (3) ☐ other, see Supplemental Box ☐ The International Bureau is requested to obtain from a digital library a certified copy of the earlier application(s) identified above, using, where applicable, the access code(s) indicated below <i>(if the earlier application(s) is available to it from a digital library)</i> : ☐ item (1) ☐ item (2) ☐ item (3) ☐ other, see Supplemental Box access code _____ access code _____ access code _____				
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2. Drawings: ☐ received: ☐ not received:	

Form PCT/RO/101 (last sheet – EFS) (July 2018) See Notes to the request form



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(71) Applicant: ONCOUSTICS INC. [CA/CA]; 25 Capreol
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9th Street, N.W., Suite 500, Washington, DC 20001 (US).

(81) Designated States (unless otherwise indicated, for every
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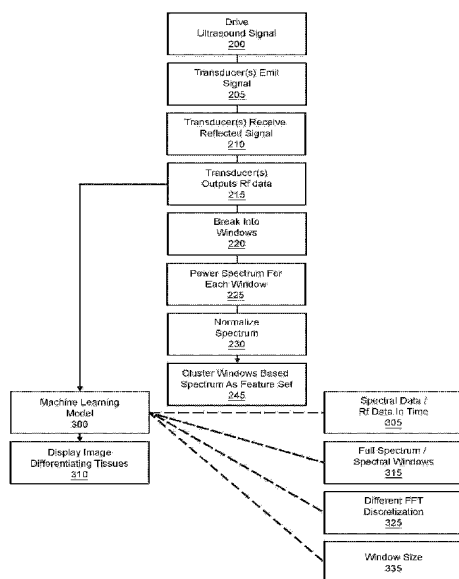


FIG. 3

(57) Abstract: The present disclosure provides for ultrasound systems and methods to pre-process ultrasound data to distinguish abnormal tissue from normal tissue. An exemplary method can include receiving a set of ultrasound data and partitioning the set into a set of windows. The method can then provide for processing the set of windows to determine a power spectrum for each window. The power spectrum for each window can be processed to determine a normalized power spectrum for each window. This normalized power spectrum can be processed for each window with a machine learning model. The method can then provide for displaying an image where each window of the set of windows is displayed using a unique identifier based on the output of the machine learning model.

CLAIMS

1. An ultrasound system comprising:
 - a transducer configured to output a set of ultrasound data;
 - a memory containing machine readable medium comprising machine executable code having stored thereon instructions;
 - a signal processing unit comprising one or more processors coupled to the memory, the one or more processors configured to execute the machine executable code to cause the one or more processors to:
 - receive the set of ultrasound data and partition the set of ultrasound data into a set of windows;
 - process the set of windows to determine a power spectrum for each window of the set of windows;
 - process the power spectrum for each window of the set of windows to determine a normalized power spectrum for each window of the set of windows; and
 - process the normalized power spectrum for each window of the set of windows with a machine learning model; and
 - display an image where each window of the set of windows is displayed using a unique identifier based on the output of the machine learning model.
2. The ultrasound system of claim 1, wherein the machine learning model is a k-means model or a model from a deep learning network comprising but not limited to one or a combination to the algorithm types of CNN (Convolutional Neural Network), RBM (Restricted Boltzmann Machine), LSTM (Long Short Term Memory) or CapsNet (Capsule Networks).
3. The ultrasound system of claim 1, wherein the machine learning model is trained using ultrasound images labeled by a radiologist.

4. The ultrasound system of claim 1, wherein the machine learning model is an unsupervised model.
5. A method comprising:
 - receiving a set of ultrasound data output from at least one ultrasound transducer representing a tissue of a patient and partitioning the set of ultrasound data into a set of windows or bounding boxes;
 - processing the set of windows to determine a power spectrum for each window of the set of windows;
 - processing the power spectrum for each window of the set of windows with a machine learning model; and
 - outputting a classification of the tissue.
6. The method of claim 5, wherein the classification is a cancer status of the tissue.
7. The method of claim 5, wherein the method further comprises processing the power spectrum for each window of the set of windows to determine a normalized power spectrum for each window of the set of windows.
8. The method of claim 5, wherein the power spectrum is taken using a continuous Fast Fourier Transform (FFT).
9. The method of claim 5, wherein the power spectrum is taken using a discrete FFT.
10. A method comprising:
 - receiving a set of ultrasound data output from at least one ultrasound transducer representing a tissue of a patient and partitioning the set of ultrasound data into a set of windows;
 - processing the set of windows with a machine learning model; and
 - outputting a classification of the tissue.

11. The method of claim 10, wherein the step of processing the set of windows with a machine learning model first comprises processing the set of windows to output a power spectrum for each window of the set of windows.
12. The method of claim 10, wherein the step of processing the set of windows with a machine learning model first comprises processing the set of windows to output a time frequency domain processing technique.

MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM ULTRASOUND RF SPECTRUMS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to and the benefit of U.S. Provisional Patent Application No. 62/597,537, filed December 12, 2017, and entitled “Machine Learning to Extract Quantitative Biomarkers from Ultrasound RF Spectrums”, the contents of which are herein incorporated by reference.

FIELD

[0002] The present invention is directed to ultrasound for classification and identification of various physiological aspects of a living organism, including tissue and biomarker identification and classification.

BACKGROUND

[0003] The following description includes information that may be useful in understanding the present invention. It is not an admission that any of the information provided herein is prior art or relevant to the presently claimed invention, or that any publication specifically or implicitly referenced is prior art.

[0004] Ultrasound imaging is widely used in clinical diagnosis and image-guided interventions. However, the field is relatively behind other areas of quantitative image analysis, including MRI, CT and X-ray analysis. For instance, many of the quantitative analysis techniques process the data from B-mode, after the ultrasound has already been converted into two dimensional images and much additional RF data has been removed. In other cases, the ultrasound RF data is analyzed using regression and best-fit models/analysis that yield specific known features for quantitative analysis. At times, these features can be directly correlated to specific tissue properties.

SUMMARY

[0005] The present disclosure provides for ultrasound systems and methods for detecting abnormal and normal tissue. An exemplary ultrasound system, according to a first embodiment of the present disclosure, can include a transducer, a memory, a signal processing unit, and one or more processors. The transducer can be configured to output a set of ultrasound data. The memory can contain machine-readable medium comprising machine-executable code having stored thereon instructions. The signal processing unit can include the one or more processors, where the one or more processors are coupled to the memory. The one or more processors can be configured to execute the machine executable code to cause the one or more processors to perform a series of steps. The series of steps can include receiving a set of ultrasound data and partitioning the set into a set of windows. The steps can then provide for processing the set of windows to determine a power spectrum for each window. The power spectrum for each window can be processed to determine a normalized power spectrum for each window. This normalized power spectrum can be processed for each window with a machine learning model. The steps can then provide for displaying an image where each window of the set of windows is displayed using a unique identifier based on the output of the machine learning model.

[0006] In some embodiments of the first disclosure, the machine learning model can be a k-means model or a model from a deep learning network. This can include (but is not limited to) one or a combination of the algorithm types of: a convolutional neural network (CNN), restricted Boltzmann machine (RBM), long short term memory (LSTM) or a capsule network (CapsNet).

[0007] In some examples, the machine learning model can be trained using ultrasound images labeled by a radiologist.

[0008] In some examples, the machine learning model can be an unsupervised model.

[0009] A second embodiment of the present disclosure can provide for a method of classifying tissue. The method can include first receiving a set of ultrasound data output from at least one ultrasound transducer. The set of ultrasound data output can represent a tissue of a

patient. The method can then provide for partitioning the set of ultrasound data into a set of windows. The method can then provide for processing the set of windows with a machine learning model. The method can then provide for outputting a classification of the tissue.

[0010] In some examples, the classification can be a cancer status of the tissue.

[0011] In some examples, the method can further include processing the power spectrum for each window to determine a normalized power spectrum for each window in the set of windows.

[0012] In some examples the power spectrum can be taken using a continuous fast Fourier transform (FFT).

[0013] In some examples, the power spectrum can be taken using a discrete FFT.

[0014] A third embodiment of the present disclosure can provide for another method of classifying tissue. This method can provide for first receiving a set of ultrasound data output from at least one ultrasound transducer. The data can represent a tissue of a patient. The method can then provide for partitioning the set of ultrasound data into a set of windows. The method can then provide for processing the set of windows with a machine learning module. The method can then provide for outputting a classification of the tissue.

[0015] In some examples of the third embodiment, the step of processing the set of windows with a machine learning model can first include processing the set of windows to output a power spectrum for each window in the set of windows.

[0016] In some examples of the present disclosure, processing the set of windows with a machine learning model can first include processing the set of windows to output a time frequency domain processing technique.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The accompanying drawings, which are incorporated in and constitute a part of this specification, exemplify the embodiments of the present invention and, together with the

description, serve to explain and illustrate principles of the invention. The drawings are intended to illustrate major features of the exemplary embodiments in a diagrammatic manner. The drawings are not intended to depict every feature of actual embodiments nor relative dimensions of the depicted elements, and are not drawn to scale.

[0018] FIG. 1 depicts a perspective view of an overview of an ultrasound system;

[0019] FIG. 2 depicts a flowchart showing a prior art method of tissue classification;

[0020] FIG. 3 depicts an example of a flowchart showing a method for classification of tissue using machine learning analysis of ultrasound data;

[0021] FIG. 4A depicts an example image of a mouse tumor using the systems and methods disclosed herein to segment the image using k-means clustering;

[0022] FIG. 4B depicts the original ultrasound image that was processed for FIG. 4A; and

[0023] FIG. 5 depicts a schematic diagram of an ultrasound image analysis system.

[0024] In the drawings, the same reference numbers and any acronyms identify elements or acts with the same or similar structure or functionality for ease of understanding and convenience. To easily identify the discussion of any particular element or act, the most significant digit or digits in a reference number refer to the Figure number in which that element is first introduced.

DETAILED DESCRIPTION

[0025] Unless defined otherwise, technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. Szycher's Dictionary of Medical Devices CRC Press, 1995, may provide useful guidance to many of the terms and phrases used herein. One skilled in the art will recognize many methods and materials similar or equivalent to those described herein, which could be used in the practice of the present invention. Indeed, the present invention is in no way limited to the methods and materials specifically described.

[0026] In some embodiments, properties such as dimensions, shapes, relative positions, and so forth, used to describe and claim certain embodiments of the invention are to be understood as being modified by the term “about.”

[0027] Various examples of the invention will now be described. The following description provides specific details for a thorough understanding and enabling description of these examples. One skilled in the relevant art will understand, however, that the invention may be practiced without many of these details. Likewise, one skilled in the relevant art will also understand that the invention can include many other obvious features not described in detail herein. Additionally, some well-known structures or functions may not be shown or described in detail below, so as to avoid unnecessarily obscuring the relevant description.

[0028] The terminology used below is to be interpreted in its broadest reasonable manner, even though it is being used in conjunction with a detailed description of certain specific examples of the invention. Indeed, certain terms may even be emphasized below; however, any terminology intended to be interpreted in any restricted manner will be overtly and specifically defined as such in this Detailed Description section.

[0029] While this specification contains many specific implementation details, these should not be construed as limitations on the scope of any inventions or of what may be claimed, but rather as descriptions of features specific to particular implementations of particular inventions. Certain features that are described in this specification in the context of separate implementations can also be implemented in combination in a single implementation. Conversely, various features that are described in the context of a single implementation can also be implemented in multiple implementations separately or in any suitable subcombination. Moreover, although features may be described above as acting in certain combinations and even initially claimed as such, one or more features from a claimed combination can in some cases be excised from the combination, and the claimed combination may be directed to a subcombination or variation of a subcombination.

[0030] Similarly, while operations may be depicted in the drawings in a particular order, this should not be understood as requiring that such operations be performed in the particular order

shown or in sequential order, or that all illustrated operations be performed, to achieve desirable results. In certain circumstances, multitasking and parallel processing may be advantageous. Moreover, the separation of various system components in the implementations described above should not be understood as requiring such separation in all implementations, and it should be understood that the described program components and systems can generally be integrated together in a single software product or packaged into multiple software products.

Overview

[0031] Conventional ultrasound spectroscopy uses ultrasound frequency spectrums from ultrasound RF data (raw sound signal as it returns into transducer) to extract specific, pre-defined quantitative parameters that can describe tissue state (e.g., information on the ultrasound scatter size, concentration and change in impedance in tissue).

[0032] In some conventional applications, systems extract sets of parameters to characterize and classify tissue from RF, or a frequency-domain RF (employing a Fourier or wavelet transform). This process takes the RF data and first normalizes it to a calibration spectrum (acquired separately) to remove the machine setting, some artifacts and some user dependencies. Next, it extracts parameters, which are correlated to different tissue pathologies. This is done by taking a certain segment of the spectrum (with an established bandwidth around the center frequency of the signal) and fitting it to a specific mathematical model or simple linear regression. However, the parameters and quality of fit are not ideal, and predetermined models and parameters usually miss valuable information degrading the accuracy and specificity of classification using these methods.

[0033] Ultrasound RF data, both beam-formed and pre-beam-forming, contains more information than standard, B-mode or 2-D, ultrasound images as collected according to the conventional methods described above. Though useful, B-mode images, which are perceptible and interpretable by human vision, require discarding the majority of ultrasound RF data to create them. The present disclosure provides for extracting, processing, and categorizing this normally-discarded information from the ultrasound RF data. This normally-discarded information can be analyzed using computer algorithms, such as ML or deep learning methods,

to recover and reveal signal information that is beyond human perception. This is unexpected and surprising, since state-of-the-art applications of artificial intelligence (AI) only enhance recognition and awareness (for example, of photographs or language) within the bounds of human senses, cognizance and comprehension.

[0034] The present disclosure therefore uses machine learning to take ultrasound *images* and to train machine learning models to recognize certain pathologies based on these conventionally qualitative images. Effectively, this system is used to automate the clinical process of a clinician analyzing images from the processed ultrasound data. However, conventional clinical images (e.g. two dimensional B-mode images) are heavily processed from the raw ultrasound data and though they appear good qualitatively, they lack information about tissue microstructure.

[0035] However, it has been discovered that using artificial intelligence/machine learning methods (“ML”) to analyze the ultrasound data as is – instead of conventional mathematical models or “fits” that parameterize the signal – provides for vastly increased accuracy and specificity. Particularly, this allows for more accurate and specific classification and identification of tissue types and biomarkers related to tissue – including for disease states. Additionally, it has been discovered that applying the ML models to the raw data or the frequency spectrum data – rather than the images (e.g. B-mode) after processing – provides much more accurate results because the already heavily processed images have much of the important ultrasound data filtered out, including that which is useful for diagnosis and classification (e.g., a lot of the microstructure of tissue is lost when processing the data to form images).

[0036] In some examples, the entire spectrum of data or a specific subset of the spectrum can be used as a feature set to train an ML model to evaluate and classify tissues in ultrasound images for screening, diagnostics and treatment monitoring applications. The spectrum-based features as is, or normalized (using standard methods) can be used as is, or combined with conventional parameters from linear regression or mathematical models. The RF ultrasound data may be converted to a normalized power spectrum which may then be fed into a trained (supervised, unsupervised or deep learning method) ML model(s) to classify tissues for specific applications, or to find specific multi-parametric biomarkers, or to identify and apply previously

unknown parameters of normal and pathological physiology. In other examples, the raw data before conversion to spectra, or the RF converted to other domains (i.e. Laplace transform, principal component analysis, etc.) may be input to ML learning algorithms.

Ultrasound System

[0037] Various conventional ultrasound systems may be utilized that include an ultrasound transducer and signal processing equipment. For instance, FIG. 1 illustrates an example of an ultrasound system that includes an ultrasound transducer 100, a signal processor 110, a mobile device 105, a network 160, display 150, server 170, and database 180.

[0038] In this example, a handheld ultrasound transducer 100 contained in a handheld case (e.g. ultrasound probe) is utilized. In other examples, a robotic arm transducer or other transducer 100 implementations may be utilized. In some examples, to focus the ultrasound beam, the transducer 100 may use phased array techniques, shaping of the transducer 100 or utilize a physical lens.

[0039] In some examples, materials on the face of the transducer 100 enable the sound to be transmitted efficiently to the patient's body 105 (e.g. human, animal) by impedance matching. For instance, this may be a rubber or other coating. In addition, a water based gel may be utilized between the patient's skin and the ultrasound transducer case. The sound waves propagate through the patient 105 until they are reflected in places where the acoustic impedance changes in the patient's 105 body. The return of the sound wave is then detected by the transducer(s) 100, which is converted to a signal that is the RF data. The RF data can be pre-beamforming in or post-beamforming.

[0040] The ultrasound data output from the transducer 100 may be processed by a processing unit 110 or other associated processors and computing devices in various ways as disclosed herein. In some cases, after processing an image showing various identified tissues or other indicators may be displayed on a display 150. The ultrasound data may be processed fully or partially by electronics included within the transducer 100 casing, on a separate processing unit 110, or an electrically connected computing device. In other examples, the data can be fully or

partially processed on a local or remote server 170 connected to the processing unit 110 and/or transducer through a network 160.

[0041] Processing and display of the ultrasound data may also take place fully or partially on an associated mobile device 105, or results of the processing may be sent to and displayed on a mobile device 105. An associated database 180 may store the ultrasound data, models utilized for processing the data, and information about various patients and testing 105. Additionally, a server 170 or separate servers 170 may process training data to form and/or update the models and store them on a database 180.

[0042] The system may connect to a variety of different ultrasound transducers 100 and/or signal processing units 110. This data maybe aggregated and analyzed by a server(s) 170 and may be stored on databases 180. The data from different processing units 110 could be utilized to continually update and train a model for processing the data, based on different types of patients and ultrasound units (e.g., for different types of transducers 100). Accordingly, the RF signal can be at any stage before image formation pre-beamforming, pre-scan conversion, post beamforming, post-scan conversion, etc.

Ultrasound Data Processing Methods

[0043] Previously described ultrasound processing methods are illustrated in the flowchart of FIG. 2. For instance, most ultrasound systems include a driver that drives the ultrasound signal 200 sent to the transducer 100. Then, the transducer 100 vibrates and emits the ultrasound signals 205 that are directed toward a patient's 105 body. The transducer then detects the reflected signals 210, and outputs the ultrasound data or raw RF data 215. Then, in previously described systems, the raw ultrasound data is typically broken up into various windows 220. Then, the power spectral for each window 225 may be determined, and the spectrum normalized 230 to calibrate for certain hardware and parameters settings (to be independent to system and acquisition parameters properties). Then, the parameters maybe extracted 235 using line of best fit or other regression models. The system them would display a parametric map or average of the parameters throughout the image 240.

[0044] FIG. 3 illustrates an example of an ultrasound processing method according to the present disclosure. As illustrated, the steps through outputting of the raw ultrasound data from the transducer 215 are largely the same. However, as illustrated, once the raw ultrasound data is output from the transducer 100, the processing steps may follow a similar or different path, but then are ultimately process by a machine learning model 300.

[0045] In some examples, the same steps of breaking the data into windows 220, performing a power spectrum for each window 225, and normalizing the spectrum 230 may be the same. For instance, many applications use a Fourier transform to turn the raw ultrasound data into spectral data for further analysis. In other examples, the raw ultrasound data may be input directly into a machine learning model 300, or optionally may undergo initial filtering techniques and transformations other than frequency processing and then may be fit into a machine learning model 300 without first converting the data into the frequency domain.

[0046] In some examples, the normalized power spectrums output for each window 225 may be used as a feature set 245 input into a machine learning model (step 300). Window size can be adjusted in step 335. The spectrum is typically discretized to be representative of the continuous spectrum to obtain the set of features. In some examples, a set of windows of data can be processed to output a time frequency domain processing time (step 305). In some examples, different processing techniques may utilize non-normalized or normalized spectrums, full spectrum or windows of spectrums 315, or in other examples the raw RF data may be input into the machine learning model or any other form of processed RF data. In some examples, different Fourier transform discretization 325 may be utilized to develop features.

[0047] In these examples, the machine learning model 300 utilized may be a model trained to find a specific type of tissue. For instance, a server 170 may constantly process new data to update and train the model to recognize, for instance, liver cancer based on a signature the model recognizes. The model may be different kinds of neural networks, deep learning neural networks, supervised or unsupervised models, or other suitable types of machine learning models.

[0048] Therefore, the present disclosure does not rely on applying artificial intelligence, machine learning, or deep learning to images made with ultrasonography (e.g. B-mode) or rely

on performing quantitative ultrasound spectroscopy (QUS). Rather, the present disclosure provides for pre-processing techniques from ultrasound spectroscopy and then feeding the power spectrum signal into a trained AI, ML or deep learning model. Feeding the power spectrum signal as such is a new step provided for by the present disclosure, which can avoid parameterization and normalize the data. Other feature sets, beyond the normalized power spectrum (NPS), can be used to train and supplement the NPS being fed into the models of the present invention. Therefore, the present disclosure provides for generating clean data and eliminating several sources of signal error (including system-specific sources of variability) by pre-processing the data. This approach additionally allows for improved training on high quality data normalized to a spectrum, and has the potential to reduce the data set size needed for training. In some embodiments of the present disclosure, training can also be performed on channel data.

[0049] RF data is the foundation to all ultrasound systems, and the methods disclosed herein allow calibration of signals originating from different systems. The present disclosure demonstrates an application of knowledge transfer. Systems and methods according to the present disclosure can separate abnormal tissue from normal tissue. This form of tissue characterization enables classification and diagnostics. The systems and methods of the present disclosure can be applied on low-cost, point-of-care (POC) ultrasound systems, which have limited function and are not usually used for diagnostic tissue characterization. The present disclosure thus enables POC devices to perform new diagnostic applications. With the right labeling information for training, the present disclosure thus provides for detecting and yielding tissue pathologies from ultrasound RF signal data that are beyond human ability to decipher. Conventional, current image formation methods, and applied algorithms, by contrast to the methods of the present disclosure, remain constrained to enhancing what a radiologist can see.

EXAMPLES

[0050] The following examples are provided to better illustrate the claimed invention and are not intended to be interpreted as limiting the scope of the invention. To the extent that specific materials or steps are mentioned, it is merely for purposes of illustration and is not intended to

limit the invention. One skilled in the art may develop equivalent means or reactants without the exercise of inventive capacity and without departing from the scope of the invention.

[0051] Several different modes of ultrasound are known. For instance, in A-mode (amplitude mode), a single transducer scans a line through the body with echoes plotted on screen as a function of depth. B-mode or 2D mode uses a linear array of transducers to simultaneously scan a plane through the body that can be viewed as a two dimensional image on screen.

[0052] FIG. 5 illustrates an example of an ultrasound transducer 100 aimed at a patient's body, that would penetrate into the body and potentially identify an abnormal, diseased, or other types of tissue 585 in the liver for example. For instance, the transducer 100 may contain a linear array of transducers 100 as illustrated in FIG. 5. Each of the transducers 100 would emit or vibrate at a certain frequency (or multiple frequencies) and sound waves would enter the patient's body. For instance, the ultrasound transducers 100 may emit sound pulses with a Gaussian intensity curve (intensity v frequency) around a central frequency within the range of, for example, 1 – 5 megahertz. For instance, the transducer(s) 100 may emit an acoustic wave that is centered around 2 megahertz, and includes frequencies around 2 megahertz with decreasing intensity to form a Gaussian curve around 2 megahertz.

[0053] When the emitted sound waves encounter various structures of the body that have different acoustic properties, portions of the sound waves get reflected back to the transducer 100 at the boundary between the structures. The greater the difference in the acoustic properties, the greater is the intensity or energy of the reflected waves. Additionally, structures of the body contribute to attenuation of the signal and scattering.

[0054] Then, once the reflected sound waves hit one or more transducer(s) the transducers will record the exact time of flight when the received wave is registered. Additionally, the intensity of the wave or pulse will be determined. Using the time of flight and the linear array of transducers 100, the system can reconstruct a two dimensional grid or data segments of ultrasound RF data that includes an array of frequencies, intensities and other data at each data segments 520. Generally, the array of frequencies can be converted into a power spectrum curve 530 that shows the returned intensity of the acoustic signal at various of frequencies. In some

examples, the system will only record different sized bands of frequencies around the emission frequency or a frequency near the emission frequency. In some examples, the bands may be 4, 5, 6, 7, or 8 dB wide.

[0055] In the case of a linear array of transducers, the system may use beamforming or other techniques that utilize concepts of destructive and constructive interference to reconstruct the frequencies and intensities for each data segments of an ultrasound plane along each RF line. As discussed earlier, in some examples, the signals may be processed into a two dimensional array of data segments that represent different readings or data at each data segment, and in turn each represent the reflected ultrasound signal at a certain location in the object (e.g., a portion of the liver if the transducer 100 is aimed at a patient's body).

[0056] In some examples, a reference will then be applied to each of the data segments 520 to normalize a reference tissue to the curve obtained from the object or patient. In other examples, the raw data output from the transducers will be processed by a machine learning model 300 to allow it to find the features. In some examples, a power spectrum 535 will be taken of each data segment 520. In some examples a larger window 510 or sliding window 510 or a bounding box 510 (as in a YOLO, "You Only Look Once," strategy) or anchor box 510 may be applied to a matrix of data segments to average or combine using other statistical techniques to provide a power spectrum 535 or other data set for each window 510.

[0057] Then, a machine learning algorithm 300 may be applied to the data set for each data segment 520, or each window 510. This may be used to classify the tissue represented in the window 510 or data segments 520. For instance, the system may classify the tissue in the window 510 as abnormal, cancerous, water, bone, or air. In some examples, the system may utilize the input of all of the data segments 520 or windows 510 to then classify each tissue, or classify larger portions of the tissue, such as a region of interest.

[0058] Then, once each data segment 520 or window 510 is classified, the system may display an image differentiating the tissues 310 by classification. The image could be displayed as a heatmap or other map similar to FIG. 4A, or could have numeric values, diagnosis, or other classification mapped to each section of tissue. In some examples, the system may output

whether or not the tissue contains any cancerous cells after classifying each of the data segments 520 or windows 510.

[0059] By contrast to FIG. 4A, FIG. 4B shows the original ultrasound image that was processed according to a method of the present disclosure to yield FIG. 4A. The contrast between FIGs. 4A and 4B shows the effectiveness of the present disclosure at producing data which can be readily analyzed and classified.

Machine Learning Models

[0060] In some examples, the machine learning model 300 will be an unsupervised algorithm. In other examples, the machine learning model 300 will be supervised. The, machine learning model 300 may take a variety of forms. For instance, the system may utilize more basic machine learning tools including 1) decision trees (“DT”), (2) Bayesian networks (“BN”), (3) artificial neural network (“ANN”), or (4) support vector machines (“SVM”). In other examples, deep learning algorithms or other more sophisticated machine learning algorithms, e.g., convolutional neural networks (“CNN”), or capsule networks (“CapsNet”) may be used.

[0061] DT programs are generally used because of their simplicity and ease of understanding. DT are classification graphs that match input data to questions asked at each consecutive step in a decision tree. The DT program moves down the “branches” of the tree based on the answers to the questions (e.g., First branch: Is the patient male? yes or no. Branch two: Is the patient having trouble urinating? yes or no, etc.).

[0062] Bayesian networks (“BN”) are based on likelihood something is true based on given independent variables and are modeled based on probabilistic relationships. BN are based purely on probabilistic relationships that determine the likelihood of one variable based on another or others. For example, BN can model the relationships between symptoms and diseases. Particularly, if a patient’s symptoms or biomarkers levels are known, a BN can be used to compute the probability that a patient has a particular disease. Thus, using an efficient BN algorithm, an inference can be made based on the input data. They are commonly used by the medical domain to represent reasoning under uncertain conditions for a wide range of

applications, including disease diagnostics, genetic counseling, and emergency medical decision support system (MDSS) design.

[0063] Artificial neural networks (“ANN”) are computational models inspired by an animal's central nervous system. They map inputs to outputs through a network of nodes. However, unlike BN, in ANN the nodes do not necessarily represent any actual variable. Accordingly, ANN may have a hidden layer of nodes that are not represented by a known variable to an observer.

[0064] ANNs are capable of pattern recognition and have been used for the medical and diagnostics fields. Their computing methods make it easier to understand a complex and unclear process that might go on during diagnosis of an illness based on input data a variety of input data including symptoms. While still facing steep limitations, ANN has demonstrated to be suitable in a clinical decision support system design and other biomedical applications, such as diagnosis of myocardial infarction, MDSS for leukemia management, and cancer detection.

[0065] Support vector machines (“SVM”) came about from a framework utilizing of machine learning statistics and vector spaces (linear algebra concept that signifies the number of dimensions in linear space) equipped with some kind of limit-related structure. In some cases, they may determine a new coordinate system that easily separates inputs into two classifications. For example, a SVM could identify a line that separates two sets of points originating from different classifications of events.

[0066] They have been applied practically and are theoretically well-founded, but can sometimes be difficult to understand. SVMs have been applied to a number of biological domains, such as MDSS for the diagnosis of tuberculosis infection, tumor classification, and biomarker discovery.

[0067] However, there is a relatively new type of machine learning algorithm that is capable of modeling very complex relationships that have a lot of variation that are called deep neural networks. Deep neural networks (DNN) have developed recently to tackle the problems of speech recognition.

[0068] In the IT industry fields, various architectures of DNN have been proposed to tackle the problems associated with algorithms such as ANN by many researchers during the last few decades. These types of DNN are CNN (Convolutional Neural Network), RBM (Restricted Boltzmann Machine), LSTM (Long Short Term Memory) etc. They are all based on the theory of ANN. They demonstrate a better performance by overcoming the back-propagation error diminishing problem associated with ANN.

[0069] In some examples, clustering based on k-means, or K-nearest neighbors approaches may be a useful machine learning model 300. In other examples, a K-means clustering methods may be used as machine learning models 300. In other examples, principle component analysis can be utilized to separate the data and classify the tissues.

Machine Learning – Training Data

[0070] Machine learning models 300 require training data to identify the features of interest that they are designed to detect. For instance, various methods may be utilized to form the machine learning models 300 including applying randomly assigned initial weights for the network and applying gradient descent using back propagation for deep learning algorithms. In other examples, a neural network with one or two hidden layers can be used without training using this technique.

[0071] In some examples, the machine learning models 300 will be trained using labeled data, or data that represents certain features, specific tissues, diagnosis, or stage of diagnosis of tissues. In other examples, the data will only be labeled with the outcome and the various relevant data may be input to train the machine learning algorithm.

[0072] For instance, to classify a tissue or window of tissue, various machine learning models 300 may be utilized that input various data disclosed herein. In some examples, the input data will be labeled by correlating by having a certified radiologist label the tissues, windows 510 or data segments 520 that include cancer data. Accordingly, the input to the machine learning algorithm for training data may be cancer boxes or non-cancerous. In other examples, it may include additional labels including water, tissue, bone, and air.

[0073]

Computer & Hardware Implementation of Disclosure

[0074] It should initially be understood that the disclosure herein may be implemented with any type of hardware and/or software, and may be a pre-programmed general purpose computing device. For example, the system may be implemented using a server, a personal computer, a portable computer, a thin client, or any suitable device or devices. The disclosure and/or components thereof may be a single device at a single location, or multiple devices at a single, or multiple, locations that are connected together using any appropriate communication protocols over any communication medium such as electric cable, fiber optic cable, or in a wireless manner.

[0075] It should also be noted that the disclosure is illustrated and discussed herein as having a plurality of modules which perform particular functions. It should be understood that these modules are merely schematically illustrated based on their function for clarity purposes only, and do not necessarily represent specific hardware or software. In this regard, these modules may be hardware and/or software implemented to substantially perform the particular functions discussed. Moreover, the modules may be combined together within the disclosure, or divided into additional modules based on the particular function desired. Thus, the disclosure should not be construed to limit the present invention, but merely be understood to illustrate one example implementation thereof.

[0076] 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. In some implementations, a server transmits data (e.g., an HTML page) to a client device (e.g., for purposes of displaying data to and receiving user input from a user interacting with the client device). Data generated at the client device (e.g., a result of the user interaction) can be received from the client device at the server.

[0077] Implementations of the subject matter described in this specification 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 subject matter described in this specification, or any combination of one or more 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”) and a wide area network (“WAN”), an inter-network (e.g., the Internet), and peer-to-peer networks (e.g., ad hoc peer-to-peer networks).

[0078] Implementations of the subject matter and the operations described in this specification can be implemented in digital electronic circuitry, or in computer software, firmware, or hardware, including the structures disclosed in this specification and their structural equivalents, or in combinations of one or more of them. Implementations of the subject matter described in this specification can be implemented as one or more computer programs, i.e., one or more modules of computer program instructions, encoded on computer storage medium for execution by, or to control the operation of, data processing apparatus. Alternatively or in addition, the program instructions can be encoded on an artificially generated propagated signal, e.g., a machine-generated electrical, optical, or electromagnetic signal that is generated to encode information for transmission to suitable receiver apparatus for execution by a data processing apparatus. A computer storage medium can be, or be included in, a computer-readable storage device, a computer-readable storage substrate, a random or serial access memory array or device, or a combination of one or more of them. Moreover, while a computer storage medium is not a propagated signal, a computer storage medium can be a source or destination of computer program instructions encoded in an artificially generated propagated signal. The computer storage medium can also be, or be included in, one or more separate physical components or media (e.g., multiple CDs, disks, or other storage devices).

[0079] The operations described in this specification can be implemented as operations performed by a “data processing apparatus” on data stored on one or more computer-readable storage devices or received from other sources.

[0080] The term “data processing apparatus” encompasses all kinds of apparatus, devices, and machines for processing data, including by way of example a programmable processor, a computer, a system on a chip, or multiple ones, or combinations, of the foregoing. The apparatus can include special purpose logic circuitry, e.g., an FPGA (field programmable gate array) or an ASIC (application specific integrated circuit). The apparatus can also include, in addition to hardware, code that creates an execution environment for the computer program in question, e.g., code that constitutes processor firmware, a protocol stack, a database management system, an operating system, a cross-platform runtime environment, a virtual machine, or a combination of one or more of them. The apparatus and execution environment can realize various different computing model infrastructures, such as web services, distributed computing and grid computing infrastructures.

[0081] A computer program (also known as a program, software, software application, script, or code) can be written in any form of programming language, including compiled or interpreted languages, declarative or procedural languages, and it can be deployed in any form, including as a stand-alone program or as a module, component, subroutine, object, or other unit suitable for use in a computing environment. A computer program may, but need not, correspond to a file in a file system. A program can be stored in a portion of a file that holds other programs or data (e.g., one or more scripts stored in a markup language document), in a single file dedicated to the program in question, or in multiple coordinated files (e.g., files that store one or more modules, sub-programs, or portions of code). A computer program can be deployed to be executed on one computer or on multiple computers that are located at one site or distributed across multiple sites and interconnected by a communication network.

[0082] The processes and logic flows described in this specification can be performed by one or more programmable processors executing one or more computer programs to perform actions by operating on input data and generating output. The processes and logic flows can also be

performed by, and apparatus can also be implemented as, special purpose logic circuitry, e.g., an FPGA (field programmable gate array) or an ASIC (application-specific integrated circuit).

[0083] Processors suitable for the execution of a computer program include, by way of example, both general and special purpose microprocessors, and any one or more processors of any kind of digital computer. Generally, a processor will receive instructions and data from a read-only memory or a random access memory or both. The essential elements of a computer are a processor for performing actions in accordance with instructions and one or more memory devices for storing instructions and data. Generally, a computer will also include, or be operatively coupled to receive data from or transfer data to, or both, one or more mass storage devices for storing data, e.g., magnetic, magneto-optical disks, or optical disks. However, a computer need not have such devices. Moreover, a computer can be embedded in another device, e.g., a mobile telephone, a personal digital assistant (PDA), a mobile audio or video player, a game console, a Global Positioning System (GPS) receiver, or a portable storage device (e.g., a universal serial bus (USB) flash drive), to name just a few. Devices suitable for storing computer program instructions and data include all forms of non-volatile memory, media and memory devices, including by way of example semiconductor memory devices, e.g., EPROM, EEPROM, and flash memory devices; magnetic disks, e.g., internal hard disks or removable disks; magneto-optical disks; and CD-ROM and DVD-ROM disks. The processor and the memory can be supplemented by, or incorporated in, special purpose logic circuitry.

CONCLUSION

[0084] The various methods and techniques described above provide a number of ways to carry out the invention. Of course, it is to be understood that not necessarily all objectives or advantages described can be achieved in accordance with any particular embodiment described herein. Thus, for example, those skilled in the art will recognize that the methods can be performed in a manner that achieves or optimizes one advantage or group of advantages as taught herein without necessarily achieving other objectives or advantages as taught or suggested herein. A variety of alternatives are mentioned herein. It is to be understood that some embodiments specifically include one, another, or several features, while others specifically

exclude one, another, or several features, while still others mitigate a particular feature by inclusion of one, another, or several advantageous features.

[0085] Furthermore, the skilled artisan will recognize the applicability of various features from different embodiments. Similarly, the various elements, features and steps discussed above, as well as other known equivalents for each such element, feature or step, can be employed in various combinations by one of ordinary skill in this art to perform methods in accordance with the principles described herein. Among the various elements, features, and steps some will be specifically included and others specifically excluded in diverse embodiments.

[0086] Although the application has been disclosed in the context of certain embodiments and examples, it will be understood by those skilled in the art that the embodiments of the application extend beyond the specifically disclosed embodiments to other alternative embodiments and/or uses and modifications and equivalents thereof.

[0087] In some embodiments, the terms “a” and “an” and “the” and similar references used in the context of describing a particular embodiment of the application (especially in the context of certain of the following claims) can be construed to cover both the singular and the plural. The recitation of ranges of values herein is merely intended to serve as a shorthand method of referring individually to each separate value falling within the range. Unless otherwise indicated herein, each individual value is incorporated into the specification as if it were individually recited herein. All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (for example, “such as”) provided with respect to certain embodiments herein is intended merely to better illuminate the application and does not pose a limitation on the scope of the application otherwise claimed. No language in the specification should be construed as indicating any non-claimed element essential to the practice of the application.

[0088] Certain embodiments of this application are described herein. Variations on those embodiments will become apparent to those of ordinary skill in the art upon reading the

foregoing description. It is contemplated that skilled artisans can employ such variations as appropriate, and the application can be practiced otherwise than specifically described herein. Accordingly, many embodiments of this application include all modifications and equivalents of the subject matter recited in the claims appended hereto as permitted by applicable law. Moreover, any combination of the above-described elements in all possible variations thereof is encompassed by the application unless otherwise indicated herein or otherwise clearly contradicted by context.

[0089] Particular implementations of the subject matter have been described. Other implementations are within the scope of the following claims. In some cases, the actions recited in the claims can be performed in a different order and still achieve desirable results. In addition, the processes depicted in the accompanying figures do not necessarily require the particular order shown, or sequential order, to achieve desirable results.

[0090] All patents, patent applications, publications of patent applications, and other material, such as articles, books, specifications, publications, documents, things, and/or the like, referenced herein are hereby incorporated herein by this reference in their entirety for all purposes, excepting any prosecution file history associated with same, any of same that is inconsistent with or in conflict with the present document, or any of same that may have a limiting effect as to the broadest scope of the claims now or later associated with the present document. By way of example, should there be any inconsistency or conflict between the description, definition, and/or the use of a term associated with any of the incorporated material and that associated with the present document, the description, definition, and/or the use of the term in the present document shall prevail.

[0091] In closing, it is to be understood that the embodiments of the application disclosed herein are illustrative of the principles of the embodiments of the application. Other modifications that can be employed can be within the scope of the application. Thus, by way of example, but not of limitation, alternative configurations of the embodiments of the application can be utilized in accordance with the teachings herein. Accordingly, embodiments of the present application are not limited to that precisely as shown and described.

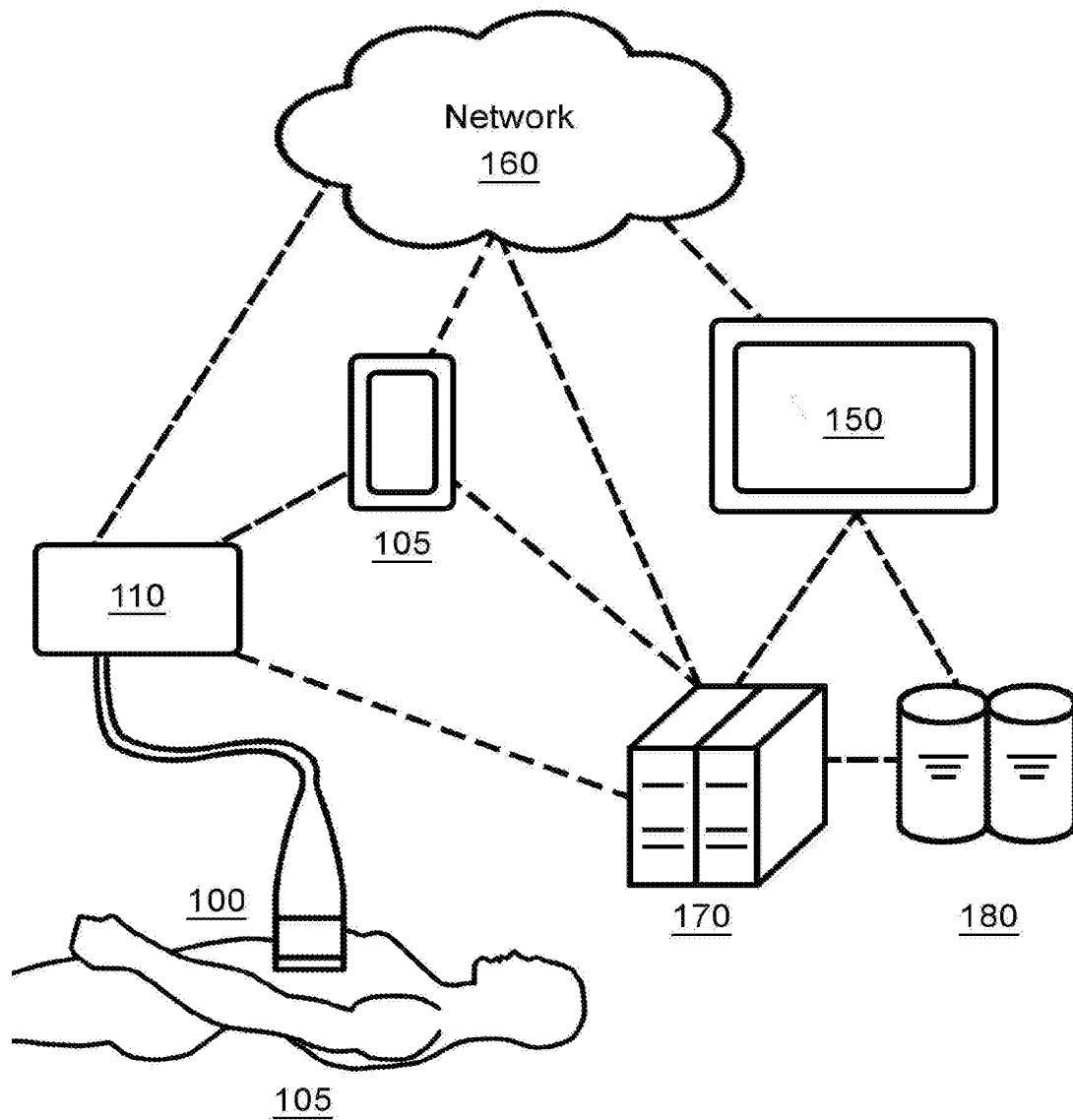


FIG. 1

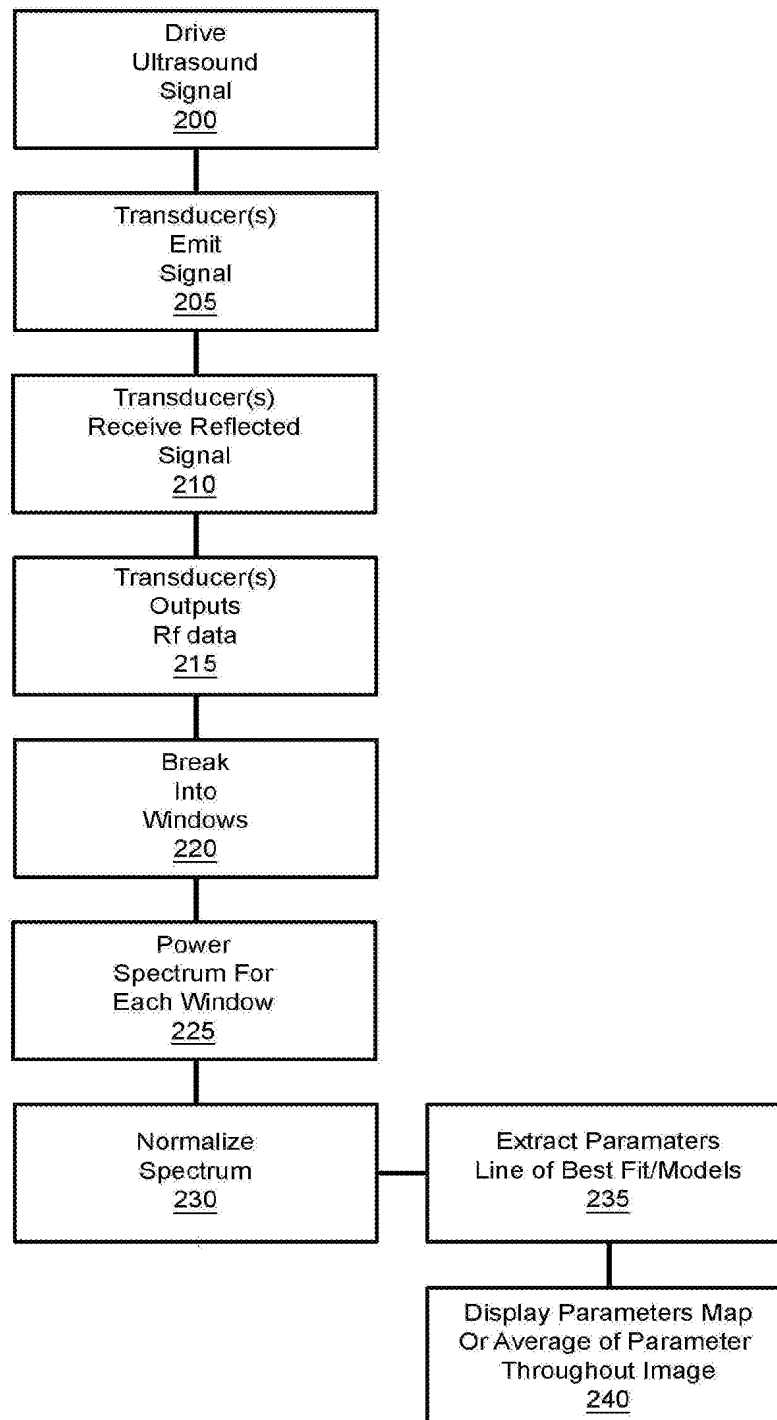


FIG. 2
(PRIOR ART)

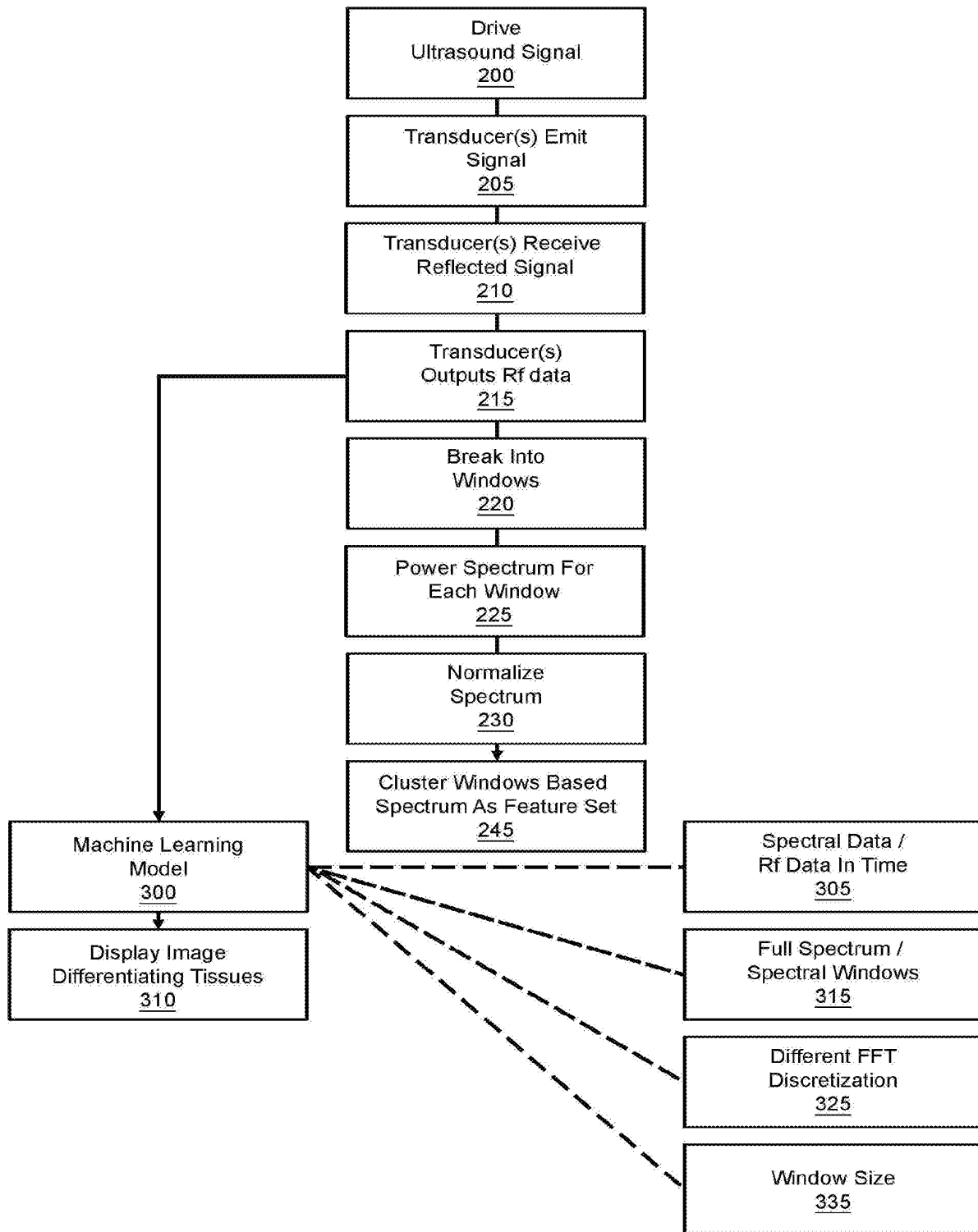


FIG. 3

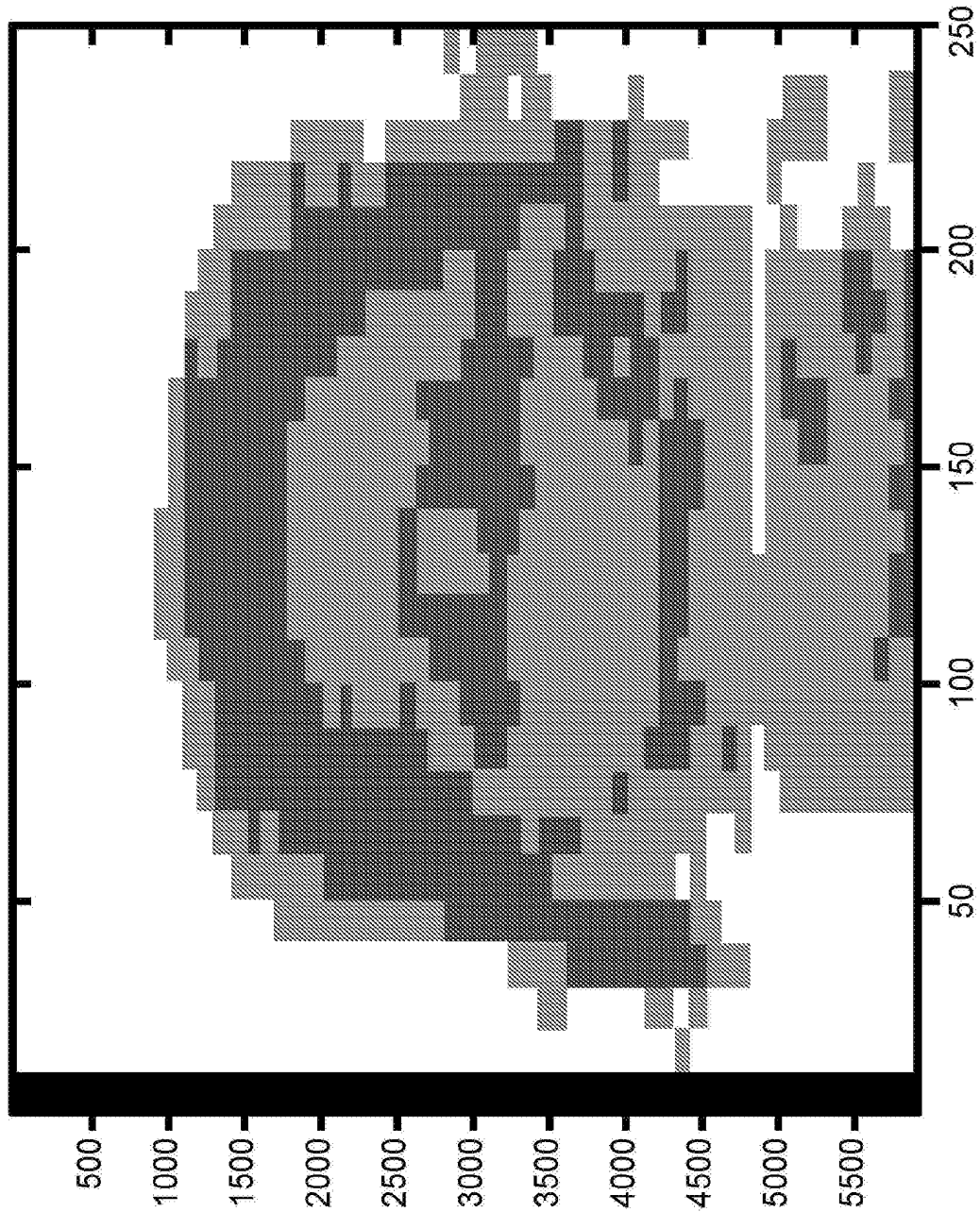


FIG. 4A

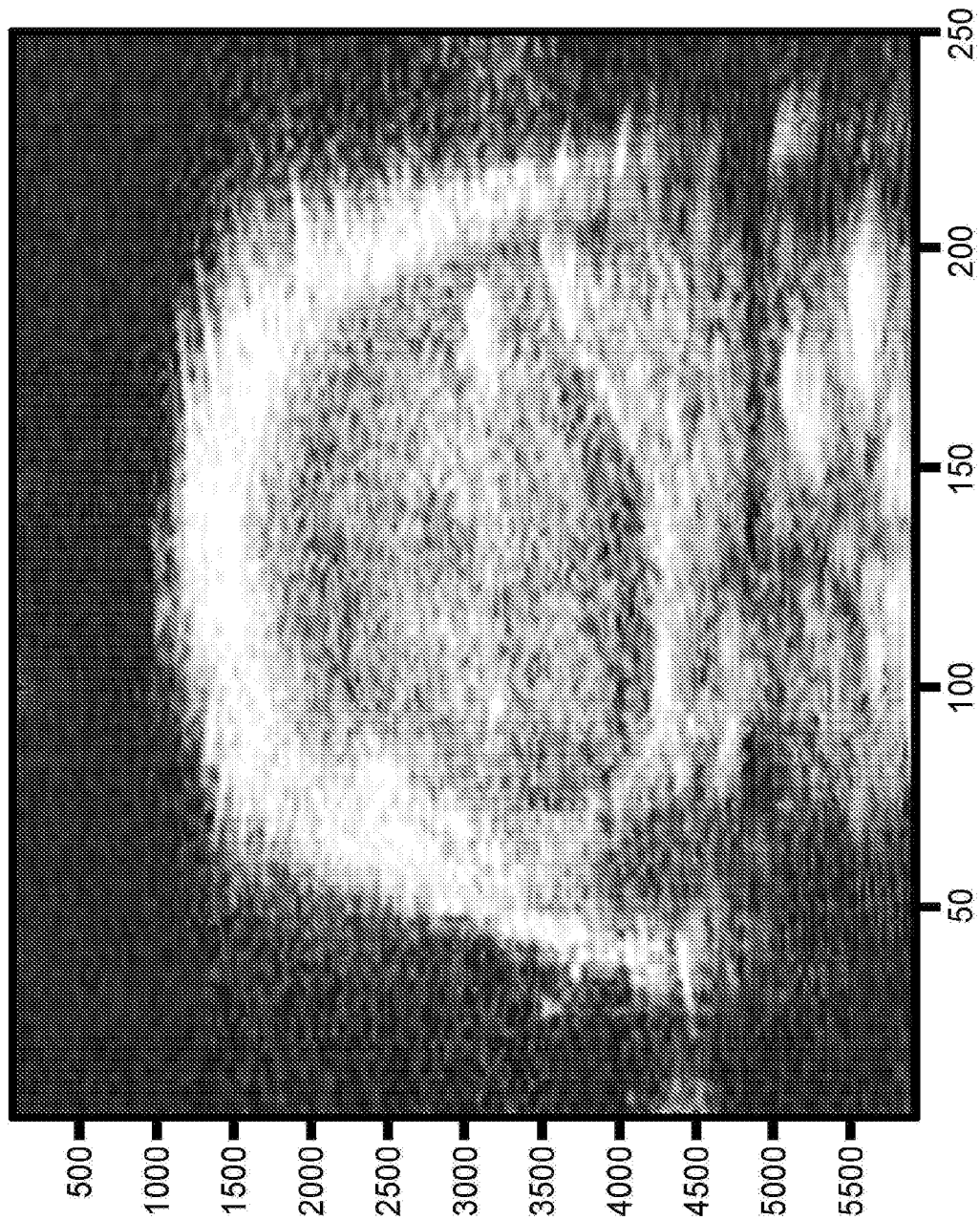


FIG. 4B

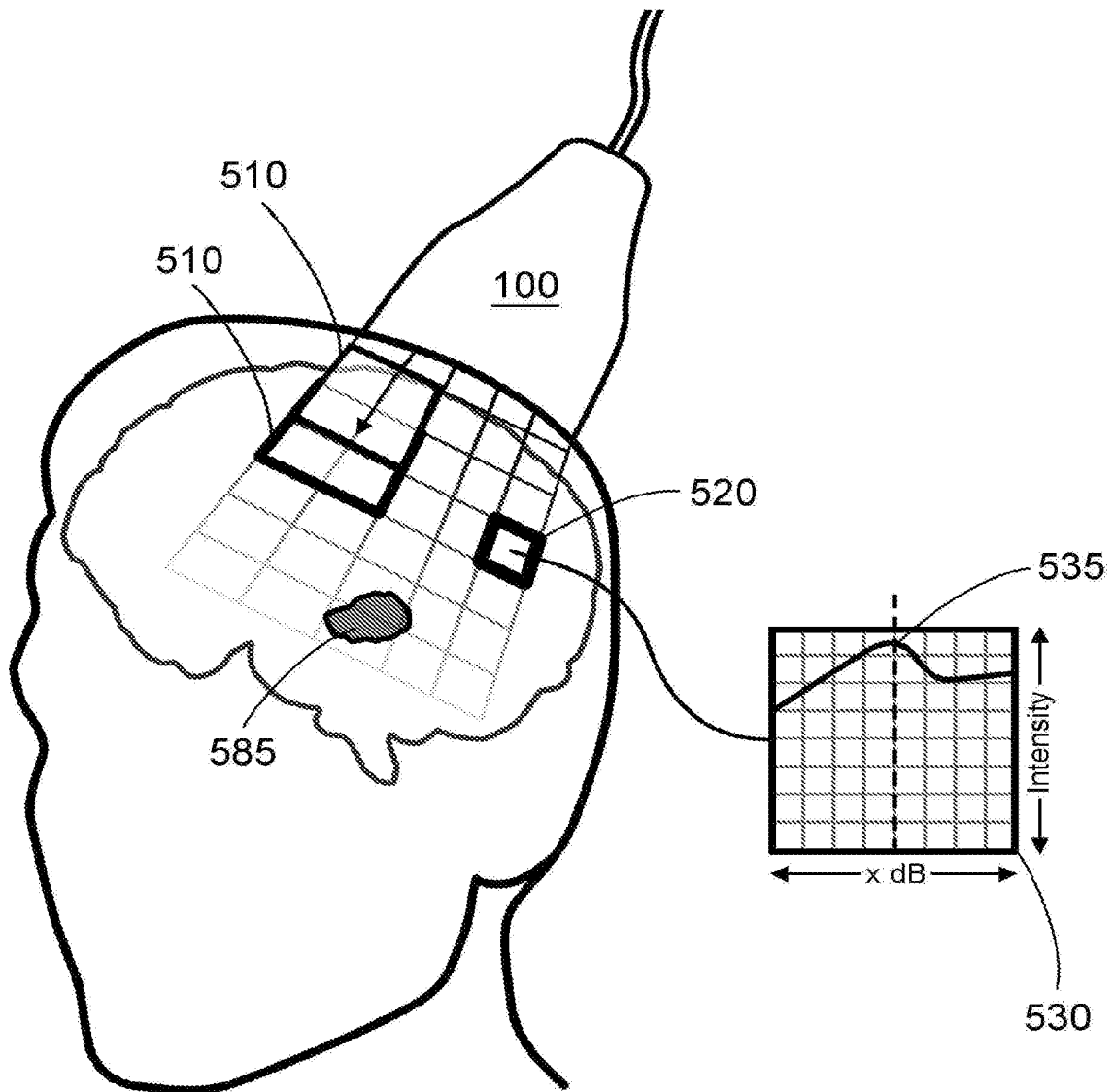


FIG. 5

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A SUBMISSION UNDER 35 U.S.C. 371		Attorney Docket No. 079633-000001US00
		U.S. Application No. (if known, see 37 CFR 1.5)
International Application No. PCT/US2018/065226	International Filing Date December 12, 2018	Priority Date Claimed December 12, 2017
Title of Invention MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS		
First Named Inventor Ahmed EL KAFFAS		
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information.		
1. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). NOTE: The express request under 35 U.S.C. 371(f) will not be effective unless the requirements under 35 U.S.C. 371(c)(1), (2), and (4) for payment of the basic national fee, copy of the International Application and English translation thereof (if required), and the oath or declaration of the inventor(s) have been received.		
2. ☐ A copy of the International Application (35 U.S.C. 371(c)(2)) is attached hereto (not required if the International Application was previously communicated by the International Bureau or was filed in the United States Receiving Office (RO/US)).		
3. An English language translation of the International Application (35 U.S.C. 371(c)(2))		
a. ☐ is attached hereto.		
b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).		
4. An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4))		
a. ☒ is attached.		
b. ☐ was previously filed in the international phase under PCT Rule 4.17(iv).		
Items 5 to 8 below concern amendments made in the international phase.		
<u>PCT Article 19 and 34 amendments</u>		
5. ☐ Amendments to the claims under PCT Article 19 are attached (not required if communicated by the International Bureau) (35 U.S.C. 371(c)(3)).		
6. ☐ English translation of the PCT Article 19 amendment is attached (35 U.S.C. 371(c)(3)).		
7. ☐ English translation of annexes (Article 19 and/or 34 amendments only) of the International Preliminary Examination Report is attached (35 U.S.C. 371(c)(5)).		
<u>Cancellation of amendments made in the international phase</u>		
8a. ☐ Do not enter the amendment made in the international phase under PCT Article 19.		
8b. ☐ Do not enter the amendment made in the international phase under PCT Article 34.		
NOTE: A proper amendment made in English under Article 19 or 34 will be entered in the U.S. national phase application absent a clear instruction from applicant not to enter the amendment(s).		
The following items 9 to 17 concern a document(s) or information included.		
9. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.		
10. ☒ A preliminary amendment.		
11. ☒ An Application Data Sheet under 37 CFR 1.76.		
12. ☐ A substitute specification. NOTE: A substitute specification cannot include claims. See 37 CFR 1.125(b).		
13. ☒ A power of attorney and/or change of address letter.		
14. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.3 and 37 CFR 1.821-1.825 (not required if sequence listing in text format was indicated on the PCT Request as part of the International Application and the sequence listing was published as part of the international application).		
15. ☐ Assignment papers (cover sheet and document(s)). Name of Assignee: _____		
16. ☐ 37 CFR 3.73(c) Statement (when there is an Assignee). _____		

This collection of information is required by 37 CFR 1.414 and 1.491-1.492. The information is required to obtain or retain a benefit by the public, which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 15 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop PCT, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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.

U.S. APPLN. No. (if known – see 37 CFR 1.5)	INTERNATIONAL APPLICATION No. PCT/US2018/065226	ATTORNEY DOCKET No. 079633-000001US00
17. ☐ Other items or information:		
The following fees have been submitted.		CALCULATIONS
18. ☒ Basic national fee (37 CFR 1.492(a))		\$300
19. ☒ Examination fee (37 CFR 1.492(c))		\$ 760
• If the written opinion prepared by ISA/US or the international preliminary examination report prepared by IPEA/US indicates all claims satisfy provisions of PCT Article 33(1)-(4)..... \$0 • All other situations		\$760
20. ☒ Search fee (37 CFR 1.492(b))		140
• If the written opinion prepared by ISA/US or the international preliminary examination report prepared by IPEA/US indicates all claims satisfy provisions of PCT Article 33(1)-(4)..... \$0 • Search fee (37 CFR 1.445(a)(2)) has been paid on the international application to the USPTO as an International Searching Authority • International Search Report prepared by an ISA other than the US and provided to the Office or previously communicated to the US by the IB..... • All other situations		\$140 \$520 \$660
TOTAL OF 18, 19, and 20 =		\$ 1200
☐ Additional fee for specification and drawings filed in paper over 100 sheets (excluding sequence listing in compliance with 37 CFR 1.821(c) or (e) in an electronic medium or computer program listing in an electronic medium) (37 CFR 1.492(j)). Fee for each additional 50 sheets of paper or fraction thereof		
Total Sheets	Extra Sheets	RATE
- 100 =	/ 50 =	x \$400
		\$
Surcharge for furnishing any of the search fee, examination fee, or the oath or declaration after the date of commencement of the national stage (37 CFR 1.492(h)).....		\$140
CLAIMS	NUMBER FILED	NUMBER EXTRA
Total claims	12 - 20 =	0
Independent claims	3 - 3 =	0
MULTIPLE DEPENDENT CLAIM(S) (if applicable)		+ \$820
Fee for submission of Sequence Listing text file of 300 MB to 800 MB (37 CFR 1.21(o)(1)).....		\$1,000
Fee for submission of Sequence Listing text file of more than 800 MB (37 CFR 1.21(o)(2)).....		\$10,000
Processing fee for furnishing the English translation later than 30 months from the earliest claimed priority date (37 CFR 1.492(i)).....		\$140 +
TOTAL OF ABOVE CALCULATIONS =		\$ 1200
☒ Applicant asserts small entity status. See 37 CFR 1.27. Fees above are reduced by 1/3.		
☐ Applicant certifies micro entity status. See 37 CFR 1.29. Fees above are reduced by 3/4. Applicant must attach form PTO/SB/15A or B or equivalent.		
TOTAL NATIONAL FEE =		\$ 600
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31).....		\$50.00 per property +
TOTAL FEES ENCLOSED =		\$ 600

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.

- a. ☐ A check in the amount of \$_____ to cover the above fees is enclosed.
- b. ☒ Please charge my Deposit Account No. 504166 in the amount of \$ 600 to cover the above fees.
- c. ☒ The Director is hereby authorized to charge additional fees which may be required, or credit any overpayment, to Deposit Account No. 504166 as follows:
- i. ☒ any required fee.
- ii. ☐ any required fee except for excess claims fees required under 37 CFR 1.492(d) and (e) and multiple dependent claim fee required under 37 CFR 1.492(f).
- d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038. The PTO-2038 should only be mailed or faxed to the USPTO. However, when paying the basic national fee, the PTO-2038 may NOT be faxed to the USPTO.

ADVISORY: If filing by EFS-Web, do NOT attach the PTO-2038 form as a PDF along with your EFS-Web submission. Please be advised that this is not recommended and by doing so your credit card information may be displayed via PAIR. To protect your information, it is recommended to pay fees online by using the electronic payment method.

NOTE: Where an appropriate time limit under 37 CFR 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the International Application to pending status.

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

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

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

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

Correspondence Address

- ☒ The address associated with Customer Number: 106303 OR ☐ Correspondence address below

Name					
Address					
City		State		Zip Code	
Country				Telephone	
Email					

Signature	/Erik Birkeneder/	Date	June 12, 2020
Name (Print/Type)	Erik Birkeneder	Registration No. (Attorney/Agent)	65299

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.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	079633-000001US00
		Application Number	
Title of Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS		
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	
	Ahmed		EL KAFFAS		
Residence Information (Select One) US Residency • Non US Residency Active US Military Service					
City	Palo Alto	Country of Residence ⁱ	CA		
Mailing Address of Inventor:					
Address 1	458 Fernando Ave.				
Address 2					
City	Palo Alto	State/Province	CA		
Postal Code	94306	Country ⁱ	US		
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button.					

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	106303		
Email Address	lapatentmb@nixonpeabody.com	Add Email	Remove Email

Application Information:

Title of the Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS		
Attorney Docket Number	079633-000001US00	Small Entity Status Claimed	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)		Suggested Figure for Publication (if any)	

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	079633-000001US00
		Application Number	
Title of Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS		

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	106303		

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)
	a 371 of international	PCT/US2018/065226	2018-12-12

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	079633-000001US00
		Application Number	
Title of Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS		
Prior Application Status	Expired	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCT/US2018/065226	Claims benefit of provisional	62597537	2017-12-12
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.			Add

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	079633-000001US00
	Application Number	
Title of Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS	

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.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	079633-000001US00
		Application Number	
Title of Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS		

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	ONCOUSTICS INC.	
Mailing Address Information For Applicant:		
Address 1	25 Capreol Crt. – 4005	
Address 2		
City	Toronto, Ontario	State/Province
Country	CA	Postal Code
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.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	079633-000001US00
		Application Number	
Title of Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS		

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. ☒			
Organization Name	ONCOUSTICS INC.		
Mailing Address Information For Assignee including Non-Applicant Assignee:			
Address 1	25 Capreol Crt. – 4005		
Address 2			
City	Toronto, Ontario	State/Province	
Country ⁱ	CA	Postal Code	M5V 3Z7
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	/Erik Birkeneder/		Date (YYYY-MM-DD)	2020-06-12
First Name	Erik	Last Name	Birkeneder	Registration Number
				65299
Additional Signature may be generated within this form by selecting the Add button. Add				

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	079633-000001US00
		Application Number	
Title of Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS		

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.**

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.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

**DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN
APPLICATION DATA SHEET (37 CFR 1.76)****Title of
Invention****MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF
SPECTRUMS**

As the below named inventor, I hereby declare that:

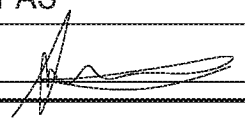
This declaration ☐ The attached application, or
is directed to:☒ United States application or PCT international application number PCT/US2018/065226
filed on December 12, 2018.

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

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

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

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

LEGAL NAME OF INVENTORInventor: Ahmed EL KAFFAS Date (Optional): 06/09/2020Signature: 

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

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

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.

REMARKS

The specification has been amended to update the priority claim.

All of the claims remaining in the application are now believed to be allowable.

Favorable consideration and a Notice of Allowance are earnestly solicited.

Commissioner is hereby authorized to charge the required fees to Deposit Account No. 504166. If additional fees are believed necessary, the Commissioner is further authorized to charge any deficiency or credit any overpayment to Deposit Account No. 504166.

If questions remain regarding this application, the Examiner is invited to contact the undersigned at (213) 629-6000.

Respectfully submitted,
Ahmed EL KAFFAS
NIXON PEABODY LLP

/Erik Birkeneder/
Erik Birkeneder
Registration No. 65,299

One California Plaza
300 S. Grand Avenue, Suite 4100
Los Angeles, CA 90071
Phone: (213) 629-6000
Facsimile: (213) 629-6001

AMENDMENTS TO THE SPECIFICATION

At the top of the first page just under the title, please amend the paragraph entitled CROSS-REFERENCE TO RELATED APPLICATIONS as follows:

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is the national phase of International Application No. PCT/US2018/065226, filed December 12, 2018, which designated the U.S. and that International Application was published under PCT Article 21(2) in English. This application claims priority to and the benefit of U.S. Provisional Patent Application No. 62/597,537, filed December 12, 2017, and entitled “Machine Learning to Extract Quantitative Biomarkers from Ultrasound RF Spectrums”, the contents of which are herein incorporated by reference.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Present Application:

Applicant : Ahmed EL KAFFAS
Title : MACHINE LEARNING TO EXTRACT QUANTITATIVE
BIOMARKERS FROM RF SPECTRUMS
Docket No. : 079633-000001US00
Date : June 12, 2020

Prior Application :

Examiner : N/A
Art Unit : N/A
Application No. : PCT/US2018/065226

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

PRELIMINARY AMENDMENT

Dear Sir:

Prior to examination of the national phase application included herewith and the calculation of fees associated with the claims thereof, please enter the following amendments and consider the accompanying remarks.

Amendment to the Specification begins on page 2.

Remarks begin on page 3.

TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

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

Application Number	
Filing Date	June 10, 2020
First Named Inventor	Ahmed EL KAFFAS
Title	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS
Art Unit	NA
Examiner Name	NA
Attorney Docket Number	079633-000001US00

SIGNATURE of Applicant or Patent Practitioner

Signature	/Erik Birkeneder/	Date (Optional)	
Name	Erik Birkeneder	Registration Number	65299
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			

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



*Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

POWER OF ATTORNEY BY APPLICANT

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

Application Number	Filing Date

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

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

106303

OR

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

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

☒ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name

Address

City

State

Zip

Country

Telephone

Email

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

ONCOUSTICS INC.

- ☐ Inventor or Joint Inventor (title not required below)
- ☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)
- ☒ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)
- ☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

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

Signature

Date (Optional)

06/09/2020

Name

Ahmed El Kaffas

Title

Founder

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

☒ Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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

Electronic Patent Application Fee Transmittal

Application Number:				
Filing Date:				
Title of Invention:	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS			
First Named Inventor/Applicant Name:	Ahmed EL KAFFAS			
Filer:	Erik J. Birkeneder/Kathleen Dunn			
Attorney Docket Number:	079633-000001US00			
Filed as Small Entity				
Filing Fees for U.S. National Stage under 35 USC 371				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
BASIC NATIONAL STAGE FEE	2631	1	150	150
NATL STAGE SEARCH FEE - U.S. WAS THE ISA	2641	1	70	70
NATL STAGE EXAM FEE - ALL OTHER CASES	2633	1	380	380
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				600

Electronic Acknowledgement Receipt

EFS ID:	39702756
Application Number:	16772304
International Application Number:	PCT/US2018/065226
Confirmation Number:	3673
Title of Invention:	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS
First Named Inventor/Applicant Name:	Ahmed EL KAFFAS
Customer Number:	106303
Filer:	Erik J. Birkeneder/Kathleen Dunn
Filer Authorized By:	Erik J. Birkeneder
Attorney Docket Number:	079633-000001US00
Receipt Date:	12-JUN-2020
Filing Date:	
Time Stamp:	12:03:58
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	\$ 600
RAM confirmation Number	E20206BC05313425
Deposit Account	504166
Authorized User	Kathleen Dunn

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

37 CFR 1.21 (Miscellaneous fees and charges)

37 CFR 1.492 (National application filing, search, and examination fees)

File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal of New Application	2020-06-12-371Transmittal-079633-000001US00.pdf	264881	no	4
			52fc1a31f03559b32d485ae4d43d61c4ce8584fc		
Warnings:					
Information:					
2	Application Data Sheet	2020-06-12-ADS-079633-000001US00.pdf	1256081	no	8
			bb12e7b4dab3529b03f54931c3d3ec914d027d3e		
Warnings:					
Information:					
3	Oath or Declaration filed	Declaration-EL-KAFFAS.pdf	136281	no	2
			6347d5f669c2ee5cedcad66c6f02883b138524c1		
Warnings:					
Information:					
4		2020-06-12-Preliminary-Amendment-079633-000001US00.pdf	108102	yes	3
			0c93b628cc76376e33beecf0e47f6bcd45eacf6		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Applicant Arguments/Remarks Made in an Amendment		3	3	
	Specification		2	2	
	Preliminary Amendment		1	1	
Warnings:					
Information:					
5	Power of Attorney	POA-Transmittal-079633-000001US00.pdf	279396	no	2
			1ed68ae1a692c8b3b329ed91103f8eac91a586ce		

Warnings:					
Information:					
6	Fee Worksheet (SB06)	fee-info.pdf	35340	no	2
			caac9e87de0170fcc61767ba6d4a701bf4c49fc9		
Warnings:					
Information:					
Total Files Size (in bytes):			2080081		
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.					

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter I of the Patent Cooperation Treaty)

(PCT Rule 44bis)

Applicant's or agent's file reference 079633-000001W00	FOR FURTHER ACTION	See item 4 below
International application No. PCT/US2018/065226	International filing date (<i>day/month/year</i>) 12 December 2018 (12.12.2018)	Priority date (<i>day/month/year</i>) 12 December 2017 (12.12.2017)
International Patent Classification (8th edition unless older edition indicated) See relevant information in Form PCT/ISA/237		
Applicant ONCOUSTICS INC.		

1.	This international preliminary report on patentability (Chapter I) is issued by the International Bureau on behalf of the International Searching Authority under Rule 44 bis.1(a).																								
2.	This REPORT consists of a total of 7 sheets, including this cover sheet.																								
	In the attached sheets, any reference to the written opinion of the International Searching Authority should be read as a reference to the international preliminary report on patentability (Chapter I) instead.																								
3.	This report contains indications relating to the following items: <table style="width: 100%;"> <tr> <td style="width: 10%; text-align: center;">☒</td> <td style="width: 30%;">Box No. I</td> <td style="width: 60%;">Basis of the report</td> </tr> <tr> <td style="text-align: center;">☐</td> <td>Box No. II</td> <td>Priority</td> </tr> <tr> <td style="text-align: center;">☐</td> <td>Box No. III</td> <td>Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</td> </tr> <tr> <td style="text-align: center;">☐</td> <td>Box No. IV</td> <td>Lack of unity of invention</td> </tr> <tr> <td style="text-align: center;">☒</td> <td>Box No. V</td> <td>Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</td> </tr> <tr> <td style="text-align: center;">☐</td> <td>Box No. VI</td> <td>Certain documents cited</td> </tr> <tr> <td style="text-align: center;">☐</td> <td>Box No. VII</td> <td>Certain defects in the international application</td> </tr> <tr> <td style="text-align: center;">☒</td> <td>Box No. VIII</td> <td>Certain observations on the international application</td> </tr> </table>	☒	Box No. I	Basis of the report	☐	Box No. II	Priority	☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability	☐	Box No. IV	Lack of unity of invention	☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement	☐	Box No. VI	Certain documents cited	☐	Box No. VII	Certain defects in the international application	☒	Box No. VIII	Certain observations on the international application
☒	Box No. I	Basis of the report																							
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☐	Box No. VI	Certain documents cited																							
☐	Box No. VII	Certain defects in the international application																							
☒	Box No. VIII	Certain observations on the international application																							
4.	The International Bureau will communicate this report to designated Offices in accordance with Rules 44bis.3(c) and 93bis.1 but not, except where the applicant makes an express request under Article 23(2), before the expiration of 30 months from the priority date (Rule 44bis .2).																								

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. +41 22 338 82 70	Date of issuance of this report 16 June 2020 (16.06.2020) Authorized officer Agnès Wittmann-Regis e-mail: pct.team6@wipo.int
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Form PCT/IB/373 (January 2004)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: EMILY N. SANDHAUS
NIXON PEABODY LLP
799 9TH STREET, N.W., SUITE 500
WASHINGTON, DC 20001

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing
(day/month/year)

15 MAR 2019

Applicant's or agent's file reference
079633-000001WO0

FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/US 18/65226

International filing date (day/month/year)

12 December 2018 (12.12.2018)

Priority date (day/month/year)

12 December 2017 (12.12.2017)

International Patent Classification (IPC) or both national classification and IPC

IPC(8) - G06K 9/36; G06K 9/42; G06N 3/04 (2019.01)

CPC - G06K 9/46; G06K 9/42; G06K 9/38; G06K 9/50; G06N 3/04; G06N 3/0436; G06N 3/08; G06N 3/086; G06T 7/00; G06T 7/0012

Applicant ONCOUSTICS INC.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Date of completion of this opinion 25 February 2019	Authorized officer Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774
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Form PCT/ISA/237 (cover sheet) (January 2015)

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US 18/65226

Box No. 1 Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:
 - ☒ the international application in the language in which it was filed.
 - ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).
2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a)).
3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:
 - a. ☐ forming part of the international application as filed:
 - ☐ in the form of an Annex C/ST.25 text file.
 - ☐ on paper or in the form of an image file.
 - b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
 - c. ☐ furnished subsequent to the international filing date for the purposes of international search only:
 - ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).
 - ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).
4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
5. Additional comments:

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US 18/65226

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	3-4, 8-9, 12	YES
	Claims	1, 2, 5-7, 10, 11	NO
Inventive step (IS)	Claims	NONE	YES
	Claims	1-12	NO
Industrial applicability (IA)	Claims	1-12	YES
	Claims	NONE	NO

2. Citations and explanations:

Claims 1, 2, 5-7, 10 and 11 lack novelty under PCT Article 33(2) as being anticipated by US 2016/0120502 A1 to Sunnybrook Research Institute (hereinafter 'SRI').

Regarding claim 1, SRI discloses an ultrasound system (abstract: Systems and methods for classifying tissue using quantitative ultrasound) comprising:

a transducer (para [0041]: where linear array transducers are used) configured to output a set of ultrasound data (para [0008]: Ultrasound echo signal data is acquired from a region-of-interest that contains the tissue, using the ultrasound system); a memory (Fig 4: 406, 424; para [0068]: microprocessor unit ("MPU") 406; para [0074]: storage 424) containing machine readable medium comprising machine executable code having stored thereon instructions (para [0069]: instructions to perform processing of the echo signal data); a signal processing unit (Fig 4: 402; para [0068]: processing unit 402) comprising one or more processors (Fig 4: 404, 406, 408; para [0068]: a digital signal processor ("DSP") 404, a microprocessor unit ("MPU") 406, and a graphics processing unit ("GPU") 408) coupled to the memory (Fig 4: 412, 424; para [0068]: DSP 404, MPU 406, GPU 408 ... are all coupled to a communication bus 412; note that Fig 4 shows the storage 424 as also being coupled to the communication bus 412), the one or more processors configured to execute the machine executable code (para [0069]: instructions to perform processing of the echo signal data) to the cause the one or more processors to: receive the set of ultrasound data (Fig 1: 102; para [0023]: acquisition of ultrasound echo signal data from a region that contains the tissue to be characterized) and partition the set of ultrasound data into a set of windows (para [0024]: selected ROI can then be segmented using a sliding window approach with or without overlap between adjacent windows); process the set of windows to determine a power spectrum for each window of the set of windows (para [0026]: a mean power spectrum can be computed in each window of a selected ROI); process the power spectrum for each window of the set of windows (para [0027]: normalized on a sliding window basis) to determine a normalized power spectrum for each window of the set of windows (para [0028]: normalizing the mean power spectrum); and process the normalized power spectrum for each window of the set of windows (para [0031]: linear regression analysis, such as a least squares fit, can then be applied to the mean normalized power spectrum to extract the MBF, SS, and SI parameters) with a machine learning model (para [0059]: machine learning techniques can be used for tissue classification and characterization); and display an image (Fig 4: 418; para [0072]: display 418 is used to display images) where each window of the set of windows is displayed using a unique identifier based on the output of the machine learning model (para [0072]: displaying the parametric maps, and for outputting other information such as data plots or other reports based on statistical measures computed from the parametric maps, including information indicating a characterization of tissues).

Regarding claim 2, SRI discloses the ultrasound system of claim 1, wherein the machine learning model is a k-means model (Fig 2A; para [0012]: scatter plot of different tumor grade sampled overlaid on territorial maps over a plane of canonical discriminant functions obtained using the means of four parameters; para [0062]: FIG. 2A corresponds to using only the means of MBF [mid-band fit], SS [spectral slope], SI [spectral 0-MHz intercept], and SAS [spacing among scatterers]; the claimed 'k-means model' is taken to read on this k=3 cluster-sorting scatter plot) or a model from a deep learning network comprising one or a combination to the algorithm types of CNN (Convolutional Neural Network), RBM (Restricted Boltzmann Machine), LSTM (Long Short Term Memory) or CapsNet (Capsule Networks).

Regarding claim 5, SRI discloses a method (abstract: methods for classifying tissue using quantitative ultrasound) comprising: receiving a set of ultrasound data (Fig 1: 102; para [0023]: acquisition of ultrasound echo signal data from a region that contains the tissue to be characterized) output from at least one ultrasound transducer (para [0041]: where linear array transducers are used) representing a tissue of a patient (para [0008]: Ultrasound echo signal data is acquired from a region-of-interest that contains the tissue, using the ultrasound system) and partitioning the set of ultrasound data into a set of windows or bounding boxes (para [0024]: selected ROI can then be segmented using a sliding window approach with or without overlap between adjacent windows); processing the set of windows to determine a power spectrum for each window of the set of windows (para [0026]: a mean power spectrum can be computed in each window of a selected ROI); processing the power spectrum for each window of the set of windows (para [0031]: linear regression analysis, such as a least squares fit, can then be applied to the mean normalized power spectrum to extract the MBF [mid-band fit], SS [spectral slope], and SI [spectral 0-MHz intercept] parameters) with a machine learning model (para [0059]: machine learning techniques can be used for tissue classification and characterization); and outputting a classification of the tissue (para [0009]: classifying the tissue as being associated with a particular histological state; para [0072]: displaying the parametric maps, and for outputting other information such as data plots or other reports based on statistical measures computed from the parametric maps, including information indicating a characterization of tissues).

-- see next page

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US 18/65226

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Claim 2 lacks clarity due to the ambiguity of the language "comprising but not limited to," which is self-contradictory and, thus, leaves doubt as to whether or not the recited limitations that follow these words limit the scope of the claim. For purposes of this written opinion "comprising but not limited to" is taken to read "comprising."

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US 18/65226

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of:

Box No. V, 2. Citations and explanations:

Regarding claim 6, SRI discloses the method of claim 5, wherein the classification is a cancer status of the tissue (para [0022]: tissue characterized as malignant cancer can additionally be graded (e.g., Grade I, II, or III)).

Regarding claim 7, SRI discloses the method of claim 5, wherein the method further comprises processing the power spectrum for each window of the set of windows (para [0027]: normalized on a sliding window basis) to determine a normalized power spectrum for each window of the set of windows (para [0028]: normalizing the mean power spectrum).

Regarding claim 10, SRI discloses a method (abstract: methods for classifying tissue using quantitative ultrasound) comprising: receiving a set of ultrasound data (Fig 1: 102; para [0023]: acquisition of ultrasound echo signal data from a region that contains the tissue to be characterized) output from at least one ultrasound transducer (para [0041]: where linear array transducers are used) representing a tissue of a patient (para [0008]: Ultrasound echo signal data is acquired from a region-of-interest that contains the tissue, using the ultrasound system) and partitioning the set of ultrasound data into a set of windows (para [0024]: selected ROI can then be segmented using a sliding window approach with or without overlap between adjacent windows); processing the set of windows (para [0026]: a mean power spectrum can be computed in each window of a selected ROI) with a machine learning model (para [0059]: machine learning techniques can be used for tissue classification and characterization); and outputting a classification of the tissue (para [0009]: classifying the tissue as being associated with a particular histological state; para [0072]: displaying the parametric maps, and for outputting other information such as data plots or other reports based on statistical measures computed from the parametric maps, including information indicating a characterization of tissues).

Regarding claim 11, SRI discloses the method of claim 10, wherein the step of processing the set of windows with a machine learning model first comprises processing the set of windows to output a power spectrum for each window of the set of windows (para [0026]: a mean power spectrum can be computed in each window of a selected ROI).

Claim 3 lacks an inventive step under PCT Article 33(3) as being obvious over SRI in view of US 2017/0178365 A1 to Siemens Healthcare GmbH (hereinafter 'Siemens').

Regarding claim 3, SRI discloses the ultrasound system of claim 1, however SRI does not disclose specifically wherein the machine learning model is trained using ultrasound images labeled by a radiologist. Siemens discloses, in the context of medical imaging (para [0009]: image recording with the use of medical imaging systems), that the machine learning model is trained using ultrasound images labeled by a radiologist (para [0040]: In a learning process of this kind manually generated reference segmentations, which have been performed by experienced radiologists, are applied to the training image data to learn the connection between textural features and contours of organ boundaries and internal and external regions). It would have been obvious to a person having ordinary skill in the art to modify the system of SRI so that the machine learning model is trained using ultrasound images labeled by a radiologist, as taught by Siemens, in order "to generate a structure prediction model, in particular a contour prediction model" (see Siemens (para [0040]), and prevent skew of the model toward use of spurious image properties).

Claim 4 lacks an inventive step under PCT Article 33(3) as being obvious over SRI in view of US 2016/0203600 A1 to Densitas Incorporated (hereinafter 'Densitas').

Regarding claim 4, SRI discloses the ultrasound system of claim 1, however SRI does not disclose specifically wherein the machine learning model is an unsupervised model. Densitas discloses, in the context of machine learning for analysis of medical imaging (para [0152]: breast density model that takes the form of a regression model that may be developed within statistical learning or machine learning frameworks), that the machine learning model is an unsupervised model (para [0155]: machine learning or statistical learning algorithms may include ... unsupervised learning). It would have been obvious to a person having ordinary skill in the art to modify the system of SRI so that the machine learning model is an unsupervised model, as taught by Densitas, as this would have allowed automated modeling with limited or no human interaction in order to quickly obtain an acceptable level of performance (para [0152]-[0156]).

Claim 8 lacks an inventive step under PCT Article 33(3) as being obvious over SRI in view of US 2009/0135051 A1 to Bishop et al. (hereinafter 'Bishop').

Regarding claim 8, SRI discloses the method of claim 5, however SRI does not disclose specifically wherein the power spectrum is taken using a continuous Fast Fourier Transform (FFT). Bishop discloses, in the context of image signal processing (abstract: produce a radar image of at least a desired portion of the field of view), wherein the power spectrum is taken (para [0052]: Real time FFT power spectra) using a continuous FFT (para [0053]: continuous FFT processing of the samples). It would have been obvious to a person having ordinary skill in the art to modify the method of SRI so that the power spectrum is taken using a continuous FFT, as taught by Bishop, as the overlapping of the samples by continuous FFT would prevent signal loss due to windowing resulting in additional details being processed and available (para [0053]).

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**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.
PCT/US 18/65226

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of:

Box No. V, 2. Citations and explanations:

Claim 9 lacks an inventive step under PCT Article 33(3) as being obvious over SRI in view of US 4,202,215 A (Meyer).

Regarding claim 9, SRI discloses the method of claim 5, however SRI does not disclose specifically wherein the power spectrum is taken using a discrete FFT. Meyer discloses, in the context of medical diagnostic ultrasound (col 1, ln 15-18: ultrasonic pressure waves ... to probe internal tissues of the body in an attempt to diagnose pathological tissue states; col 1, ln 19: diagnostic ultrasound), that the power spectrum (col 8, ln 59-60: Fig. 8 shows such a plot where attenuation is linearly dependent upon frequency) is taken using a discrete FFT (col 9, ln 3-13: discrete (fast) Fourier transform subroutine). It would have been obvious to a person having ordinary skill in the art to modify the method of SRI so that the power spectrum is taken using a discrete FFT, as taught by Meyer, for piecewise analysis of inhomogeneous tissue (see Meyer at col 8, ln 48-50: each additional tissue segment to determine each segment's attenuation coefficient) in progressive tissue segments (see Meyer at col 9, ln 53-54: This process is repeated until all segments are analyzed) to avoid errors resulting from analyzing time segments of echo wave trains (see Meyer at col 2, ln 67 . col 3, ln 3: computing Fourier power spectrums from time segments of echo wave trains ... method yields inaccurate results because the original time segments frequently contain echoes returning from adjoining tissue segments).

Claim 12 lacks an inventive step under PCT Article 33(3) as being obvious over SRI in view of US 6,434,261 B1 to Zhang et al. (hereinafter 'Zhang').

Regarding claim 12, SRI discloses the method of claim 10, however SRI does not disclose specifically wherein the step of processing the set of windows with a machine learning model first comprises processing the set of windows to output a time frequency domain processing technique. Zhang discloses, in the context of automated image signal processing (col 2, ln 66-67: method for automatically detecting an abnormal portion of a digital image), that the step of processing the set of windows with a machine learning model first comprises processing the set of windows to output a time frequency domain processing technique (col 7, ln 28-31: the wavelet transform divides time-frequency domain by constant Q resolution cells. This type of split is often effective in signal processing applications). It would have been obvious to a person having ordinary skill in the art to modify the method of SRI to include processing the set of windows to output a time frequency domain processing technique, as taught by Zhang, to provide "a higher time resolution for higher frequency components and high frequency resolution for lower frequency components" when trying to identify "singularity information [that] appears in higher frequency channels" (see Zhang at col 7, ln 31-33, 44-45).

Claims 1-12 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used in industry.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	16772304
	Filing Date	2020-06-12
	First Named Inventor	Ahmed EL KAFFAS
	Art Unit	NA
	Examiner Name	NA
	Attorney Docket Number	079633-000001US00

U.S.PATENTS						Remove
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6238342	B2	2001-05-29	Feleppa et al.	

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	1	20160238568	A1	2016-08-18	Feleppa et al.	

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

Application Number	16772304
Filing Date	2020-06-12
First Named Inventor	Ahmed EL KAFFAS
Art Unit	NA
Examiner Name	NA
Attorney Docket Number	079633-000001US00

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

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

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

Application Number	16772304
Filing Date	2020-06-12
First Named Inventor	Ahmed EL KAFFAS
Art Unit	NA
Examiner Name	NA
Attorney Docket Number	079633-000001US00

CERTIFICATION STATEMENT

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

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

OR

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

See attached certification statement.

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

☒ A certification statement is not submitted herewith.

SIGNATURE

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

Signature	/Erik Birkeneder/	Date (YYYY-MM-DD)	2020-08-28
Name/Print	Erik Birkeneder	Registration Number	65299

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

Privacy Act Statement

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

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

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

Electronic Acknowledgement Receipt

EFS ID:	40409378
Application Number:	16772304
International Application Number:	
Confirmation Number:	3673
Title of Invention:	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS
First Named Inventor/Applicant Name:	Ahmed EL KAFFAS
Customer Number:	106303
Filer:	Erik J. Birkeneder/Kathleen Dunn
Filer Authorized By:	Erik J. Birkeneder
Attorney Docket Number:	079633-000001US00
Receipt Date:	28-AUG-2020
Filing Date:	
Time Stamp:	10:45:49
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	2020-08-28-IDS-079633-001US00.pdf	1006729	no	4
			ad3da8366bd8e50137f2df8b01610366ca29e0b5		

Warnings:

Information:	
Total Files Size (in bytes):	1006729
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875						Application or Docket Number 16/772,304				
APPLICATION AS FILED - PART I										
(Column 1)		(Column 2)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY				
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)			
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	160		N/A				
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A	70		N/A				
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	400		N/A				
TOTAL CLAIMS (37 CFR 1.16(j))	12	minus 20 = *	x 50 =	0.00	OR					
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3	minus 3 = *	x 240 =	0.00						
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			0.00						
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00						
			TOTAL	630		TOTAL				
* If the difference in column 1 is less than zero, enter "0" in column 2.										
APPLICATION AS AMENDED - PART II										
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY		
AMENDMENT A		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	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))							OR		
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	
AMENDMENT B		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	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))							OR		
	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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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
16/772,304	06/12/2020		600	079633-000001US00	12	3

CONFIRMATION NO. 3673

FILING RECEIPT



0000000121786103

106303
Nixon Peabody LLP
300 South Grand Avenue, Suite 4100
Los Angeles, CA 90071

Date Mailed: 12/07/2020

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)

Ahmed EL KAFFAS, Palo Alto, CANADA;

Applicant(s)

ONCOUSTICS INC., Toronto, Ontario, CANADA;
Ahmed EL KAFFAS, Palo Alto, CA

Assignment For Published Patent Application

ONCOUSTICS INC., Toronto, Ontario, CANADA

Power of Attorney: The patent practitioners associated with Customer Number 106303

Domestic Priority data as claimed by applicant

This application is a 371 of PCT/US2018/065226 12/12/2018
which claims benefit of 62/597,537 12/12/2017

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: 12/03/2020

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/772,304**

Projected Publication Date: 03/18/2021

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS

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 Assets Control, 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).

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The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

technology, manufacture products, deliver services, and grow your business, visit <http://www.SelectUSA.gov> or call +1-202-482-6800.



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U.S. APPLICATION NO.	FIRST NAMED INVENTOR	ATTY. DOCKET NO.
16/772,304	Ahmed EL KAFFAS	079633-000001US00

106303
Nixon Peabody LLP
300 South Grand Avenue, Suite 4100
Los Angeles, CA 90071

INTERNATIONAL APPLICATION NO.	
PCT/US2018/065226	
I.A. FILING DATE	PRIORITY DATE
12/12/2018	12/12/2017

CONFIRMATION NO. 3673
371 ACCEPTANCE LETTER



OC000000121786104

Date Mailed: 12/07/2020

NOTICE OF ACCEPTANCE OF APPLICATION UNDER 35 U.S.C 371 AND 37 CFR 1.495

The applicant is hereby advised that the United States Patent and Trademark Office, in its capacity as a Designated / Elected Office (37 CFR 1.495), has ACCEPTED the above identified international application for national patentability examination in the United States Patent and Trademark Office.

The United States Application Number assigned to the application is shown above. A Filing Receipt will be issued for the present application in due course. **THE DATE APPEARING ON THE FILING RECEIPT AS THE "FILING DATE or 371(c) DATE" IS THE DATE ON WHICH THE LAST OF THE 35 U.S.C. 371 (c)(1) and (c)(2) REQUIREMENTS HAS BEEN RECEIVED IN THE OFFICE. THIS DATE IS SHOWN BELOW.** The filing date of the above identified application is the international filing date of the international application (Article 11(3) and 35 U.S.C. 363)

06/12/2020
DATE OF RECEIPT OF 35 U.S.C.
371(c)(1) and (c)(2) REQUIREMENTS

The following items have been received:

- Indication of Small Entity Status
- Copy of the International Application filed on 06/12/2020
- Copy of the International Search Report filed on 06/12/2020
- Preliminary Amendments filed on 06/12/2020
- Information Disclosure Statements filed on 08/28/2020
- Inventor's Oath or Declaration filed on 06/12/2020
- Request for Immediate Examination filed on 06/12/2020
- U.S. Basic National Fees filed on 06/12/2020
- Assignee Statement for PGPUB filed on 06/12/2020
- Authorize Access to Search Results filed on 06/12/2020
- Priority Documents filed on 06/12/2020
- Power of Attorney filed on 06/12/2020
- Authorization to Permit Access filed on 06/12/2020
- Application Data Sheet (37 CFR 1.76) filed on 06/12/2020

Applicant is reminded that any communications to the United States Patent and Trademark Office must be mailed to the address given in the heading and include the U.S. application no. shown above (37 CFR 1.5)

PAUL T BALTIMORE

Telephone: (703) 756-1510

MULTIPLE DEPENDENT CLAIM FEE CALCULATION SHEET Substitute for Form PTO-1360 (For use with Form PTO/SB/06)							Application Number 16772304		Filing Date				
							Applicant(s) Ahmed EL KAFFAS						
							* May be used for additional claims or amendments						
CLAIMS	AS FILED		AFTER FIRST AMENDMENT		AFTER SECOND AMENDMENT			*		*		*	
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/772,304	06/12/2020	Ahmed EL KAFFAS	079633-000001US00

CONFIRMATION NO. 3673

PUBLICATION NOTICE



OC000000124192133

106303
Nixon Peabody LLP
300 South Grand Avenue, Suite 4100
Los Angeles, CA 90071

Title: MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS

Publication No. US-2021-0077073-A1

Publication Date: 03/18/2021

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently <http://www.uspto.gov/patft/>.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently <https://portal.uspto.gov/pair/PublicPair>. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/772,304	06/12/2020	Ahmed EL KAFFAS	079633-000001US00	3673
106303	7590	06/21/2022	EXAMINER	
Nixon Peabody LLP			SHIN, SOO JUNG	
300 South Grand Avenue, Suite 4100			ART UNIT	PAPER NUMBER
Los Angeles, CA 90071			2667	
			NOTIFICATION DATE	DELIVERY MODE
			06/21/2022	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):

ipairlink@nixonpeabody.com
lapatentmb@nixonpeabody.com
slevy@nixonpeabody.com

Office Action Summary

Application No.

16/772,304

Applicant(s)

EL KAFFAS, Ahmed

Examiner

SOO J SHIN

Art Unit

2667

AIA (FITF) Status

Yes

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

Period for Reply

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

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

Status

1) ☒ Responsive to communication(s) filed on 12 June 2020.

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

2a) ☐ This action is **FINAL**.

2b) ☒ This action is non-final.

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

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

Disposition of Claims*

5) ☒ Claim(s) 1-12 is/are pending in the application.

5a) Of the above claim(s) ____ is/are withdrawn from consideration.

6) ☐ Claim(s) ____ is/are allowed.

7) ☒ Claim(s) 1-12 is/are rejected.

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

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

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

Application Papers

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

11) ☒ The drawing(s) filed on 12 June 2020 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.

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

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

Priority under 35 U.S.C. § 119

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

Certified copies:

a) ☐ All b) ☐ Some** c) ☐ None of the:

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

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

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

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

Attachment(s)

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

3) ☐ Interview Summary (PTO-413)

Paper No(s)/Mail Date ____.

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b)

4) ☐ Other: ____.

Paper No(s)/Mail Date ____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.
2. In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

Priority

3. Applicant's claim for the benefit of a prior-filed application under 35 U.S.C. 119(e) or under 35 U.S.C. 120, 121, 365(c), or 386(c) is acknowledged.

Drawings

4. The drawings are objected to because Figs. 4A and 4B do not axis labels. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR

1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 112

5. The following is a quotation of 35 U.S.C. 112(b):

(b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claim 2 is rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor (or for applications subject to pre-AIA 35 U.S.C. 112, the applicant), regards as the invention.

Claim 2 recites the limitation “but not limited to” in line 2. The limitation renders the claim indefinite because the limitation has no metes and bounds and it is not clear which additional elements outside of the listed algorithms are included in the deep learning network. A claim that requires the exercise of subjective judgment without restriction renders the claim indefinite. *In re Musgrave*, 431 F.2d 882, 893, 167 USPQ 280, 289 (CCPA 1970). Claim scope cannot depend solely on the unrestrained, subjective opinion of a particular individual purported to be practicing the invention. *Datamize LLC v. Plumtree Software, Inc.*, 417 F.3d 1342, 1350, 75 USPQ2d 1801, 1807 (Fed. Cir. 2005)); see also *Interval Licensing LLC v. AOL, Inc.*, 766 F.3d 1364, 1373, 112 USPQ2d 1188 (Fed. Cir. 2014). For the purpose of further examination, claim 2 has been interpreted as using either a k-means model or any deep learning method.

Claim Rejections - 35 USC § 102

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a)(1) the claimed invention was patented, described in a printed publication, or in public use, on sale, or otherwise available to the public before the effective filing date of the claimed invention.

(a)(2) the claimed invention was described in a patent issued under section 151, or in an application for patent published or deemed published under section 122(b), in which the patent or application, as the case may be, names another inventor and was effectively filed before the effective filing date of the claimed invention.

8. Claim(s) 1, 2, and 5-12 is/are rejected under 35 U.S.C. 102(a)(1) and 102(a)(2) as being anticipated by Sadeghi-Naini *et al.* (US 2016/0120502 A1), hereinafter referred to as **Sadeghi-Naini**.

Regarding **claim 1**, Sadeghi-Naini teaches an ultrasound system comprising:

a transducer configured to output a set of ultrasound data (**Sadeghi-Naini Abstract**: “Systems and methods for classifying tissue using quantitative ultrasound techniques”;

Sadeghi-Naini ¶0035: “transducer width, L”);

a memory containing machine readable medium comprising machine executable code having stored thereon instructions (**Sadeghi-Naini ¶0074**: “The processing unit 402 can also include a temporary storage 424 and a display controller 426. As an example, the temporary storage 424 can store temporary information. For instance, the temporary storage 424 can be a random access memory.”);

a signal processing unit comprising one or more processors coupled to the memory, the one or more processors configured to execute the machine executable code to the cause the one or more processors to (**Sadeghi-Naini ¶0068**: “the processing unit 402 can include one or more processors. As an example, the processing unit 402 may include one or more of a digital

signal processor ('DSP') 404, a microprocessor unit ('MPU') 406, and a graphics processing unit ('GPU') 408”):

receive the set of ultrasound data and partition the set of ultrasound data into a set of windows (**Sadeghi-Naini ¶0024**: “each selected ROI can then be segmented using a sliding window approach with or without overlap between adjacent windows.”);

process the set of windows to determine a power spectrum for each window of the set of windows (**Sadeghi-Naini ¶0004**: “By modeling the ultrasonic power spectrum as an acoustic impedance autocorrelation function, it has been demonstrated that SS can be related to effective scatterer size”; **Sadeghi-Naini ¶0026**: “a mean power spectrum can be computed in each window of a selected ROI by taking the squared magnitude of the Fourier transform of the Hanning gated RF echo ... and averaging the results across the RF lines”; **Sadeghi-Naini ¶0028**: “such reference echo signal data can be used for normalizing the mean power spectrum on which linear regression analyses will be performed in order to extract a number of quantitative ultrasound parameters, such as MBG, SS, and SI”; **Sadeghi-Naini ¶0079**: “Power spectra were calculated using a Fourier transform of the raw RF data for each scan line through the ROI and subsequently averaged. The power spectra were corrected for attenuation, with a fixed attenuation coefficient of 0.7 dB/MHz/cm, using a point attenuation compensation approach.”);

process the power spectrum for each window of the set of windows to determine a normalized power spectrum for each window of the set of windows (**Sadeghi-Naini ¶0028 & ¶0079** discussed above); and

process the normalized power spectrum for each window of the set of windows with a machine learning model (**Sadeghi-Naini ¶0059**: “other pattern recognition or machine learning techniques can be used for tissue classification and characterization”); and

display an image where each window of the set of windows is displayed using a unique identifier based on the output of the machine learning model (**Sadeghi-Naini ¶0072**: “The

display 418 is used to display images ... and other information ... the display 418 can be used for displaying the parametric maps, and for outputting other information such as data plots or other reports based on statistical measures computed from the parametric maps, including information indicating a characterization of tissues” – the parametric maps are generated from the parameters determined for each ROI).

Regarding **claim 2**, Sadeghi-Naini teaches the ultrasound system of claim 1, wherein the machine learning model is a k-means model or a model from a deep learning network comprising but not limited to one or a combination to the algorithm types of CNN (Convolutional Neural Network), RBM (Restricted Boltzmann Machine), LSTM (Long Short Term Memory) or CapsNet (Capsule Networks) (Note that only one of the alternative limitations is required by the claim language. Refer to the 35 U.S.C. 112(b) rejection above regarding claim interpretation.

Sadeghi-Naini ¶0012: “scatter plot of different tumor grade sampled overlaid on territorial maps over a plane of canonical discriminant functions obtained using the means of four parameters”;

Sadeghi-Naini ¶0059: “using artificial neural networks (‘ANNs’) or a support vector machine (‘SVM’).”; **Sadeghi-Naini Fig. 2 & ¶0062:** “FIG. 2A corresponds to using only the means of MBF, SS, SI, and SAS; FIG. 2B corresponds to using only the CON, ENE, HOM, and COR of MBF, SS, SI, and SAS; and FIG. 2C corresponds to using both the means and CON, ENE, HOM, and COR of MBF, SS, SI, and SAS”).

Regarding **claim 5**, Sadeghi-Naini teaches a method comprising:

receiving a set of ultrasound data output from at least one ultrasound transducer representing a tissue of a patient and partitioning the set of ultrasound data into a set of windows or bounding boxes (Note that only one of the alternative limitations is required by the claim language. **Sadeghi-Naini ¶0024 & ¶0074** discussed above);

processing the set of windows to determine a power spectrum for each window of the set of windows (**Sadeghi-Naini ¶0004, ¶0026, ¶0028 & ¶0079** discussed above);

processing the power spectrum for each window of the set of windows with a machine learning model (**Sadeghi-Naini ¶0028 & ¶0079** discussed above); and

outputting a classification of the tissue (**Sadeghi-Naini ¶0072** discussed above).

Regarding **claim 6**, Sadeghi-Naini teaches the method of claim 5, wherein the classification is a cancer status of the tissue (**Sadeghi-Naini ¶0022**: “a tissue characterized as malignant cancer can additionally be graded (e.g., Grade I, II, or III), and tissue characterized as fibrotic liver can additionally be characterized based on stage of liver fibrosis. As such, the systems and methods described here provide for non-invasive, highly accurate characterization and grading of tissues”).

Regarding **claim 7**, Sadeghi-Naini teaches the method of claim 5, wherein the method further comprises processing the power spectrum for each window of the set of windows to determine a normalized power spectrum for each window of the set of windows (**Sadeghi-Naini ¶0028 & ¶0079** discussed above)

Regarding **claim 8**, Sadeghi-Naini teaches the method of claim 5, wherein the power spectrum is taken using a continuous Fast Fourier Transform (FFT) (**Sadeghi-Naini ¶0026** discussed above; **Sadeghi-Naini ¶0031**: “f is frequency and FFT(...) is the Fast Fourier Transform operator”).

Regarding **claim 9**, Sadeghi-Naini teaches the method of claim 5, wherein the power spectrum is taken using a discrete FFT (**Sadeghi-Naini Eqn. (1) & ¶0031**: “where f is frequency and FFT(...) is the Fast Fourier Transform operator - the time domain signals (t, x_i) are transformed into frequency, i.e., DFT is used. **Sadeghi-Naini ¶0035**: “The normalized AR power

spectrum $S_{AR}(f)$, is obtained similar to Eqn. (1) ... discrete depth intervals at which the reference echo data is obtained”).

Regarding **claim 10**, Sadeghi-Naini teaches a method comprising:

receiving a set of ultrasound data output from at least one ultrasound transducer representing a tissue of a patient and partitioning the set of ultrasound data into a set of windows (**Sadeghi-Naini ¶0024 & ¶0074** discussed above);

processing the set of windows with a machine learning model (**Sadeghi-Naini ¶0004, ¶0028 & ¶0079** discussed above); and

outputting a classification of the tissue (**Sadeghi-Naini ¶0022 & ¶0072** discussed above).

Regarding **claim 11**, Sadeghi-Naini teaches the method of claim 10, wherein the step of processing the set of windows with a machine learning model first comprises processing the set of windows to output a power spectrum for each window of the set of windows (**Sadeghi-Naini ¶0026, ¶0028 & ¶0079** discussed above)

Regarding **claim 12**, Sadeghi-Naini teaches the method of claim 10, wherein the step of processing the set of windows with a machine learning model first comprises processing the set of windows to output a time frequency domain processing technique (**Sadeghi-Naini Eqn. (1) & ¶0031 & ¶0035** discussed above. The equation uses DFT, converting the time domain to frequency, as shown in equation 1).

Claim Rejections - 35 USC § 103

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

A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

10. The factual inquiries for establishing a background for determining obviousness under 35 U.S.C. 103 are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

11. Claim(s) 3-4 is/are rejected under 35 U.S.C. 103 as being unpatentable over Sadeghi-Naini *et al.* (US 2016/0120502 A1), in view of Kallenberg *et al.* (US 2017/0249739 A1), hereinafter referred to as **Sadeghi-Naini** and **Kallenberg**, respectively.

Regarding **claim 3**, Sadeghi-Naini teaches the ultrasound system of claim 1, wherein the machine learning model is trained using ultrasound images labeled (**Sadeghi-Naini ¶0055**: “To characterize tissue using LDA, the linear discriminant can be trained for the tissue being analyzed ... This training can be performed in real-time or, preferably, can be performed off-line with the results stored in a feature set database that can be provided during processing”).

However, Sadeghi-Naini does not appear to explicitly teach that the labeling is performed by a radiologist.

Pertaining to the same field of endeavor, Kallenberg teaches that the labeling is performed by a radiologist (**Kallenberg ¶0080**: “A trained radiologist annotated the skin-air boundary and the pectoral muscle by a polygon tool ... The pixels and their labels form the training data for the CSAE pipeline and the extent to which the resulting pixel classification can reproduce the dense tissue segmentation is evaluated using 5-fold cross-validation”;

Kallenberg Table 1 & Kallenberg ¶0094: “between the automated segmentation A and the segmentation of the radiologist B, and (ii) the root mean squared error between the percent density (PMD) as measured by the machinery and the radiologist”).

Sadeghi-Naini and Kallenberg are considered to be analogous art because they are directed to ultrasound image processing for tissue classification. It would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to have modified the system and method for classifying and characterizing tissue using quantitative ultrasound parametric maps (as taught by Sadeghi-Naini) to use radiologist-labeled data for training (as taught by Kallenberg) because the combination allows the machine-learned automated results to be compared with expert analysis using cross validation (Kallenberg ¶0094).

Regarding **claim 4**, Sadeghi-Naini teaches the ultrasound system of claim 1, but does not appear to explicitly teach that the machine learning model is an unsupervised model.

Pertaining to the same field of endeavor, Kallenberg teaches that the machine learning model is an unsupervised model (**Kallenberg ¶0050:** “The features can also be learned in an unsupervised way, e.g. using Restricted Boltzmann Machines”; **Kallenberg ¶0056:** “the individual unsupervised training of (shallow) layers results in an unsupervised deep learning procedure”).

It would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to have modified the system and method for classifying and characterizing tissue using quantitative ultrasound parametric maps (as taught by Sadeghi-Naini) to use radiologist-labeled data for training (as taught by Kallenberg) because the combination allows the use of autoencoders (Kallenberg ¶0066).

Conclusion

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to SOO J SHIN whose telephone number is (571)272-9753. The examiner can normally be reached M-F; 10-6.

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, Matthew Bella can be reached on (571)272-7778. 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.

/Soo Shin/
Primary Examiner, Art Unit 2667

Notice of References Cited	Application/Control No. 16/772,304		Applicant(s)/Patent Under Reexamination EL KAFFAS, Ahmed	
	Examiner SOO J SHIN		Art Unit 2667	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20160238568-A1	08-2016	Feleppa; Ernest J.	G16H50/30	1/1
*	B	US-6238342-B1	05-2001	Feleppa; Ernest Joseph	A61B17/3403	600/437
*	C	US-20160120502-A1	05-2016	Sadeghi-Naini; Ali	A61B8/5223	600/443
*	D	US-8192362-B2	06-2012	Kolios; Michael	A61B8/08	600/443
*	E	US-20170249739-A1	08-2017	KALLENBERG; Michiel	G06V10/454	1/1
	F					
	G					
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	I					
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	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

<i>Search Notes</i> 	Application/Control No. 16/772,304	Applicant(s)/Patent Under Reexamination EL KAFFAS, Ahmed
	Examiner SOO J SHIN	Art Unit 2667

CPC - Searched*		
Symbol	Date	Examiner
A61B 8/463, 8/5223 (limited by keyword search)	06/15/2022	SJS
G06K 9/6223, 9/6259, 9/6267 (limited by keyword search)	06/15/2022	SJS
G06N 3/04, 3/08, 3/088, 20/10 (limited by keyword search)	06/15/2022	SJS
G06T 7/0012, 2207/10132, 2207/20081, 2207/20084 (limited by keyword search)	06/15/2022	SJS
G06V 10/143, 10/22, 10/82 (limited by keyword search)	06/15/2022	SJS
G16H 30/40 (limited by keyword search)	06/15/2022	SJS

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.

/Soo Shin/ Primary Examiner, Art Unit 2667	
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<i>Search Notes</i> 	Application/Control No. 16/772,304	Applicant(s)/Patent Under Reexamination EL KAFFAS, Ahmed
	Examiner SOO J SHIN	Art Unit 2667

Search Notes		
Search Notes	Date	Examiner
A61B 8/463, 8/5223 (limited by keyword search)	06/15/2022	SJS
G06K 9/6223, 9/6259, 9/6267 (limited by keyword search)	06/15/2022	SJS
G06N 3/04, 3/08, 3/088, 20/10 (limited by keyword search)	06/15/2022	SJS
G06T 7/0012, 2207/10132, 2207/20081, 2207/20084 (limited by keyword search)	06/15/2022	SJS
G06V 10/143, 10/22, 10/82 (limited by keyword search)	06/15/2022	SJS
G16H 30/40 (limited by keyword search)	06/15/2022	SJS
PE2E search history attached	06/15/2022	SJS
NPL search	06/15/2022	SJS
Inventor/assignee search	06/15/2022	SJS

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/Soo Shin/ Primary Examiner, Art Unit 2667	
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PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	6	("6238342" "20160238568").did.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:23 PM
L2	3	"20160120502".pn.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:25 PM
L3	4207	ultrasound AND (machine near3 learn\$3) AND ((partition\$3 divid\$4 sub\$divide) WITH (region area section))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:37 PM
L4	231	L3 AND (power near4 spectr\$4)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:37 PM
L5	29	L3 AND (normali\$6 WITH (power near4 spectr\$4))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:37 PM
L6	15914	ultrasound AND (machine near3 learn\$3) AND (partition\$3 divi\$6 sub\$divi\$6 sub\$region)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:39 PM
L7	93	L6 AND (normali\$6 WITH (power near4 spectr\$4))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:39 PM
L8	10	L7 AND (slid\$4 near10 window)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:44 PM
L9	857	L6 AND (slid\$4 near10 window)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:44 PM
L10	147	L6 AND (normali\$6 WITH power WITH spectr\$4)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO;	OR	ON	ON	2022/06/14 06:45 PM

			JPO; DERWENT; IBM_TDB)				
L11	1188	L6 AND (display\$3 SAME ((label\$4 identif\$3 "id" tag annotat\$4) WITH (window region)))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:46 PM
L12	127	L9 AND (display\$3 SAME ((label\$4 identif\$3 "id" tag annotat\$4) WITH (window region)))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:46 PM
L13	9	L12 AND (power near10 spectr\$4)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:47 PM
L14	4	((US-20160238568- A1).did. AND DWPI.dbnm.) OR ((US- 6238342-B1 OR US- 8192362-B2).did. AND USPT.dbnm.) OR ((US- 20160120502-A1).did. AND PGPB.dbnm.)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:57 PM
L15	2	L14 AND (divid\$4 divis\$4 partition\$4)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:57 PM
L16	2	L15 AND (power near4 spectr\$4)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:57 PM
L17	1	L16 AND (machine near5 learn\$3)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:57 PM
L18	1	L14 AND (slid\$4 near10 window)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:58 PM
L19	4	((US-20160238568- A1).did. AND DWPI.dbnm.) OR ((US- 6238342-B1 OR US- 8192362-B2).did. AND USPT.dbnm.) OR ((US- 20160120502-A1).did. AND PGPB.dbnm.)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 07:52 PM
L20	3	L19 AND transducer	(US-PGPUB; USPAT;	OR	ON	ON	2022/06/15

		AND ultrasound AND memory AND processor	USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				07:52 PM
L21	3	L20 AND (power near3 spectr\$4)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 08:25 PM
L22	2	L20 AND (machine near3 learn\$3)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 08:29 PM
L23	2	L20 AND (display\$4 WITH (roi window region))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 08:30 PM
L24	3	L19 AND display\$4	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 08:31 PM
L25	2	L19 AND ((display\$4 monitor screen output\$4) WITH (roi window region interest))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 08:31 PM
L26	3	L19 AND (means deep convolutional neural boltzmann lstm capsule)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 08:52 PM
L27	2	L19 AND train\$3	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:02 PM
L28	3	L19 AND (radiologist doctor physician expert user person human)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:07 PM
L29	0	L19 AND unsupervis\$4	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:10 PM
L30	0	L19 AND supervis\$4	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:10 PM

L31	2	L19 AND (fft OR fourier)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:16 PM
L32	0	L19 AND (discrete near10 (fft OR fourier))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:18 PM
L33	3	L19 AND discrete	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:18 PM
L34	22	ultrasound AND (tissue WITH classification) AND radiologist AND (unsupervised near10 train\$3)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:33 PM
L35	4	L34 AND (power near3 spectr\$4)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:33 PM
L36	8	(el near3 kaffas near3 ahmed).in.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:47 PM
L37	3	(el near3 kaffas near3 ahmed).aanm.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:48 PM
L38	2	oncoustics.as.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:48 PM
L39	3	oncoustics.aanm.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:48 PM
L40	3	(L36 L37) AND (L38 L39)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:48 PM
L41	9	(L36 L37L38 L39)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT;	OR	ON	ON	2022/06/15 09:48 PM

			IBM_TDB)				
L42	5	L41 AND ultrasound.clm.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:48 PM
L43	2	L42 AND (power near5 spectr\$4).clm.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:49 PM
L44	2	L43 AND (A61B8/5223 OR A61B8/463 OR G06K9/6223 OR G06K9/6259 OR G06N3/04 OR G06N3/08 OR G06T7/0012 OR G06V10/22 OR G16H30/40 OR G06T2207/10132 OR G06T2207/20081 OR G06T2207/20084 OR G06V10/143 OR G06V10/82 OR G06N20/10 OR G06N3/088 OR G06K9/6267).cpc.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:50 PM
L45	6	L41 AND (A61B8/5223 OR A61B8/463 OR G06K9/6223 OR G06K9/6259 OR G06N3/04 OR G06N3/08 OR G06T7/0012 OR G06V10/22 OR G16H30/40 OR G06T2207/10132 OR G06T2207/20081 OR G06T2207/20084 OR G06V10/143 OR G06V10/82 OR G06N20/10 OR G06N3/088 OR G06K9/6267).cpc.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:50 PM
L46	313	L9 AND (A61B8/5223 OR A61B8/463 OR G06K9/6223 OR G06K9/6259 OR G06N3/04 OR G06N3/08 OR G06T7/0012 OR G06V10/22 OR G16H30/40 OR G06T2207/10132 OR G06T2207/20081 OR	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:50 PM

		G06T2207/20084 OR G06V10/143 OR G06V10/82 OR G06N20/10 OR G06N3/088 OR G06K9/6267).cpc.					
L47	51	L10 AND (A61B8/5223 OR A61B8/463 OR G06K9/6223 OR G06K9/6259 OR G06N3/04 OR G06N3/08 OR G06T7/0012 OR G06V10/22 OR G16H30/40 OR G06T2207/10132 OR G06T2207/20081 OR G06T2207/20084 OR G06V10/143 OR G06V10/82 OR G06N20/10 OR G06N3/088 OR G06K9/6267).cpc.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:51 PM

PE2E SEARCH - Search History (Interference)

There are no Interference searches to show.

Doc code: IDS

PTO/SB/08a (02-18)

Doc description: Information Disclosure Statement (IDS) Filed

Approved for use through 11/30/2020. OMB 0651-0031

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	16772304
	Filing Date	2020-06-12
	First Named Inventor	Ahmed EL KAFFAS
	Art Unit	NA
	Examiner Name	NA
	Attorney Docket Number	079633-000001US00

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Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6238342	B2	2001-05-29	Feleppa et al.	

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	1	20160238568	A1	2016-08-18	Feleppa et al.	

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

Application Number	16772304	
Filing Date	2020-06-12	
First Named Inventor	Ahmed EL KAFFAS	
Art Unit	NA	
Examiner Name	NA	
Attorney Docket Number	079633-000001US00	

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Examiner Signature	/Soo Shin/	Date Considered	06/15/2022
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

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

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16772304
Filing Date	2020-06-12
First Named Inventor	Ahmed EL KAFFAS
Art Unit	NA
Examiner Name	NA
Attorney Docket Number	079633-000001US00

CERTIFICATION STATEMENT

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

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

OR

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

See attached certification statement.

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

☒ A certification statement is not submitted herewith.

SIGNATURE

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

Signature	/Erik Birkeneder/	Date (YYYY-MM-DD)	2020-08-28
Name/Print	Erik Birkeneder	Registration Number	65299

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/772,304	Filing Date 06/12/2020	☐ To be Mailed
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ENTITY: ☐ LARGE ☒ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE (\$)	FEE (\$)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 = *		x \$50 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 = *		x \$230 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED - PART II

	10/21/2022	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)
AMENDMENT	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0	x \$50 =	0
	Independent (37 CFR 1.16(h))	* 4	Minus	*** 3	= 1	x \$240 =	240
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	240
AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x \$0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x \$0 =	
	☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
						TOTAL ADD'L FEE	
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.						SLIE	
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".						/AMANDA CHRISTINE LEMUS/	
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".							
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875				Application or Docket Number 16/772,304		Filing Date 06/12/2020		☐ To be Mailed			
ENTITY: ☐ LARGE ☒ SMALL ☐ MICRO											
APPLICATION AS FILED - PART I											
		(Column 1)		(Column 2)							
FOR		NUMBER FILED		NUMBER EXTRA		RATE (\$)		FEE (\$)			
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))		N/A		N/A		N/A					
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))		N/A		N/A		N/A					
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))		N/A		N/A		N/A					
TOTAL CLAIMS (37 CFR 1.16(i))		minus 20 = *				x \$50 =					
INDEPENDENT CLAIMS (37 CFR 1.16(h))		minus 3 = *				x \$230 =					
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))		If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).									
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))											
* If the difference in column 1 is less than zero, enter "0" in column 2.						TOTAL					
APPLICATION AS AMENDED - PART II											
		(Column 1)		(Column 2)		(Column 3)					
AMENDMENT	10/21/2022	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR		PRESENT EXTRA		RATE (\$)		ADDITIONAL FEE (\$)	
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0			x \$50 =		0	
	Independent (37 CFR 1.16(h))	* 4	Minus	*** 3	= 1			x \$240 =		240	
	☐ Application Size Fee (37 CFR 1.16(s))										
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))										
								TOTAL ADD'L FEE		240	
		(Column 1)		(Column 2)		(Column 3)					
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR		PRESENT EXTRA		RATE (\$)		ADDITIONAL FEE (\$)	
	Total (37 CFR 1.16(i))	*	Minus	**	=			x \$0 =			
	Independent (37 CFR 1.16(h))	*	Minus	***	=			x \$0 =			
	☐ Application Size Fee (37 CFR 1.16(s))										
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))										
								TOTAL ADD'L FEE			
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.								SLIE			
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".								/AMANDA CHRISTINE LEMUS/			
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".											
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.											

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Application Number: 16772304

Document Date: 10/21/2022

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No. : 16/772,304
Confirmation No. : 3673
Applicants : Oncoustics Inc.
Inventor: : Ahmed EL KAFFAS
Filed : June 12, 2020
Title : MACHINE LEARNING TO EXTRACT QUANTITATIVE
BIOMARKERS FROM ULTRASOUND RF SPECTRUMS
TC/A.U. : 2667
Examiner : Soo Jung Shin
Docket No. : 079633-000001US00
Customer No. : 106303

**AMENDMENT AND RESPONSE TO
NON-FINAL OFFICE ACTION MAILED JUNE 21, 2022**

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

Dear Commissioner:

This is filed in response to the Non-Final Office Action mailed June 21, 2022. A response was due three months from the mailing date, being September 21, 2022. The Applicant is submitting a one-month extension of time, resulting in the due date being October 21, 2022. Thus this response is considered timely.

Please enter the following remarks into the record for this application.

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

Amendments to the Specification begin on page 3 of this paper.

Amendments to the Claims begin on page 4 of this paper.

Remarks begin on page 8 of this paper.

AMENDMENT TO THE DRAWINGS

Applicant is submitting replacement formal drawings that insert the axis labels (x and y coordinates for the image) for Figs. 4A and 4B herewith.

AMENDMENT TO THE SPECIFICATION

Please amend paragraph 44 on page 10 as follows:

[0044] FIG. 3 illustrates an example of an ultrasound processing method according to the present disclosure. As illustrated, the steps through outputting of the raw ultrasound data from the transducer 215 are largely the same. However, as illustrated, once the raw ultrasound data is output from the transducer 100, the processing steps may follow a similar or different path, but then are ultimately processed ~~process~~ by a machine learning model 300.

AMENDMENT TO THE CLAIMS

The listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) An ultrasound system comprising:
 - a transducer configured to output a single static set of raw ultrasound radio frequency (RF) data from a tissue area;
 - a memory containing machine readable medium comprising machine executable code having stored thereon instructions;
 - a signal processing unit comprising one or more processors coupled to the memory, the one or more processors configured to execute the machine executable code to cause the one or more processors to:
 - receive the single static set of raw ultrasound RF data ~~and partition the set of ultrasound data into a set of windows~~;
 - ~~process the set of windows to determine a power spectrum for each window of the set of windows~~;
 - ~~process the power spectrum for each window of the set of windows to determine a normalized power spectrum for each window of the set of windows~~; and
 - process the single static set of raw RF ultrasound data ~~normalized power spectrum for each window of the set of windows~~ with a machine learning model; and
 - output classification of the raw RF ultrasound data from an output of the machine learning model.
2. (Currently Amended) The ultrasound system of claim 1, wherein the machine learning model is a k-means model or a model from a deep learning network comprising ~~but not limited to~~ one or a combination to the algorithm types of CNN (Convolutional Neural Network), RBM (Restricted Boltzmann Machine), LSTM (Long Short Term Memory) or CapsNet (Capsule Networks).
3. (Original) The ultrasound system of claim 1, wherein the machine learning model is trained using ultrasound images labeled by a radiologist.

4. (Original) The ultrasound system of claim 1, wherein the machine learning model is an unsupervised model.

5. (Currently Amended) A method comprising:

receiving a single static set of raw ultrasound radio frequency (RF) data output from at least one ultrasound transducer, the single static set of raw ultrasound RF data representing a tissue area of a patient ~~and partitioning the set of ultrasound data into a set of windows or bounding boxes~~;

processing the single static set of raw ultrasound RF data ~~set of windows~~ to determine a power spectrum ~~for each window of the set of windows~~;

processing the determined power spectrum as an input into ~~for each window of the set of windows~~ with a machine learning model; and

outputting a classification of the tissue area from the machine learning model.

6. (Original) The method of claim 5, wherein the classification is a cancer status of the tissue.

7. (Currently Amended) The method of claim 5, wherein the method further comprises processing the power spectrum ~~for each window of the set of windows~~ to determine a normalized power spectrum ~~for each window of the set of windows~~.

8. (Original) The method of claim 5, wherein the power spectrum is taken using a continuous Fast Fourier Transform (FFT).

9. (Original) The method of claim 5, wherein the power spectrum is taken using a discrete FFT.

10. (Currently Amended) A method comprising:

receiving a single static set of raw ultrasound radio frequency (RF) data output from at least one ultrasound transducer representing a tissue area of a patient ~~and partitioning the set of ultrasound data into a set of windows~~;

processing the single static set of ultrasound RF data as an input to set of windows with a machine learning model; and

outputting a classification of the tissue area from the machine learning model.

11. (Currently Amended) The method of claim 10, ~~wherein the step of processing the set of windows with a machine learning model first comprises~~ further comprising:

partitioning the single static set of raw ultrasound RF data into a set of windows or bounding boxes; and

processing the set of windows to output a power spectrum for each window of the set of windows.

12. (Currently Amended) The method of claim ~~11~~ 40, wherein the step of processing the set of windows ~~with a machine learning model first~~ comprises processing the set of windows to output a time frequency domain processing technique.

13. (New) The method of claim 10, wherein the machine learning model is a k-means model or a model from a deep learning network comprising one or a combination to the algorithm types of CNN (Convolutional Neural Network), RBM (Restricted Boltzmann Machine), LSTM (Long Short Term Memory) or CapsNet (Capsule Networks).

14. (New) The method of claim 10, wherein the machine learning model is trained using ultrasound images labeled by a radiologist.

15. (New) The method of claim 10, wherein the machine learning model is an unsupervised model.

16. (New) The method of claim 10, wherein the classification is a cancer status of the tissue.

17. (New) The method of claim 10, further comprising outputting a specific multi-parametric biomarker from the machine learning model.

18. (New) The system of claim 1, wherein the processor is operable to display an image representing the set of ultrasound data using a unique identifier based on the output of the machine learning model.

19. (New) An ultrasound system comprising:

a transducer configured to output a single static set of raw ultrasound radio frequency (RF) data from a tissue area; and

a signal processing unit operable to:

receive the single static set of raw ultrasound RF data

process the set of single static set of raw ultrasound RF data to determine a raw power spectrum;

process the raw power spectrum as an input to a machine learning model; and

output a classification of the raw power from an output of the machine learning model.

20. (New) The system of claim 19, further comprising a display, wherein the signal processing unit is operable to display an image representing the set of power spectrum data using a unique identifier based on the output of the machine learning model on the display.

REMARKS/ARGUMENTS

Claims 1-19 are currently pending. Claims 1-2, 5-7 and 10-12 have been amended. New claims 13-20 have been added. After entry of this paper, claims 1-20 remain pending.

Interview Summary

The undersigned expresses appreciation for the telephone interview conducted with the Examiner and inventor Ahmed Al-Kaffas on Oct. 20, 2022. The Sadeghi-Naini reference was discussed as well as the Uniyal reference sent by the Examiner. The Examiner agreed that the proposed claim amendments distinguished over the Sadeghi-Naini reference. The Examiner indicated a new search would be conducted. Applicants agreed to further amend the claims to distinguish the Uniyal reference and submit further written arguments.

Claim Rejections – 35 USC § 112

Claim 2 is rejected under 35 U.S.C. 112(b) as being indefinite in relation to the term “but not limited to.” Applicant has amended claim 2 to eliminate this term.

Claim Rejections – 35 USC §§ 102 and 103

Claim(s) 1, 2, and 5-12 is/are rejected under 35 U.S.C. 102(a)(1) and 102(a)(2) as being anticipated by Sadeghi-Naini *et al.* (US 2016/0120502 A1), hereinafter referred to as Sadeghi-Naini.

Claim(s) 3-4 is/are rejected under 35 U.S.C. 103 as being unpatentable over Sadeghi-Naini *et al.* (US 2016/0120502 A1), in view of Kallenberg *et al.* (US 2017/0249739 A1), hereinafter referred to as Sadeghi-Naini and Kallenberg, respectively.

The present invention is directed toward a simplified machine learning classification of raw ultrasound RF signals for ultrasound or power spectrum based classification of a tissue area. As explained in the Interview, a static set of raw ultrasound RF signals is collected for an area. This is a snapshot of the tissue area as opposed to taking a time series of RF signals. The raw ultrasound RF signals or the power spectrum derived from the raw ultrasound RF signals are input into a machine learning model to output classification of the tissue area. The classification may be cancerous or non-cancerous tissue for example.

Claims 1, 5 and 10 have been amended to recite that the transducer is “configured to output a single static set of raw ultrasound radio frequency (RF) data from a tissue area.” Support for these amendments may be found in at least paragraphs 45, 54 and 56 of the printed publication. Claims 1 and 10 have been further amended to recite that the machine learning model processes the single static set of raw RF ultrasound data. Claim 5 has been amended to recite that a power spectrum is determined from the raw ultrasound RF data and the power spectrum is input into the machine learning model. Support for these amendments may be found in at least paragraph 45 of the printed publication.

In contrast, Sadeghi-Naini discloses a classification process that depends on pre-processing the RF ultrasound data as discussed in the Interview. First, parameters are determined that are calculated directly from raw echo signal data as explained in paragraph 24 of Sadeghi-Naini. Paragraph 25 explains that such parameters may include a mid-band fit, spectral slope, spectral intercept and the like, which are mapped as images. A first order statistic of the mapped parameters is produced and a second order statistical measure of the mapped parameters is computed as explained in paragraphs 43-45 of Sadeghi-Naini. Sadeghi-Naini teaches using a linear discriminant analysis (LDA) to characterize the tissue based on the first and second order statistics. Thus, as explained in the Interview Sadeghi-Naini does not disclose inputting raw ultrasound RF data into the machine learning model as Sadeghi-Naini requires a two stage parameterization of raw data for input in the LDA/machine learning model. In fact, paragraph 32 of the printed publication specifically distinguishes prior art systems such as Sadeghi-Naini that require parameterization of the raw data as inputs in the machine learning model.

The Office Action cites paragraph 59 of Sadeghi-Naini as disclosing use of a machine learning model. However, paragraph 59 only discloses use of machine learning as an alternative to the LNA. Thus, Sadeghi-Naini requires determination of mapped parameters and further processing as an input to the machine learning/LNA. Sadeghi-Naini does not disclose inputting raw RF data from the ultrasonic transducer or a power spectrum derived from the raw RF data as an input to the machine learning model as now required by claims 1, 5, and 10.

The newly cited Uniyal reference (“Ultrasound RF Time Series for Classification of Breast Lesions” IEEE TRANSACTIONS ON MEDICAL IMAGING, VOL. 34, NO. 2, FEBRUARY 2015) was also discussed in the Interview. Uniyal relies on a time series of ultrasound data. In order to distinguish Uniyal, the claims have been amended to recite a single static set of ultrasound

RF data. As explained in the Interview, the claims rely on a snapshot of the ultrasound RF data rather than a time series. Applicant respectfully submits the amended claims are allowable over all of the cited reference.

Applicant has added new dependent claims depending from claims 1 and 10 that reflect additional features. New independent claim 19 has been added. Claim 19 is allowable for the same reasons that claim 5 is allowable. Finally, new claim 17 recites “outputting a specific multi-parametric biomarker from the machine learning model.” New claim 17 is supported by at least paragraph 36 of the printed publication and is separately allowable.

CONCLUSION

In view of the foregoing, Applicant believes all claims now pending in this Application are in condition for allowance and an action to that end is respectfully requested.

Except for the issue fees payable under 37 C.F.R. §1.18, the Director is authorized to charge any additional fees during the pendency of this application, including any required extension of time fees, or credit any overpayment, to Deposit Account Number 50-3557. This paragraph is intended to be a constructive petition for extension of time in accordance with 37 C.F.R. §1.136(a)(3).

If the Examiner believes that a telephone call would help advance prosecution, the Examiner is kindly invited to call the undersigned attorney at (312) 425-8641.

Respectfully submitted,

/Wayne L. Tang—Reg. No. 36028/
Wayne L. Tang
Reg. No. 36,028

Date: October 21, 2022
Customer No. 106303
NIXON PEABODY LLP
300 South Grand Avenue, Suite 4100
Los Angeles, CA 90071

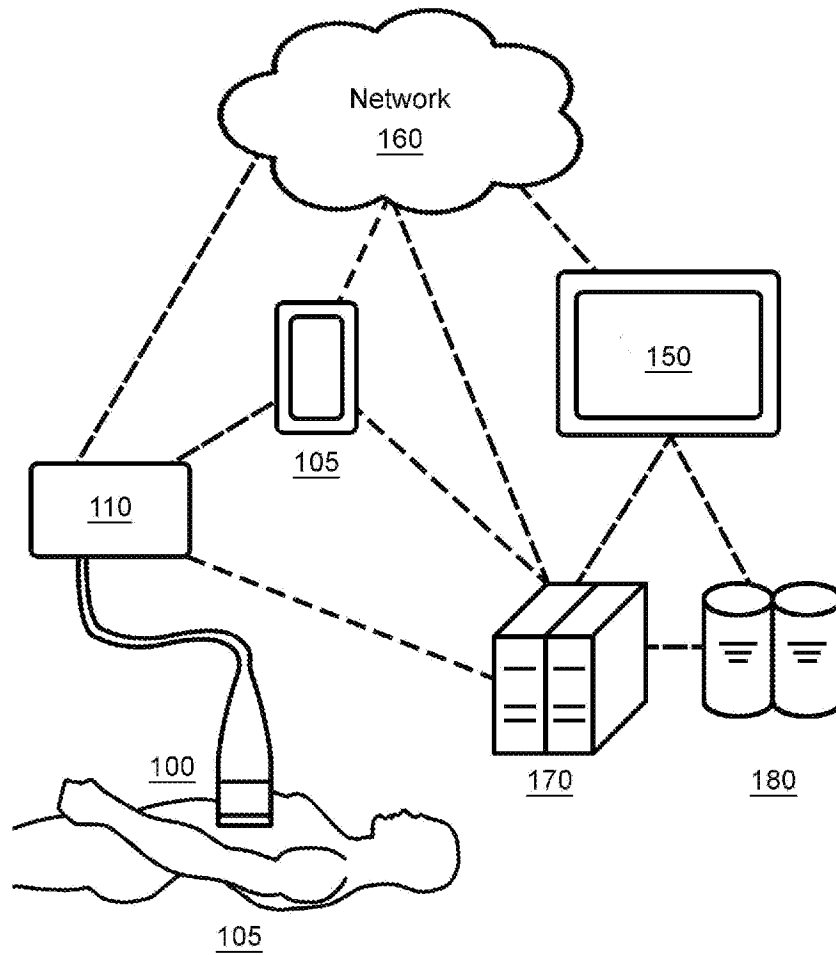


FIG. 1

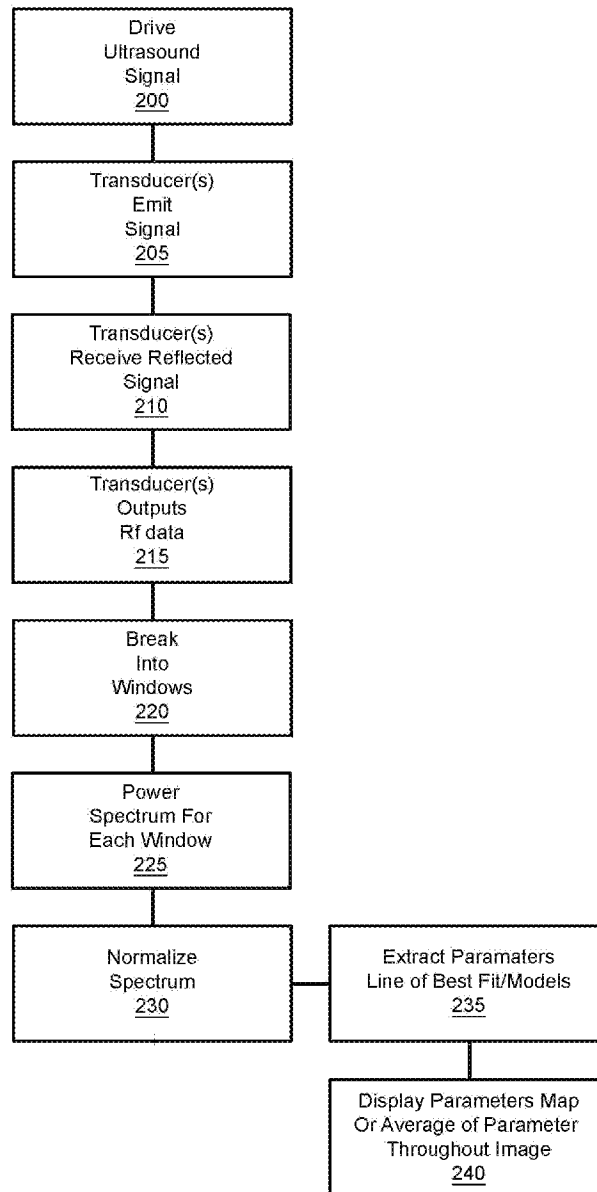


FIG. 2
(PRIOR ART)

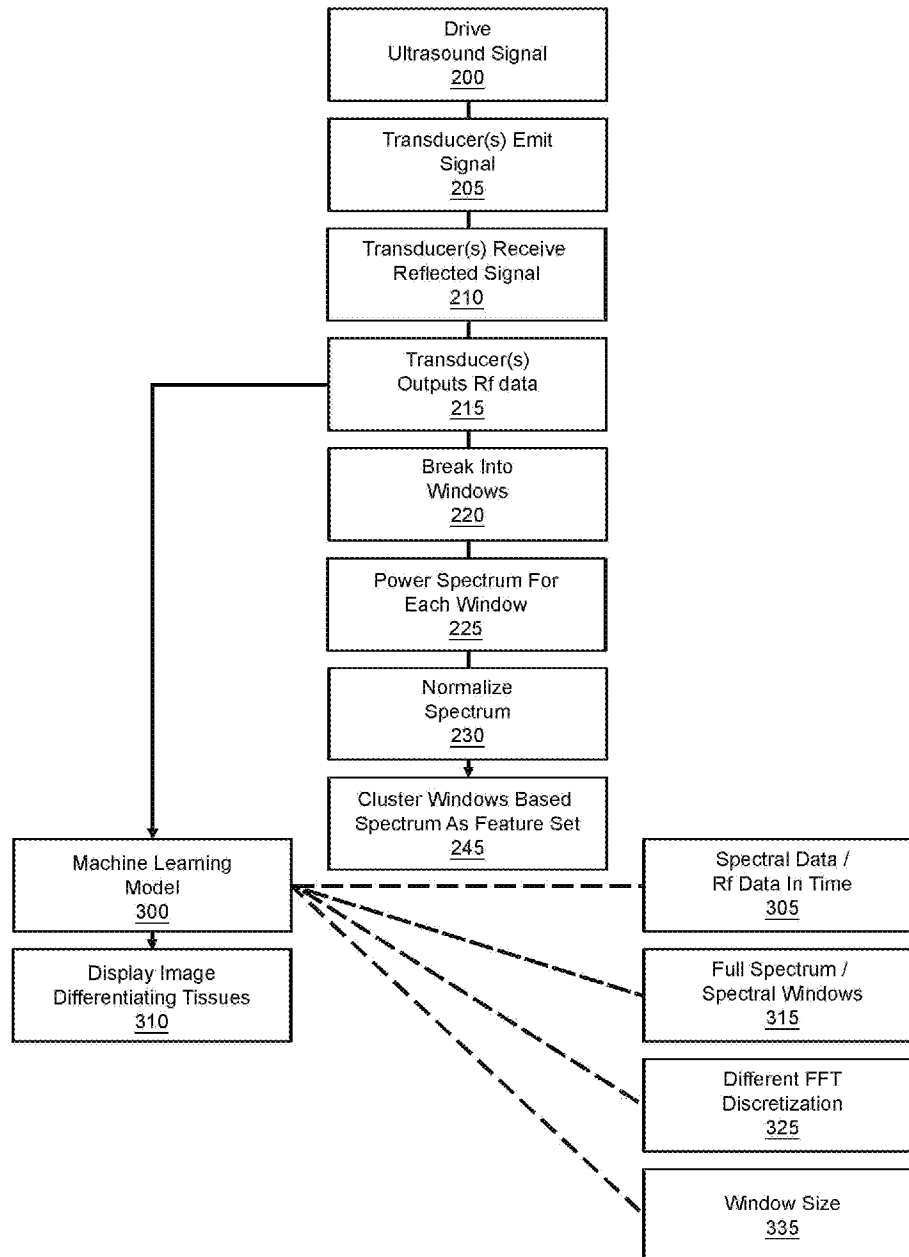


FIG. 3

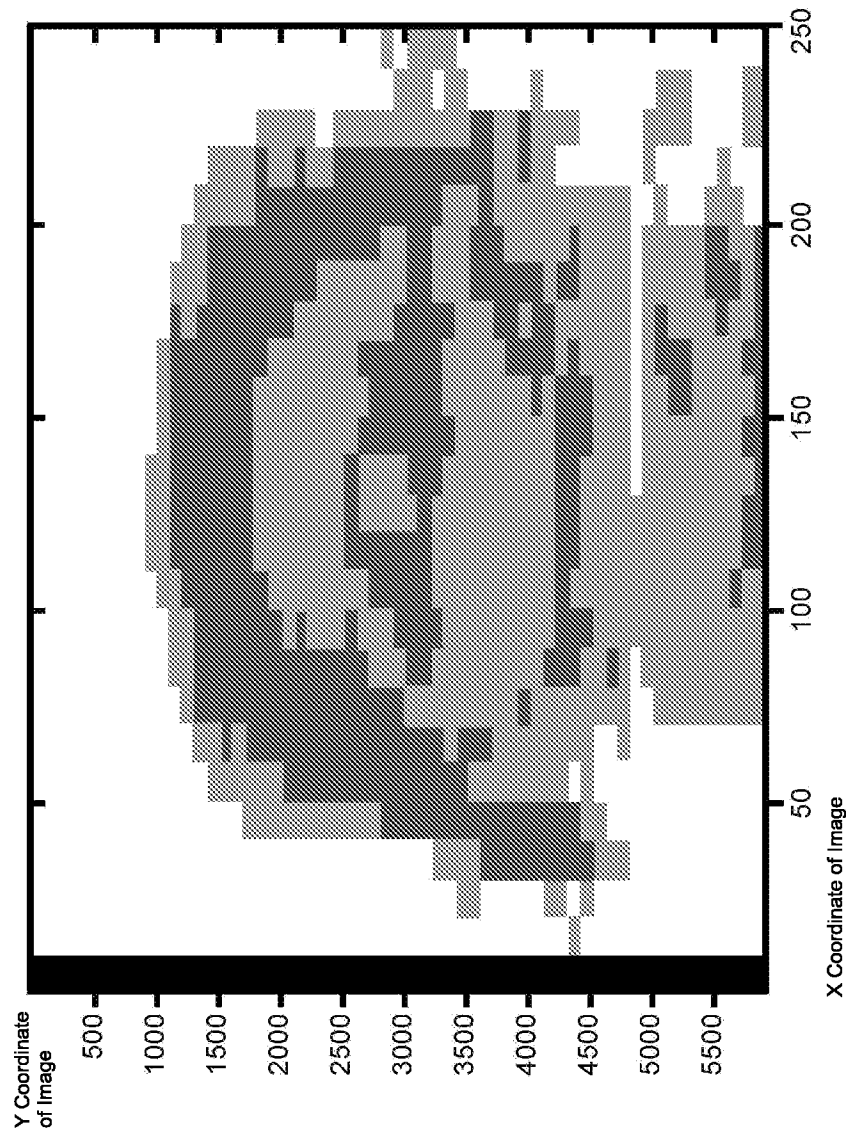


FIG. 4A

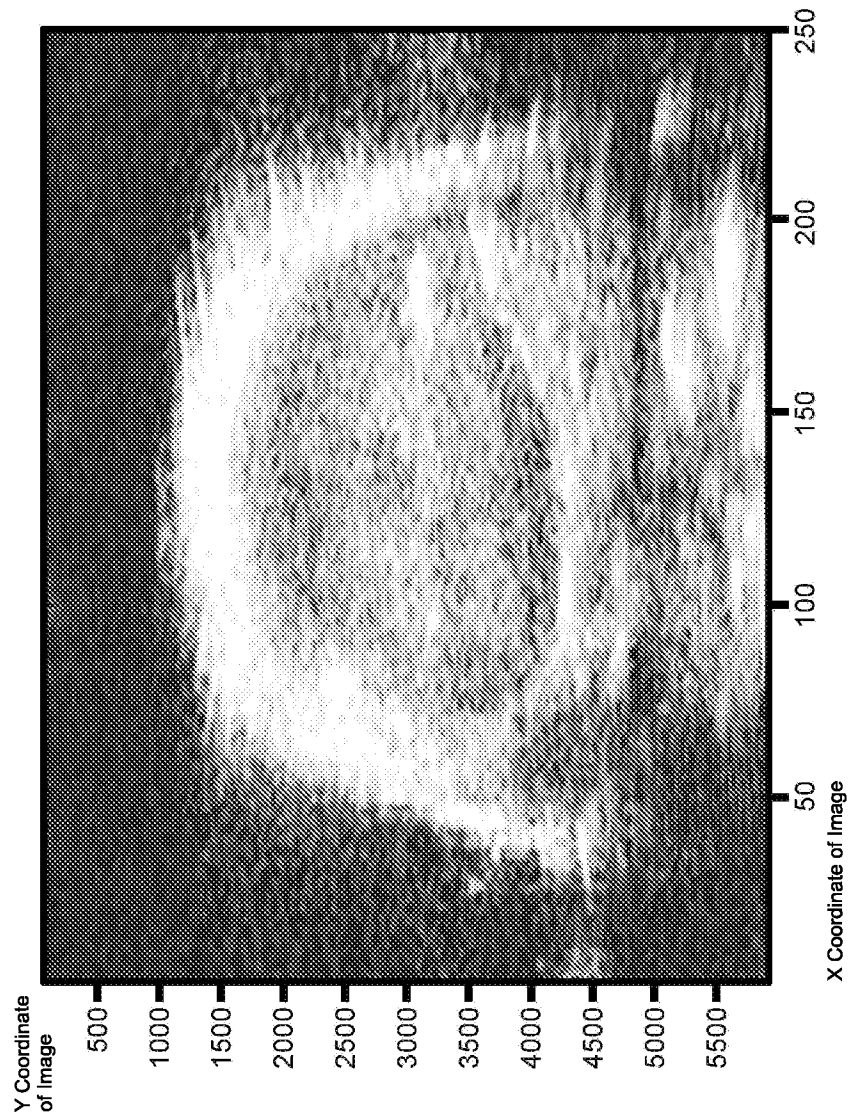


FIG. 4B

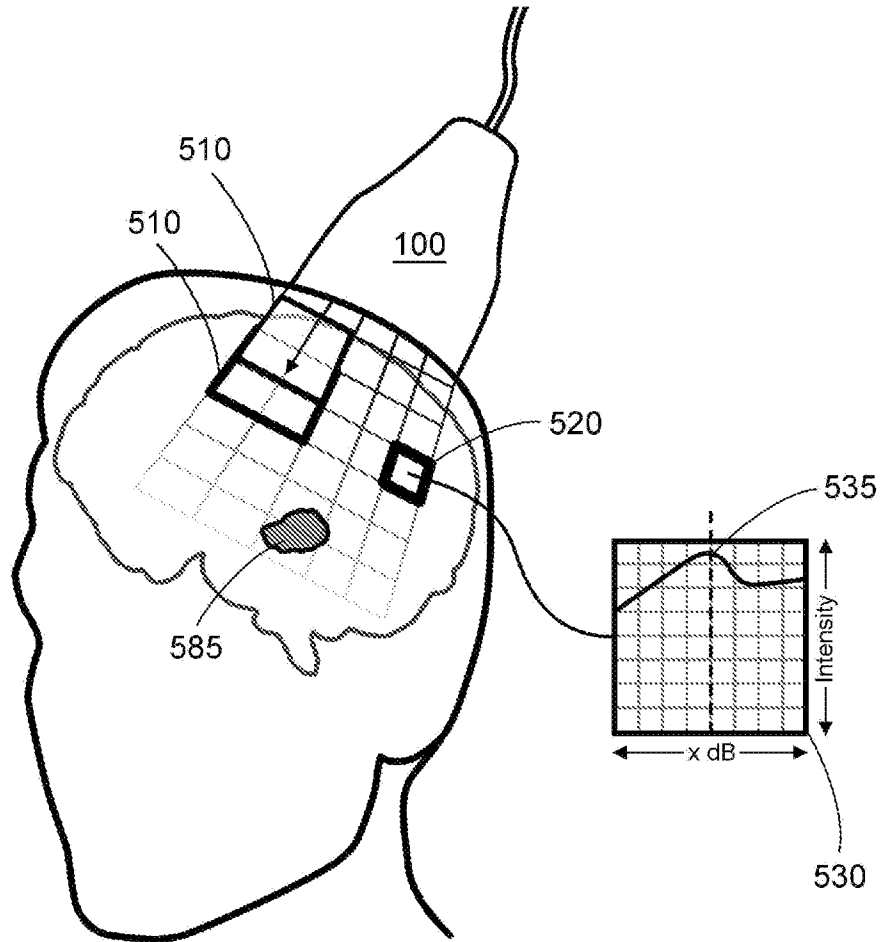


FIG. 5

Electronic Patent Application Fee Transmittal

Application Number:	16772304			
Filing Date:	12-Jun-2020			
Title of Invention:	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS			
First Named Inventor/Applicant Name:	Ahmed EL KAFFAS			
Filer:	Wayne L. Tang./Linda Stewart			
Attorney Docket Number:	079633-000001US00			
Filed as Small Entity				
Filing Fees for U.S. National Stage under 35 USC 371				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
INDEPENDENT CLAIMS IN EXCESS OF 3	2614	1	240	240
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Extension - 1 month with \$0 paid	2251	1	110	110
Miscellaneous:				
Total in USD (\$)				350

Electronic Acknowledgement Receipt

EFS ID:	46868304
Application Number:	16772304
International Application Number:	
Confirmation Number:	3673
Title of Invention:	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS
First Named Inventor/Applicant Name:	Ahmed EL KAFFAS
Customer Number:	106303
Filer:	Wayne L. Tang./Linda Stewart
Filer Authorized By:	Wayne L. Tang.
Attorney Docket Number:	079633-000001US00
Receipt Date:	21-OCT-2022
Filing Date:	12-JUN-2020
Time Stamp:	14:51:33
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	\$350
RAM confirmation Number	E20220KE52421417
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		2022-10-21_AmendmentResponse_to_NonFinalOfficeAction_of_6-21-2022_079633-000001US00.pdf	170954	yes	10
			a4ee53668d0b999120a577a0f82df6df088da3c5		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Amendment/Request for Reconsideration-After Non-Final Rejection		1	1	
	Drawings-only black and white line drawings		2	2	
	Specification		3	3	
	Claims		4	7	
	Applicant Arguments/Remarks Made in an Amendment		8	10	
Warnings:					
Information:					
2	Drawings-only black and white line drawings	2022-10-21_US_FIGS_ReplacementFigs_4A-4B_75adobe_079633-000001US00.pdf	2842418	no	6
			62934e2894bd809e88fa766bd2cce061fe4eb767e		
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	40837	no	2
			e46fce1bce0ca8c105333698b77838437004c16d		
Warnings:					
Information:					
Total Files Size (in bytes):			3054209		

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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

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New International Application Filed with the USPTO as a Receiving Office

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

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No. : 16/772,304
Confirmation No. : 3673
Applicants : Oncoustics Inc.
Inventor: : Ahmed EL KAFFAS
Filed : June 12, 2020
Title : MACHINE LEARNING TO EXTRACT QUANTITATIVE
BIOMARKERS FROM ULTRASOUND RF SPECTRUMS
TC/A.U. : 2667
Examiner : Soo Jung Shin
Docket No. : 079633-000001US00
Customer No. : 106303

**SUPPLEMENTAL CORRECTED AMENDMENT TO
AMENDMENT AND RESPONSE TO
NON-FINAL OFFICE ACTION MAILED JUNE 21, 2022**

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

Dear Commissioner:

This is a supplemental corrected Amendment to the Amendment and Response previously filed on October 21, 2022, which was filed in response to the Non-Final Office Action mailed June 21, 2022. A response was due three months from the mailing date, being September 21, 2022. The Applicant previously submitted the fee for a one-month extension of time, which resulted in the due date being October 21, 2022. Thus this response is considered timely.

Please enter the following remarks into the record for this application.

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

Amendments to the Specification begin on page 3 of this paper.

Amendments to the Claims begin on page 4 of this paper.

Remarks begin on page 8 of this paper.

AMENDMENT TO THE DRAWINGS

Applicant is submitting replacement formal drawings that insert the axis labels (x and y coordinates for the image) for Figs. 4A and 4B herewith.

AMENDMENT TO THE SPECIFICATION

Please amend paragraph 44 on page 10 as follows:

[0044] FIG. 3 illustrates an example of an ultrasound processing method according to the present disclosure. As illustrated, the steps through outputting of the raw ultrasound data from the transducer 215 are largely the same. However, as illustrated, once the raw ultrasound data is output from the transducer 100, the processing steps may follow a similar or different path, but then are ultimately processed ~~process~~ by a machine learning model 300.

AMENDMENT TO THE CLAIMS

The listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) An ultrasound system comprising:
 - a transducer configured to output a single static set of raw ultrasound radio frequency (RF) data forming a single frame of a tissue area;
 - a memory containing machine readable medium comprising machine executable code having stored thereon instructions;
 - a signal processing unit comprising one or more processors coupled to the memory, the one or more processors configured to execute the machine executable code to cause the one or more processors to:
 - receive the single static set of raw ultrasound RF data ~~and partition the set of ultrasound data into a set of windows~~;
 - ~~process the set of windows to determine a power spectrum for each window of the set of windows~~;
 - ~~process the power spectrum for each window of the set of windows to determine a normalized power spectrum for each window of the set of windows~~; and
 - process the single static set of raw RF ultrasound data ~~normalized power spectrum for each window of the set of windows~~ with a machine learning model; and
 - output classification of the raw RF ultrasound data from an output of the machine learning model.
2. (Currently Amended) The ultrasound system of claim 1, wherein the machine learning model is a k-means model or a model from a deep learning network comprising ~~but not limited to~~ one or a combination to the algorithm types of CNN (Convolutional Neural Network), RBM (Restricted Boltzmann Machine), LSTM (Long Short Term Memory) or CapsNet (Capsule Networks).
3. (Original) The ultrasound system of claim 1, wherein the machine learning model is trained using ultrasound images labeled by a radiologist.

4. (Original) The ultrasound system of claim 1, wherein the machine learning model is an unsupervised model.

5. (Currently Amended) A method comprising:

receiving a single static set of raw ultrasound radio frequency (RF) data output from at least one ultrasound transducer, the single static set of raw ultrasound RF data forming a single frame representing a tissue area of a patient ~~and partitioning the set of ultrasound data into a set of windows or bounding boxes~~;

processing the single static set of raw ultrasound RF data ~~set of windows~~ to determine a power spectrum ~~for each window of the set of windows~~;

processing the determined power spectrum as an input into ~~for each window of the set of windows~~ with a machine learning model; and

outputting a classification of the tissue area from the machine learning model.

6. (Original) The method of claim 5, wherein the classification is a cancer status of the tissue.

7. (Currently Amended) The method of claim 5, wherein the method further comprises processing the power spectrum ~~for each window of the set of windows~~ to determine a normalized power spectrum ~~for each window of the set of windows~~.

8. (Original) The method of claim 5, wherein the power spectrum is taken using a continuous Fast Fourier Transform (FFT).

9. (Original) The method of claim 5, wherein the power spectrum is taken using a discrete FFT.

10. (Currently Amended) A method comprising:

receiving a single static set of raw ultrasound radio frequency (RF) data output from at least one ultrasound transducer forming a single frame representing a tissue area of a patient ~~and partitioning the set of ultrasound data into a set of windows~~;

processing the single static set of ultrasound RF data as an input to set of windows with a machine learning model; and

outputting a classification of the tissue area from the machine learning model.

11. (Currently Amended) The method of claim 10, ~~wherein the step of processing the set of windows with a machine learning model first comprises~~ further comprising:

partitioning the single static set of raw ultrasound RF data into a set of windows or bounding boxes; and

processing the set of windows to output a power spectrum for each window of the set of windows.

12. (Currently Amended) The method of claim ~~11~~ 40, wherein the step of processing the set of windows ~~with a machine learning model first comprises~~ processing the set of windows to output a time frequency domain processing technique.

13. (New) The method of claim 10, wherein the machine learning model is a k-means model or a model from a deep learning network comprising one or a combination to the algorithm types of CNN (Convolutional Neural Network), RBM (Restricted Boltzmann Machine), LSTM (Long Short Term Memory) or CapsNet (Capsule Networks).

14. (New) The method of claim 10, wherein the machine learning model is trained using ultrasound images labeled by a radiologist.

15. (New) The method of claim 10, wherein the machine learning model is an unsupervised model.

16. (New) The method of claim 10, wherein the classification is a cancer status of the tissue.

17. (New) The method of claim 10, further comprising outputting a specific multi-parametric biomarker from the machine learning model.

18. (New) The system of claim 1, wherein the processor is operable to display an image representing the set of ultrasound data using a unique identifier based on the output of the machine learning model.
19. (New) An ultrasound system comprising:
a transducer configured to output a single static set of raw ultrasound radio frequency (RF) data forming a single frame of a tissue area; and
a signal processing unit operable to:
receive the single static set of raw ultrasound RF data
process the set of single static set of raw ultrasound RF data to determine a raw power spectrum;
process the raw power spectrum as an input to a machine learning model; and
output a classification of the raw power from an output of the machine learning model.
20. (New) The system of claim 19, further comprising a display, wherein the signal processing unit is operable to display an image representing the set of power spectrum data using a unique identifier based on the output of the machine learning model on the display.

REMARKS/ARGUMENTS

Claims 1-19 are currently pending. Claims 1-2, 5-7 and 10-12 have been amended. New claims 13-20 have been added. After entry of this paper, claims 1-20 remain pending.

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Claims 1, 5 and 10 have been amended to recite that the transducer is “configured to output a single static set of raw ultrasound radio frequency (RF) data forming a single frame of a tissue area.” Support for these amendments may be found in at least paragraphs 45, 54 and 56 and Fig. 4B of the printed publication. Claims 1 and 10 have been further amended to recite that the machine learning model processes the single static set of raw RF ultrasound data. Claim 5 has been amended to recite that a power spectrum is determined from the raw ultrasound RF data and the power spectrum is input into the machine learning model. Support for these amendments may be found in at least paragraph 45 of the printed publication.

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RF data in a single frame of the tissue area. As explained in the Interview, the claims rely on a single “snapshot” frame of the ultrasound RF data rather than a time series or RF data as disclosed in Uniya. Applicant respectfully submits the amended claims are allowable over all of the cited reference.

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Respectfully submitted,

/Wayne L. Tang—Reg. No. 36028/

Wayne L. Tang

Reg. No. 36,028

Date: October 21, 2022

Customer No. 106303

NIXON PEABODY LLP

300 South Grand Avenue, Suite 4100

Los Angeles, CA 90071

Electronic Acknowledgement Receipt

EFS ID:	46869555
Application Number:	16772304
International Application Number:	
Confirmation Number:	3673
Title of Invention:	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS
First Named Inventor/Applicant Name:	Ahmed EL KAFFAS
Customer Number:	106303
Filer:	Wayne L. Tang./Linda Stewart
Filer Authorized By:	Wayne L. Tang.
Attorney Docket Number:	079633-000001US00
Receipt Date:	21-OCT-2022
Filing Date:	12-JUN-2020
Time Stamp:	16:02:42
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2022-10-21_SUPPLEMENTAL-CORRECTED_AmendmtResponse_to_NFOAction_of_6-21-2022_079633-000001US00.pdf	171281 e5e1e6094ab7b74fd3ea41e86006cd38e42691a9	yes	10

	Multipart Description/PDF files in .zip description		
	Document Description	Start	End
	Supplemental Response or Supplemental Amendment	1	1
	Drawings-only black and white line drawings	2	2
	Specification	3	3
	Claims	4	7
	Applicant Arguments/Remarks Made in an Amendment	8	10

Warnings:

Information:

Total Files Size (in bytes):	171281
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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.



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/772,304	06/12/2020	Ahmed EL KAFFAS	079633-000001US00	3673
106303	7590	10/25/2022	EXAMINER	
Nixon Peabody LLP			SHIN, SOO JUNG	
300 South Grand Avenue, Suite 4100			ART UNIT	PAPER NUMBER
Los Angeles, CA 90071			2667	
			NOTIFICATION DATE	DELIVERY MODE
			10/25/2022	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):

ipairlink@nixonpeabody.com
lapatentmb@nixonpeabody.com
slevy@nixonpeabody.com

<i>Applicant-Initiated Interview Summary</i>	Application No. 16/772,304	Applicant(s) EL KAFFAS, Ahmed		
	Examiner SOO J SHIN	Art Unit 2667	AIA (First Inventor to File) Status Yes	Page 1 of 1

All Participants (applicant, applicants representative, PTO personnel)	Title	Type
SOO J SHIN	Primary Examiner	Telephonic
Wayne Tang (Reg. No. 36,028)	Attorney of Record	
Ahmed el Kaffas	Inventor	

Date of Interview: 20 October 2022

Issues Discussed:

35 U.S.C. 102

The proposed amendment has been discussed. A new prior art reference (Uniyal et al.) appears to teach the amended limitations. Inventor noted that Uniyal uses a time series US data whereas the invention uses images that are non-coherent in time (e.g., a static frame). Inventor further noted that Uniyal performs parameterization, but is not required in the invention. The examiner suggested incorporating [0036] of the specification ("The RF ultrasound data may be converted to a normalized power spectrum which may then be fed into a trained (supervised, unsupervised or deep learning method) ML model(s) to classify tissues for specific applications, or to find specific multi-parametric biomarkers, or to identify and apply previously unknown parameters of normal and pathological physiology.")

☒ Attachment

/Soo Shin/ Primary Examiner, Art Unit 2667	
Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04 Please further see: MPEP 713.04 Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b) 37 CFR § 1.2 Business to be transacted in writing	

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview.

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

Notice of References Cited	Application/Control No. 16/772,304		Applicant(s)/Patent Under Reexamination EL KAFFAS, Ahmed	
	Examiner SOO J SHIN		Art Unit 2667	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
	A					
	B					
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	Uniyal et al., "Ultrasound RF Time Series for Classification of Breast Lesions," IEEE Transactions on Medical Imaging, Vol. 34, No. 2, February 2015 (Year: 2015)
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Applicant Initiated Interview Request Form

Application No.: 16/772,304 First Named Inventor: Ahmed EL KAFFAS
 Examiner: Soo Shin Art Unit 2667 Status of Application: Non-Final

Tentative Participants:

(1) Soo Shin (2) Wayne Tang
 (3) Ahmed el Kaffas (4) _____

Confirmed Date of

Interview: Oct. 20, 2022 **Confirmed Time:** 2:00 PM (Eastern)

Type of Interview Requested:

(1) ☒ Telephonic (2) ☐ Personal (3) ☐ Video Conference

Exhibit To Be Shown or Demonstrated:

☐ YES

☒ NO

If yes, provide brief description: _____

Issues To Be Discussed

Issues (Rej., Obj., etc)	Claims/ Fig. #s	Prior Art	Discussed	Agreed	Not Agreed
(1) <u>102</u>	<u>1-2, 5-12</u>	<u>Sadeghi-Naini (US2016/0120502)</u>	☐	☐	☐
(2) _____	_____	_____	☐	☐	☐
☒ Continuation Sheet Attached ☐ Proposed Amendment or Arguments Attached					

Brief Description of Arguments to be Presented:

See Continuation Sheet on next page.

An interview was conducted on the above-identified application on _____.

NOTE:

This form should be completed by applicant and submitted to the examiner in advance of the interview (see MPEP §713.01).

This application will not be delayed from issue because of applicant's failure to submit a written record of this interview. Therefore, applicant is advised to file a statement of the substance of this interview (37 CFR 1.133(b)) as soon as possible.

/Wayne Tang, Reg. No. 36,028/

Applicant/Applicant's Representative Signature

Examiner/SPE Signature

Wayne Tang

Typed/Printed Name of Applicant or Representative

36,028

Registration Number, if applicable

Continuation Sheet Serial No. 16/772,304 Atty Dkt No. 079633-000001US00

Proposed Claim Amendments – For Discussion Purposes Only

1. (Currently Amended) An ultrasound system comprising:
 - a transducer configured to output a set of raw ultrasound radio frequency (RF) data from a tissue;
 - a memory containing machine readable medium comprising machine executable code having stored thereon instructions;
 - a signal processing unit comprising one or more processors coupled to the memory, the one or more processors configured to execute the machine executable code to the cause the one or more processors to:
 - receive the set of raw ultrasound RF data ~~and partition the set of ultrasound data into a set of windows~~;
 - ~~process the set of windows to determine a power spectrum for each window of the set of windows~~;
 - ~~process the power spectrum for each window of the set of windows to determine a normalized power spectrum for each window of the set of windows~~; and
 - process the set of raw RF ultrasound data ~~normalized power spectrum for each window of the set of windows~~ with a machine learning model; and
 - output classification of the raw RF ultrasound data from an output of the machine learning model.

5. (Currently Amended) A method comprising:
 - receiving a set of raw ultrasound radio frequency (RF) data output from at least one ultrasound transducer, the set of raw ultrasound RF data representing a tissue of a patient ~~and partitioning the set of ultrasound data into a set of windows or bounding boxes~~;
 - processing the raw ultrasound RF data ~~set of windows~~ to determine a power spectrum ~~for each window of the set of windows~~;
 - processing the determined power spectrum as an input into ~~for each window of the set of windows~~ with a machine learning model; and
 - outputting a classification of the tissue from the machine learning model.

10. (Currently Amended) A method comprising:

receiving a set of raw ultrasound radio frequency (RF) data output from at least one ultrasound transducer representing a tissue of a patient ~~and partitioning the set of ultrasound data into a set of windows;~~

processing the raw ultrasound RF data as an input to set of windows with a machine learning model; and

outputting a classification of the tissue from the machine learning model.

Brief Description Of Arguments

- The present claims relate to using raw ultrasonic RF signals or power spectrum data derived directly from raw ultrasonic RF signals as inputs to a machine learning model to classify an area such as a tissue as cancerous or non-cancerous

- Sadeghi-Naini discloses determining parameters such as mid-band fit, spectral slope, spectral intercept that are calculated from raw echo signal data as explained in paragraphs 24-25. A first order statistic of the mapped parameters is produced and a second order statistical measure of the mapped parameters is computed as explained in paragraphs 43-45.

- Sadeghi-Naini teaches using a linear discriminant analysis (LDA) to characterize the tissue based on the calculated first and second order statistics. Paragraph 59 discloses use of machine learning as an alternative to the LNA. Thus, Sadeghi-Naini requires determination of mapped parameters and further processing as an input to the machine learning/LNA.

- Sadeghi-Naini does not disclose inputting raw ultrasonic RF data from the ultrasonic transducer or a power spectrum derived from the raw ultrasonic RF data as an input to the machine learning model.



UNITED STATES PATENT AND TRADEMARK OFFICE

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

NOTICE OF ALLOWANCE AND FEE(S) DUE

106303 7590 11/10/2022
Nixon Peabody LLP
300 South Grand Avenue, Suite 4100
Los Angeles, CA 90071

EXAMINER	
SHIN, SOO JUNG	
ART UNIT	PAPER NUMBER

2667

DATE MAILED: 11/10/2022

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/772,304	06/12/2020	Ahmed EL KAFFAS	079633-000001US00	3673

TITLE OF INVENTION: MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	\$600	\$0.00	\$0.00	\$600	02/10/2023

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

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

HOW TO REPLY TO THIS NOTICE:

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

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

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

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

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

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

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

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

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

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.

106303 7590 11/10/2022
Nixon Peabody LLP
300 South Grand Avenue, Suite 4100
Los Angeles, CA 90071

Certificate of Mailing or Transmission

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

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/772,304	06/12/2020	Ahmed EL KAFFAS	079633-000001US00	3673

TITLE OF INVENTION: MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	\$600	\$0.00	\$0.00	\$600	02/10/2023

EXAMINER	ART UNIT	CLASS-SUBCLASS
SHIN, SOO JUNG	2667	600-408000

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,

1 _____

(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.

2 _____

3 _____

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

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

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

4a. Fees submitted: ☐ Issue Fee ☐ Publication Fee (if required) ☐ Advance Order - # of Copies _____

4b. Method of Payment: (Please first reapply any previously paid fee shown above)

☐ Electronic Payment via EFS-Web ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. Change in Entity Status (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

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

Authorized Signature _____

Date _____

Typed or printed name _____

Registration No. _____



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/772,304	06/12/2020	Ahmed EL KAFFAS	079633-000001US00	3673
106303	7590	11/10/2022	EXAMINER	
Nixon Peabody LLP			SHIN, SOO JUNG	
300 South Grand Avenue, Suite 4100				
Los Angeles, CA 90071			ART UNIT	PAPER NUMBER
			2667	
DATE MAILED: 11/10/2022				

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

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

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

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

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

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

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

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

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

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

Notice of Allowability	Application No. 16/772,304	Applicant(s) EL KAFFAS, Ahmed	
	Examiner SOO J SHIN	Art Unit 2667	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 amendment filed on 10/21/2022.
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

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

3. ☒ The allowed claim(s) is/are 1-20. 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)	5. ☐ Examiner's Amendment/Comment
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.	6. ☒ Examiner's Statement of Reasons for Allowance
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.	7. ☐ Other _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.	

/Soo Shin/
Primary Examiner, Art Unit 2667

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Response to Amendment

2. The amendment filed on October 21, 2022 has been entered.
3. The amendment of claims 1, 2, 5, 7, 10, 11, and 12 and addition of claims 13-20 have been acknowledged.
4. In view of the amendment, the 35 U.S.C. 112(b), 102(a)(1), 102(a)(2), and 103 rejections have been withdrawn.

Drawings

5. The replacement drawings filed on October 21, 2022 have been accepted. The drawing objections have been withdrawn.

Allowable Subject Matter

6. Claims 1-20 are allowed.
7. The following is an examiner's statement of reasons for allowance:

Applicant has overcome all of the 35 U.S.C. 112(b) rejections and incorporated allowable subject matter with the independent claims. The prior art of record teaches that it was known at the time the application was filed to process the raw ultrasound radiofrequency time-series data with a machine learning model, e.g., SVM, to classify malignant vs. benign breast lesions.

However, the prior art, alone or in combination, does not appear to teach or suggest that a single static set of raw ultrasound radiofrequency data is processed with a machine learning model to output the classification results.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to SOO J SHIN whose telephone number is (571)272-9753. The examiner can normally be reached M-F; 10-6.

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, Matthew Bella can be reached on (571)272-7778. 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.

/Soo Shin/

Primary Examiner, Art Unit 2667

<i>Index of Claims</i> 	Application/Control No. 16/772,304	Applicant(s)/Patent Under Reexamination EL KAFFAS, Ahmed
	Examiner SOO J SHIN	Art Unit 2667

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

CLAIMS										
☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47										
CLAIM		DATE								
Final	Original	06/15/2022	11/03/2022							
1	1	✓	=							
2	2	✓	=							
3	3	✓	=							
4	4	✓	=							
6	5	✓	=							
7	6	✓	=							
8	7	✓	=							
9	8	✓	=							
10	9	✓	=							
11	10	✓	=							
12	11	✓	=							
13	12	✓	=							
14	13		=							
15	14		=							
16	15		=							
17	16		=							
18	17		=							
5	18		=							
19	19		=							
20	20		=							

<i>Search Notes</i> 	Application/Control No. 16/772,304	Applicant(s)/Patent Under Reexamination EL KAFFAS, Ahmed
	Examiner SOO J SHIN	Art Unit 2667

CPC - Searched*		
Symbol	Date	Examiner
A61B 8/463, 8/5223 (limited by keyword search)	06/15/2022	SJS
G06K 9/6223, 9/6259, 9/6267 (limited by keyword search)	06/15/2022	SJS
G06N 3/04, 3/08, 3/088, 20/10 (limited by keyword search)	06/15/2022	SJS
G06T 7/0012, 2207/10132, 2207/20081, 2207/20084 (limited by keyword search)	06/15/2022	SJS
G06V 10/143, 10/22, 10/82 (limited by keyword search)	06/15/2022	SJS
G16H 30/40 (limited by keyword search)	06/15/2022	SJS
A61B 8/463, 8/5223 (limited by keyword search)	11/03/2022	SJS
G06K 9/6223, 9/6259, 9/6267 (limited by keyword search)	11/03/2022	SJS
G06N 3/04, 3/08, 3/088, 20/10 (limited by keyword search)	11/03/2022	SJS
G06T 7/0012, 2207/10132, 2207/20081, 2207/20084 (limited by keyword search)	11/03/2022	SJS
G06V 10/143, 10/22, 10/82 (limited by keyword search)	11/03/2022	SJS
G16H 30/40 (limited by keyword search)	11/03/2022	SJS

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.

/Soo Shin/ Primary Examiner, Art Unit 2667	
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<i>Search Notes</i> 	Application/Control No. 16/772,304	Applicant(s)/Patent Under Reexamination EL KAFFAS, Ahmed
	Examiner SOO J SHIN	Art Unit 2667

Search Notes		
Search Notes	Date	Examiner
A61B 8/463, 8/5223 (limited by keyword search)	06/15/2022	SJS
G06K 9/6223, 9/6259, 9/6267 (limited by keyword search)	06/15/2022	SJS
G06N 3/04, 3/08, 3/088, 20/10 (limited by keyword search)	06/15/2022	SJS
G06T 7/0012, 2207/10132, 2207/20081, 2207/20084 (limited by keyword search)	06/15/2022	SJS
G06V 10/143, 10/22, 10/82 (limited by keyword search)	06/15/2022	SJS
G16H 30/40 (limited by keyword search)	06/15/2022	SJS
PE2E search history attached	06/15/2022	SJS
NPL search	06/15/2022	SJS
Inventor/assignee search	06/15/2022	SJS
A61B 8/463, 8/5223 (limited by keyword search)	11/03/2022	SJS
G06K 9/6223, 9/6259, 9/6267 (limited by keyword search)	11/03/2022	SJS
G06N 3/04, 3/08, 3/088, 20/10 (limited by keyword search)	11/03/2022	SJS
G06T 7/0012, 2207/10132, 2207/20081, 2207/20084 (limited by keyword search)	11/03/2022	SJS
G06V 10/143, 10/22, 10/82 (limited by keyword search)	11/03/2022	SJS
G16H 30/40 (limited by keyword search)	11/03/2022	SJS
PE2E search updated	11/03/2022	SJS
NPL search updated	11/03/2022	SJS
Inventor/assignee search updated	11/03/2022	SJS

/Soo Shin/ Primary Examiner, Art Unit 2667	
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<i>Search Notes</i> 	Application/Control No. 16/772,304	Applicant(s)/Patent Under Reexamination EL KAFFAS, Ahmed
	Examiner SOO J SHIN	Art Unit 2667

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
A61B	8/463, 8/5223	11/03/2022	SJS
G06K	9/6223, 9/6259, 9/6267	11/03/2022	SJS
G06N	3/04, 3/08, 3/088, 20/10	11/03/2022	SJS
G06T	7/0012, 2207/10132, 2207/20081, 2207/20084	11/03/2022	SJS
G06V	10/143, 10/22, 10/82	11/03/2022	SJS
G16H	30/40	11/03/2022	SJS

/Soo Shin/ Primary Examiner, Art Unit 2667	
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Issue Classification 	Application/Control No. 16/772,304	Applicant(s)/Patent Under Reexamination EL KAFFAS, Ahmed	
	Examiner SOO J SHIN	Art Unit 2667	

CPC						
Symbol					Type	Version
A61B	/	8	/	5223	F	2013-01-01
G16H	/	30	/	40	I	2018-01-01
A61B	/	8	/	463	I	2013-01-01
G06K	/	9	/	6223	I	2013-01-01
G06K	/	9	/	6259	I	2013-01-01
G06N	/	3	/	04	I	2013-01-01
G06N	/	3	/	08	I	2013-01-01
G06T	/	7	/	0012	I	2013-01-01
G06V	/	10	/	22	I	2022-01-01
G06T	/	2207	/	10132	A	2013-01-01
G06T	/	2207	/	20081	A	2013-01-01
G06T	/	2207	/	20084	A	2013-01-01

CPC Combination Sets					
Symbol				Type	Set

NONE (Assistant Examiner) _____ (Date) _____		Total Claims Allowed: 20	
/Soo Shin/ Primary Examiner, Art Unit 2667 (Primary Examiner) _____ (Date) _____		03 November 2022 O.G. Print Claim(s) 1	O.G. Print Figure 5

Issue Classification 	Application/Control No. 16/772,304	Applicant(s)/Patent Under Reexamination EL KAFFAS, Ahmed
	Examiner SOO J SHIN	Art Unit 2667

INTERNATIONAL CLASSIFICATION				
CLAIMED				
A61B	/	8	/	00
A61B	/	8	/	08
G06K	/	9	/	62
G06N	/	20	/	10
G06N	/	3	/	04
G06N	/	3	/	08
G06T	/	7	/	00
G06V	/	10	/	143
G06V	/	10	/	22
G06V	/	10	/	764
G06V	/	10	/	82
G16H	/	30	/	40

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	SUBCLASS
600	408

CROSS REFERENCES(S)						
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)					

NONE		Total Claims Allowed:	
(Assistant Examiner) _____ (Date) _____		20	
/Soo Shin/ Primary Examiner, Art Unit 2667 (Primary Examiner) _____ (Date) _____		O.G. Print Claim(s)	O.G. Print Figure
		1	5

<i>Issue Classification</i> 	Application/Control No. 16/772,304	Applicant(s)/Patent Under Reexamination EL KAFFAS, Ahmed
	Examiner SOO J SHIN	Art Unit 2667

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47															
CLAIMS															
Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	11	10	19	19										
2	2	12	11	20	20										
3	3	13	12												
4	4	14	13												
6	5	15	14												
7	6	16	15												
8	7	17	16												
9	8	18	17												
10	9	5	18												

NONE (Assistant Examiner) _____ (Date) _____		Total Claims Allowed: 20	
/Soo Shin/ Primary Examiner, Art Unit 2667 (Primary Examiner) _____ (Date) _____		03 November 2022 O.G. Print Claim(s) 1	O.G. Print Figure 5

Bibliographic Data

Application No: 16/772,304

Foreign Priority claimed: ☐ Yes ☒ No

35 USC 119 (a-d) conditions met: ☐ Yes ☒ No ☐ Met After Allowance

Verified and Acknowledged:

/Soo Shin/

Examiner's Signature

Initials

Title:

MACHINE LEARNING TO EXTRACT QUANTITATIVE
BIOMARKERS FROM RF SPECTRUMS

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
06/12/2020	600	2667	079633-000001US00
RULE			

APPLICANTS

ONCOUSTICS INC., Toronto, Ontario, CANADA

Ahmed EL KAFFAS, Palto Alto, CA, UNITED STATES

INVENTORS

Ahmed EL KAFFAS, Palo Alto, CANADA

CONTINUING DATA

This application is a 371 of PCT/US2018/065226 12/12/2018

PCT/US2018/065226 has PRO of 62597537 12/12/2017

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

12/03/2020

**** SMALL ENTITY ****

STATE OR COUNTRY

CANADA

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300 South Grand Avenue, Suite 4100

Los Angeles, CA 90071

UNITED STATES

FILING FEE RECEIVED

\$600

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	6	("6238342" "20160238568").did.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:23 PM
L2	3	"20160120502".pn.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:25 PM
L3	4207	ultrasound AND (machine near3 learn\$3) AND ((partition\$3 divid\$4 sub\$divide) WITH (region area section))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:37 PM
L4	231	L3 AND (power near4 spectr\$4)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:37 PM
L5	29	L3 AND (normali\$6 WITH (power near4 spectr\$4))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:37 PM
L6	15914	ultrasound AND (machine near3 learn\$3) AND (partition\$3 divi\$6 sub\$divi\$6 sub\$region)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:39 PM
L7	93	L6 AND (normali\$6 WITH (power near4 spectr\$4))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:39 PM
L8	10	L7 AND (slid\$4 near10 window)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:44 PM
L9	857	L6 AND (slid\$4 near10 window)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:44 PM
L10	147	L6 AND (normali\$6 WITH power WITH spectr\$4)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO;	OR	ON	ON	2022/06/14 06:45 PM

			JPO; DERWENT; IBM_TDB)				
L11	1188	L6 AND (display\$3 SAME ((label\$4 identif\$3 "id" tag annotat\$4) WITH (window region)))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:46 PM
L12	127	L9 AND (display\$3 SAME ((label\$4 identif\$3 "id" tag annotat\$4) WITH (window region)))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:46 PM
L13	9	L12 AND (power near10 spectr\$4)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:47 PM
L14	4	((US-20160238568- A1).did. AND DWPI.dbnm.) OR ((US- 6238342-B1 OR US- 8192362-B2).did. AND USPT.dbnm.) OR ((US- 20160120502-A1).did. AND PGPB.dbnm.)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:57 PM
L15	2	L14 AND (divid\$4 divis\$4 partition\$4)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:57 PM
L16	2	L15 AND (power near4 spectr\$4)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:57 PM
L17	1	L16 AND (machine near5 learn\$3)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:57 PM
L18	1	L14 AND (slid\$4 near10 window)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/14 06:58 PM
L19	4	((US-20160238568- A1).did. AND DWPI.dbnm.) OR ((US- 6238342-B1 OR US- 8192362-B2).did. AND USPT.dbnm.) OR ((US- 20160120502-A1).did. AND PGPB.dbnm.)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 07:52 PM
L20	3	L19 AND transducer	(US-PGPUB; USPAT;	OR	ON	ON	2022/06/15

		AND ultrasound AND memory AND processor	USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				07:52 PM
L21	3	L20 AND (power near3 spectr\$4)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 08:25 PM
L22	2	L20 AND (machine near3 learn\$3)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 08:29 PM
L23	2	L20 AND (display\$4 WITH (roi window region))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 08:30 PM
L24	3	L19 AND display\$4	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 08:31 PM
L25	2	L19 AND ((display\$4 monitor screen output\$4) WITH (roi window region interest))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 08:31 PM
L26	3	L19 AND (means deep convolutional neural boltzmann lstm capsule)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 08:52 PM
L27	2	L19 AND train\$3	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:02 PM
L28	3	L19 AND (radiologist doctor physician expert user person human)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:07 PM
L29	0	L19 AND unsupervis\$4	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:10 PM
L30	0	L19 AND supervis\$4	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:10 PM

L31	2	L19 AND (fft OR fourier)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:16 PM
L32	0	L19 AND (discrete near10 (fft OR fourier))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:18 PM
L33	3	L19 AND discrete	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:18 PM
L34	22	ultrasound AND (tissue WITH classification) AND radiologist AND (unsupervised near10 train\$3)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:33 PM
L35	4	L34 AND (power near3 spectr\$4)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:33 PM
L36	8	(el near3 kaffas near3 ahmed).in.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:47 PM
L37	3	(el near3 kaffas near3 ahmed).aanm.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:48 PM
L38	2	oncoustics.as.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:48 PM
L39	3	oncoustics.aanm.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:48 PM
L40	3	(L36 L37) AND (L38 L39)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:48 PM
L41	9	(L36 L37L38 L39)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT;	OR	ON	ON	2022/06/15 09:48 PM

			IBM_TDB)				
L42	5	L41 AND ultrasound.clm.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:48 PM
L43	2	L42 AND (power near5 spectr\$4).clm.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:49 PM
L44	2	L43 AND (A61B8/5223 OR A61B8/463 OR G06K9/6223 OR G06K9/6259 OR G06N3/04 OR G06N3/08 OR G06T7/0012 OR G06V10/22 OR G16H30/40 OR G06T2207/10132 OR G06T2207/20081 OR G06T2207/20084 OR G06V10/143 OR G06V10/82 OR G06N20/10 OR G06N3/088 OR G06K9/6267).cpc.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:50 PM
L45	6	L41 AND (A61B8/5223 OR A61B8/463 OR G06K9/6223 OR G06K9/6259 OR G06N3/04 OR G06N3/08 OR G06T7/0012 OR G06V10/22 OR G16H30/40 OR G06T2207/10132 OR G06T2207/20081 OR G06T2207/20084 OR G06V10/143 OR G06V10/82 OR G06N20/10 OR G06N3/088 OR G06K9/6267).cpc.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:50 PM
L46	313	L9 AND (A61B8/5223 OR A61B8/463 OR G06K9/6223 OR G06K9/6259 OR G06N3/04 OR G06N3/08 OR G06T7/0012 OR G06V10/22 OR G16H30/40 OR G06T2207/10132 OR G06T2207/20081 OR	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:50 PM

		G06T2207/20084 OR G06V10/143 OR G06V10/82 OR G06N20/10 OR G06N3/088 OR G06K9/6267).cpc.					
L47	51	L10 AND (A61B8/5223 OR A61B8/463 OR G06K9/6223 OR G06K9/6259 OR G06N3/04 OR G06N3/08 OR G06T7/0012 OR G06V10/22 OR G16H30/40 OR G06T2207/10132 OR G06T2207/20081 OR G06T2207/20084 OR G06V10/143 OR G06V10/82 OR G06N20/10 OR G06N3/088 OR G06K9/6267).cpc.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/06/15 09:51 PM
L48	5	((US-20160238568- A1).did. AND DWPI.dbnm.) OR ((US- 6238342-B1 OR US- 8192362-B2).did. AND USPT.dbnm.) OR ((US- 20160120502-A1 OR US-20170249739- A1).did. AND PGPB.dbnm.)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/20 01:18 PM
L49	2	L48 AND ((input learn\$4 process\$4) WITH ((raw "rf" radiofrequency) near5 ultrasound))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/20 01:19 PM
L50	2	L34 AND ((input learn\$4 process\$4) WITH ((raw "rf" radiofrequency) near5 ultrasound))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/20 01:20 PM
L51	3217	((input learn\$4 process\$4) WITH ((raw "rf" radiofrequency) near5 ultrasound))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/20 01:20 PM
L52	761	L51 AND (A61B8/5223 OR A61B8/463 OR G06K9/6223 OR G06K9/6259 OR G06N3/04 OR G06N3/08 OR G06T7/0012 OR	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/20 01:20 PM

		G06V10/22 OR G16H30/40 OR G06T2207/10132 OR G06T2207/20081 OR G06T2207/20084 OR G06V10/143 OR G06V10/82 OR G06N20/10 OR G06N3/088 OR G06K9/6267).cpc.					
L53	41	L52 AND (classif\$7 near10 ("rf" raw radiofrequency))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/10/20 01:21 PM
L54	5	((US-20160238568- A1).did. AND DWPI.dbnm.) OR ((US- 6238342-B1 OR US- 8192362-B2).did. AND USPT.dbnm.) OR ((US- 20160120502-A1 OR US-20170249739- A1).did. AND PGPB.dbnm.)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/03 05:29 PM
L55	0	L54 AND (static\$4 near10 (radio\$frequency radiofrequency "rf"))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/03 05:29 PM
L56	12	ultrasound AND ((classif\$7 learn\$4) SAME static\$4 near10 (radio\$frequency radiofrequency "rf"))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/03 05:30 PM
L57	9	(el near3 kaffas near3 ahmed).in.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/03 05:45 PM
L58	3	(el near3 kaffas near3 ahmed).aanm.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/03 05:45 PM
L59	2	oncoustics.as.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/03 05:45 PM
L60	3	oncoustics.aanm.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/03 05:45 PM

L61	3	(L36 L37) AND (L38 L39)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/03 05:45 PM
L62	10	(L36 L37L38 L39)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/03 05:45 PM
L63	6	L41 AND ultrasound.clm.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/03 05:45 PM
L64	2	L42 AND (power near5 spectr\$4).clm.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/03 05:45 PM
L65	2	L43 AND (A61B8/5223 OR A61B8/463 OR G06K9/6223 OR G06K9/6259 OR G06N3/04 OR G06N3/08 OR G06T7/0012 OR G06V10/22 OR G16H30/40 OR G06T2207/10132 OR G06T2207/20081 OR G06T2207/20084 OR G06V10/143 OR G06V10/82 OR G06N20/10 OR G06N3/088 OR G06K9/6267).cpc.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/03 05:45 PM
L66	8	L41 AND (A61B8/5223 OR A61B8/463 OR G06K9/6223 OR G06K9/6259 OR G06N3/04 OR G06N3/08 OR G06T7/0012 OR G06V10/22 OR G16H30/40 OR G06T2207/10132 OR G06T2207/20081 OR G06T2207/20084 OR G06V10/143 OR G06V10/82 OR G06N20/10 OR G06N3/088 OR G06K9/6267).cpc.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/03 05:45 PM
L67	346	L9 AND (A61B8/5223	(US-PGPUB; USPAT;	OR	ON	ON	2022/11/03

		OR A61B8/463 OR G06K9/6223 OR G06K9/6259 OR G06N3/04 OR G06N3/08 OR G06T7/0012 OR G06V10/22 OR G16H30/40 OR G06T2207/10132 OR G06T2207/20081 OR G06T2207/20084 OR G06V10/143 OR G06V10/82 OR G06N20/10 OR G06N3/088 OR G06K9/6267).cpc.	USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				05:45 PM
L68	63	L10 AND (A61B8/5223 OR A61B8/463 OR G06K9/6223 OR G06K9/6259 OR G06N3/04 OR G06N3/08 OR G06T7/0012 OR G06V10/22 OR G16H30/40 OR G06T2207/10132 OR G06T2207/20081 OR G06T2207/20084 OR G06V10/143 OR G06V10/82 OR G06N20/10 OR G06N3/088 OR G06K9/6267).cpc.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/03 05:45 PM
L69	5	((US-20160238568-A1).did. AND DWPI.dbnm.) OR ((US- 6238342-B1 OR US- 8192362-B2).did. AND USPT.dbnm.) OR ((US- 20160120502-A1 OR US-20170249739- A1).did. AND PGPB.dbnm.)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/03 05:45 PM
L70	2	L48 AND ((input learn\$4 process\$4) WITH ((raw "rf" radiofrequency) near5 ultrasound))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/03 05:45 PM
L71	2	L34 AND ((input learn\$4 process\$4) WITH ((raw "rf" radiofrequency) near5 ultrasound))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/03 05:45 PM
L72	3228	((input learn\$4 process\$4) WITH ((raw "rf" radiofrequency)	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO;	OR	ON	ON	2022/11/03 05:45 PM

		near5 ultrasound))	JPO; DERWENT; IBM_TDB)				
L73	767	L51 AND (A61B8/5223 OR A61B8/463 OR G06K9/6223 OR G06K9/6259 OR G06N3/04 OR G06N3/08 OR G06T7/0012 OR G06V10/22 OR G16H30/40 OR G06T2207/10132 OR G06T2207/20081 OR G06T2207/20084 OR G06V10/143 OR G06V10/82 OR G06N20/10 OR G06N3/088 OR G06K9/6267).cpc.	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/03 05:45 PM
L74	41	L52 AND (classif\$7 near10 ("rf" raw radiofrequency))	(US-PGPUB; USPAT; USOCR; FIT (CN, FR, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/11/03 05:45 PM

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N1	0	ultrasound.clm. AND ((classif\$7 learn\$4) SAME static\$4 near10 (radio\$frequency radiofrequency "rf")).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/03 05:47 PM
N2	681	ultrasound.clm. AND static\$4.clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/03 05:48 PM
N3	86	N2 AND (radiofrequency radio\$frequency "rf").clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/03 05:48 PM
N4	3	N3 AND (A61B8/5223 OR A61B8/463 OR G06K9/6223 OR G06K9/6259 OR G06N3/04 OR G06N3/08 OR G06T7/0012 OR G06V10/22 OR G16H30/40 OR G06T2207/10132 OR G06T2207/20081 OR G06T2207/20084 OR G06V10/143 OR G06V10/82 OR	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/03 05:49 PM

		G06N20/10 OR G06N3/088 OR G06K9/6267).cpc.					
N5	7	N3 AND ((machine near5 learn\$4) OR (svm neural artificial)).clm.	(US-PGPUB; USPAT)	OR	ON	ON	2022/11/03 05:49 PM



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/772,304	06/12/2020	Ahmed EL KAFFAS	079633-000001US00	3673
106303	7590	11/16/2022	EXAMINER	
Nixon Peabody LLP			SHIN, SOO JUNG	
300 South Grand Avenue, Suite 4100			ART UNIT	PAPER NUMBER
Los Angeles, CA 90071			2667	
			NOTIFICATION DATE	DELIVERY MODE
			11/16/2022	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):

ipairlink@nixonpeabody.com
lapatentmb@nixonpeabody.com
slevy@nixonpeabody.com



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Application No. : 16772304
Applicant : El Kaffas
Filing Date : 06/12/2020
Date Mailed : 11/16/2022

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).

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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)
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- ☐ 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:**
The figure label for FIGs. 4A-4B are not oriented in the same direction as the figure. See 37 CFR 1.84 (p)(1).

SCORE Placeholder Sheet for IFW Content

Application Number: 16772304

Document Date: 11/18/2022

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- Drawing

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No. : 16/772,304
Confirmation No. : 3673
Applicants : Oncoustics Inc.
Inventor: : Ahmed EL KAFFAS
Filed : June 12, 2020
Title : MACHINE LEARNING TO EXTRACT QUANTITATIVE
BIOMARKERS FROM ULTRASOUND RF SPECTRUMS
TC/A.U. : 2667
Examiner : Soo Jung Shin
Docket No. : 079633-000001US00
Customer No. : 106303

**RESPONSE TO NOTICES TO FILE CORRECTED
APPLICATION PAPERS OF NOVEMBER 16, 2022 AND NOVEMBER 18, 2022**

Mail Stop Issue Fee *via EFS*
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

This is a Response to the Notice to File Corrected Application Papers mailed November 16, 2022 and the Response to the Notice to File Corrected Application Papers mailed November 18, 2022. A response was due two months from the mailing date, being January 16, 2023 and January 18, 2023. Thus, this response is considered timely.

Please enter the following remarks into the record for this application.

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

Remarks begin on page 3 of this paper.



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/772,304	06/12/2020	Ahmed EL KAFFAS	079633-000001US00	3673
106303	7590	11/16/2022	EXAMINER	
Nixon Peabody LLP			SHIN, SOO JUNG	
300 South Grand Avenue, Suite 4100			ART UNIT	PAPER NUMBER
Los Angeles, CA 90071			2667	
			NOTIFICATION DATE	DELIVERY MODE
			11/16/2022	ELECTRONIC

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ipairlink@nixonpeabody.com
lapatentmb@nixonpeabody.com
slevy@nixonpeabody.com



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Commissioner for Patents
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Application No. : 16772304
Applicant : El Kaffas
Filing Date : 06/12/2020
Date Mailed : 11/16/2022

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See attachment(s).

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IDENTIFICATION OF DRAWING DEFICIENCIES

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- ☐ 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)
- ☐ Data, a reference number, or part of the drawing is truncated or missing, or a lead line has no reference number. FIG(s)
- ☐ 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)
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- ☐ OTHER:
- ☒ **COMMENTS:**
The figure label for FIGs. 4A-4B are not oriented in the same direction as the figure. See 37 CFR 1.84 (p)(1).



ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #
16/772,304

RECEIPT DATE / TIME
11/18/2022 03:01:43 PM ET

ATTORNEY DOCKET #
079633-000001US00

Title of Invention

MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS

Application Information

APPLICATION TYPE	Utility - U.S. National Stage under 35 USC 371	PATENT #	-
CONFIRMATION #	3673	FILED BY	Linda Stewart
PATENT CENTER #	61197715	FILING DATE	06/12/2020
CUSTOMER #	106303	FIRST NAMED INVENTOR	Ahmed EL KAFFAS
INTL. APPLICATION #	-	INTL. FILING DATE	-
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Wayne Tang

Documents

TOTAL DOCUMENTS: 7

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
2022-11-16_NoticeFileCorrectdAppPapers_FIGS_079633-000001US00.pdf	3	Post Allowance Communication - Incoming	115 KB
2022-11-18_US_FIGS_ReplacementFigures_4A-4B_adobe_079633-000001US00.pdf	6	Drawings-only black and white line drawings	2858 KB
2022-11-18_Notice_File_CorrectApp_Papers_ADS_079633-	3	Post Allowance Communication - Incoming	101 KB

000001US00.pdf

2022-11-18__CORRECTED__ADS__Oncoustics__adobe22_079633-000001US00.pdf	7	Application Data Sheet	657 KB
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Warning: This is not a USPTO supplied ADS fillable form. Data in the form cannot be automatically loaded to other USPTO systems.

2022-11-18__AmendmtResponse__Notices__FileCorctdApplPapers__11-16and18_2022_079633-000001US00.pdf	3	-	139 KB
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2022-11-18__AmendmtResponse__Notices__FileCorctdApplPapers__11-16and18_2022_079633-000001US00-A.NA.pdf	(1-1)	1	Amendment after Notice of Allowance (Rule 312)	134 KB
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2022-11-18__AmendmtResponse__Notices__FileCorctdApplPapers__11-16and18_2022_079633-000001US00-DRW.pdf	(2-2)	1	Drawings-only black and white line drawings	104 KB
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2022-11-18__AmendmtResponse__Notices__FileCorctdApplPapers__11-16and18_2022_079633-000001US00-REM.pdf	(3-3)	1	Applicant Arguments/Remarks Made in an Amendment	106 KB
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Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
2022-11-	B47F0958A226F014B411A626038D0E6FC3B6D0D427F71DE79

16_NoticeFileCorrectdAppPape rs_FIGS_079633- 000001US00.pdf	ACF216B0A8CC2E19B41F8F9CA5C3A8AF1731192E60CBB8413 AA10447716D77D2F830A033135F202
2022-11- 18_US_FIGS_ReplacementFigs _4A-4B_adobe_079633- 000001US00.pdf	EF3724B837B663754E9EE060A4EAA97740863EB5F6DC1A8BD BB92501D21FAFFD4B96063473200F78C05D70C4F7CFC78179 BA01DEF996DE584BD237C11AA53612
2022-11- 18_Notice_File_CorrectApp_Pa pers_ADS_079633- 000001US00.pdf	839B3697A8EF70CAB54E8B1E464A8B1D4174FA715C234091A C7E194C9B587EC560D9FEC4B48B7A0087A6B6218070949DDC D10EABAE398F6E95F09FFFC0D73DD5
2022-11- 18_CORRECTED_ADS_Oncou stics_adobe22_079633- 000001US00.pdf	110674C6CBF551526BE38E12765F27373C0B54949F63EEB416 CA766F185307D5BD7EAF65B5396C712C6EDDD4722FAB020B 90B092D3406A3CFDDD914A61030DD7
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000001US00-REM.pdf

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.



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/772,304	06/12/2020	Ahmed EL KAFFAS	079633-000001US00	3673
106303	7590	11/18/2022	EXAMINER	
Nixon Peabody LLP			SHIN, SOO JUNG	
300 South Grand Avenue, Suite 4100			ART UNIT	PAPER NUMBER
Los Angeles, CA 90071			2667	
			NOTIFICATION DATE	DELIVERY MODE
			11/18/2022	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):

ipairlink@nixonpeabody.com
lapatentmb@nixonpeabody.com
slevy@nixonpeabody.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. : 16772304
Applicant : El Kaffas
Filing Date : 06/12/2020
Date Mailed : 11/18/2022

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).

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P.O. Box 1450, Alexandria, VA 22313-1450".*

/Kam Sin/
Publication Branch
Office of Data Management
(571) 272-4200

Application No. 16772304

**IDENTIFICATION OF APPLICATION DEFICIENCIES
IN APPLICATION FILED ON OR AFTER SEPTEMBER 16, 2012**

- ☐ Applicant must provide legible text for the following item(s).
- ☐ Specification filed , page(s) .
- ☐ Claims filed , claim(s) .
- ☐ Other: .
- ☐ Applicant must provide missing information on the following page(s) of the specification by amending the specification to add the missing text. No new matter may be added.
Page/line no(s).
- ☐ The specification refers to one or more applications by attorney docket number and does not show the U.S. application number(s). Applicant must supply the U.S. application number in place of each attorney docket number.
Page/line no(s).
- ☐ Applicant must provide an Abstract of the Disclosure.
- ☒ The Application Data Sheet (ADS dated 06/12/2020) does not supply the inventor's city and/or does not supply the inventor's U.S. state and/or does not supply the inventor's country. Applicant must submit a signed, in accordance with 37 CFR 1.76(e) and 1.33(b), application data sheet that corrects this deficiency. To be in compliance with 37 CFR 1.76, the corrected application data sheet must identify the information being changed by using underlining for additions and strikethroughs or brackets for deletions.
- ☒ Other: inventor has country "CA" instead of state "CA"

The response to this notice should contain only amended papers, as the waiver of 37 CFR 1.312 is limited to corrections of documents specifically requested in the notice.

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.

CORRECTED Application Data Sheet 37 CFR 1.76		Attorney Docket Number	079633-000001US00
		Application Number	
Title of Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS		
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	
	Ahmed		EL KAFFAS		
Residence Information (Select One)					
☒ US Residency ☐ Non US Residency ☐ Active US Military Service					
Residence Information (Select One)					
☒ US Residency ☐ Non US Residency ☐ Active US Military Service					
City	Palo Alto	State/Province	CA	Country of Residence	US

Mailing Address of Inventor:					
Address 1	458 Fernando Ave.				
Address 2					
City	Palo Alto	State/Province	CA		
Postal Code	94306	Country	US		
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	106303		
Email Address	lapatentmb@nixonpeabody.com	Add Email	Remove Email

Application Information:

Title of the Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS		
Attorney Docket Number	079633-000001US00	Small Entity Status Claimed	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)		Suggested Figure for Publication (if any)	

CORRECTED		Attorney Docket Number	079633-000001US00
Application Data Sheet 37 CFR 1.76		Application Number	
Title of Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS		

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	106303		

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)
	a 371 of international	PCT/US2018/065226	2018-12-12

CORRECTED		Attorney Docket Number		079633-000001US00	
Application Data Sheet 37 CFR 1.76		Application Number			
Title of Invention		MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS			
Prior Application Status	Expired			Remove	
Application Number		Continuity Type		Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCT/US2018/065226		Claims benefit of provisional		62597537	2017-12-12
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.					Add

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	Countryⁱ	Filing Date (YYYY-MM-DD)	Access Codeⁱ (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.

CORRECTED		Attorney Docket Number	079633-000001US00
Application Data Sheet 37 CFR 1.76		Application Number	
Title of Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS		

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.

CORRECTED		Attorney Docket Number	079633-000001US00
Application Data Sheet 37 CFR 1.76		Application Number	
Title of Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS		

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	ONCOUSTICS INC.	
Mailing Address Information For Applicant:		
Address 1	25 Capreol Crt. – 4005	
Address 2		
City	Toronto, Ontario	State/Province
Country	CA	Postal Code
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.

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CORRECTED		Attorney Docket Number	079633-000001US00
Application Data Sheet 37 CFR 1.76		Application Number	
Title of Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS		

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.			
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If the Assignee or Non-Applicant Assignee is an Organization check here. ☒			
Organization Name	ONCOUSTICS INC.		
Mailing Address Information For Assignee including Non-Applicant Assignee:			
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Address 2			
City	Toronto, Ontario	State/Province	
Country i	CA	Postal Code	M5V 3Z7
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	/Erik Birkeneder/		Date (YYYY-MM-DD)	2022-11-18 ~~2020-06-12~~
First Name	Erik	Last Name	Birkeneder	Registration Number
				65299
Additional Signature may be generated within this form by selecting the Add button. Add				

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<u>CORRECTED</u>		Attorney Docket Number	079633-000001US00
Application Data Sheet 37 CFR 1.76		Application Number	
Title of Invention	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS		

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.**

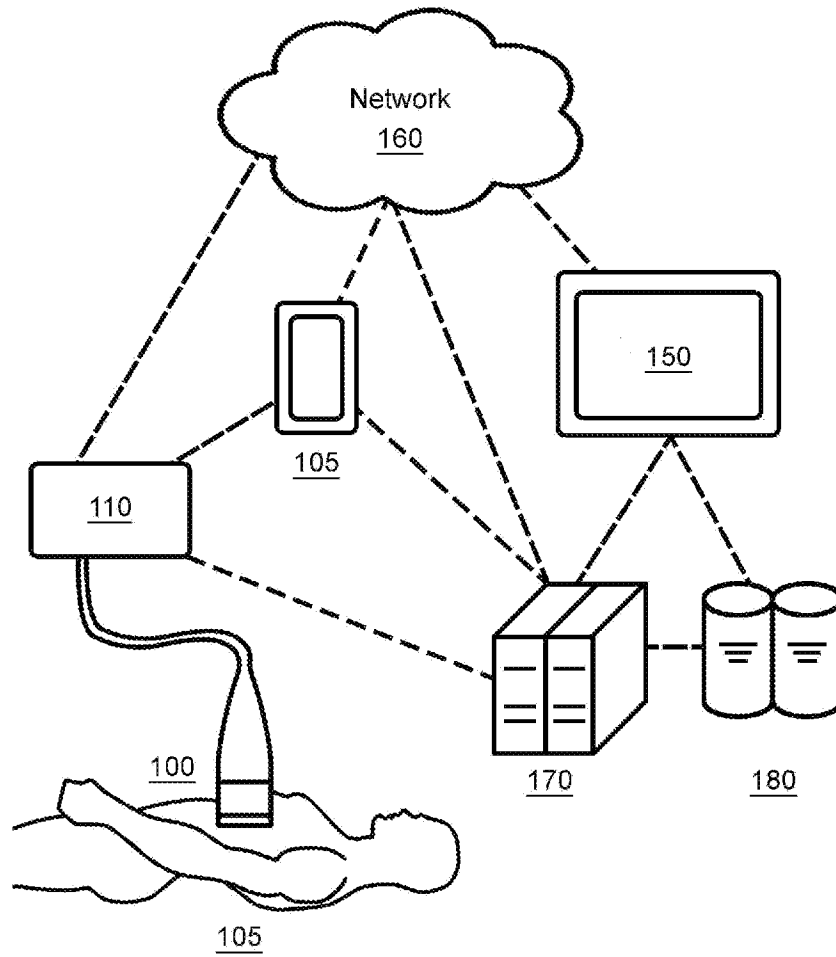


FIG. 1

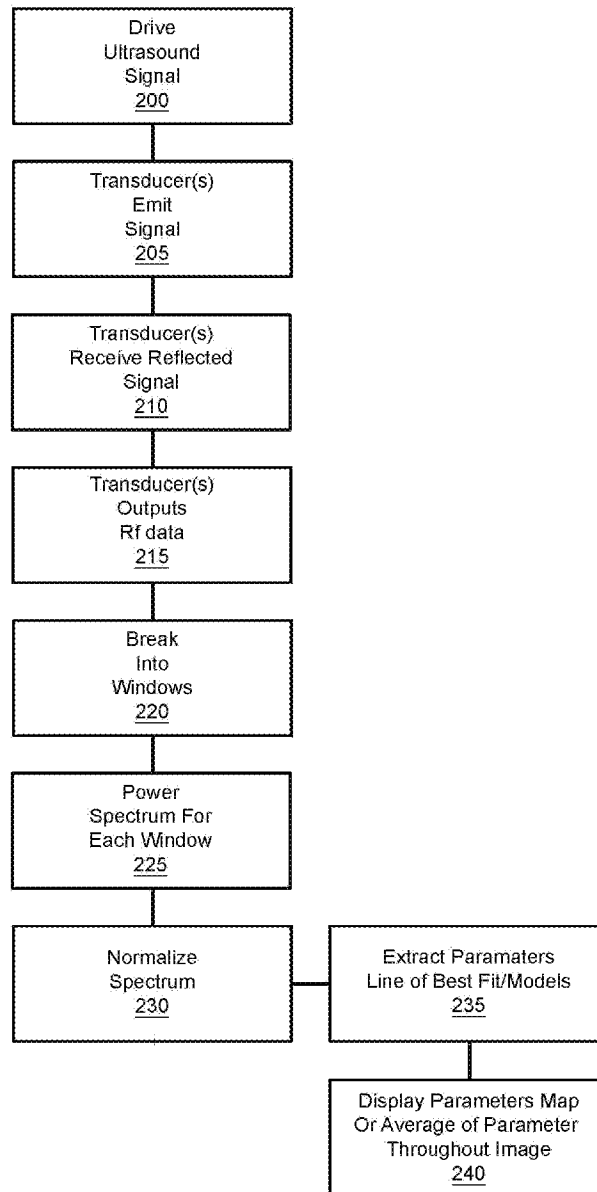


FIG. 2
(PRIOR ART)

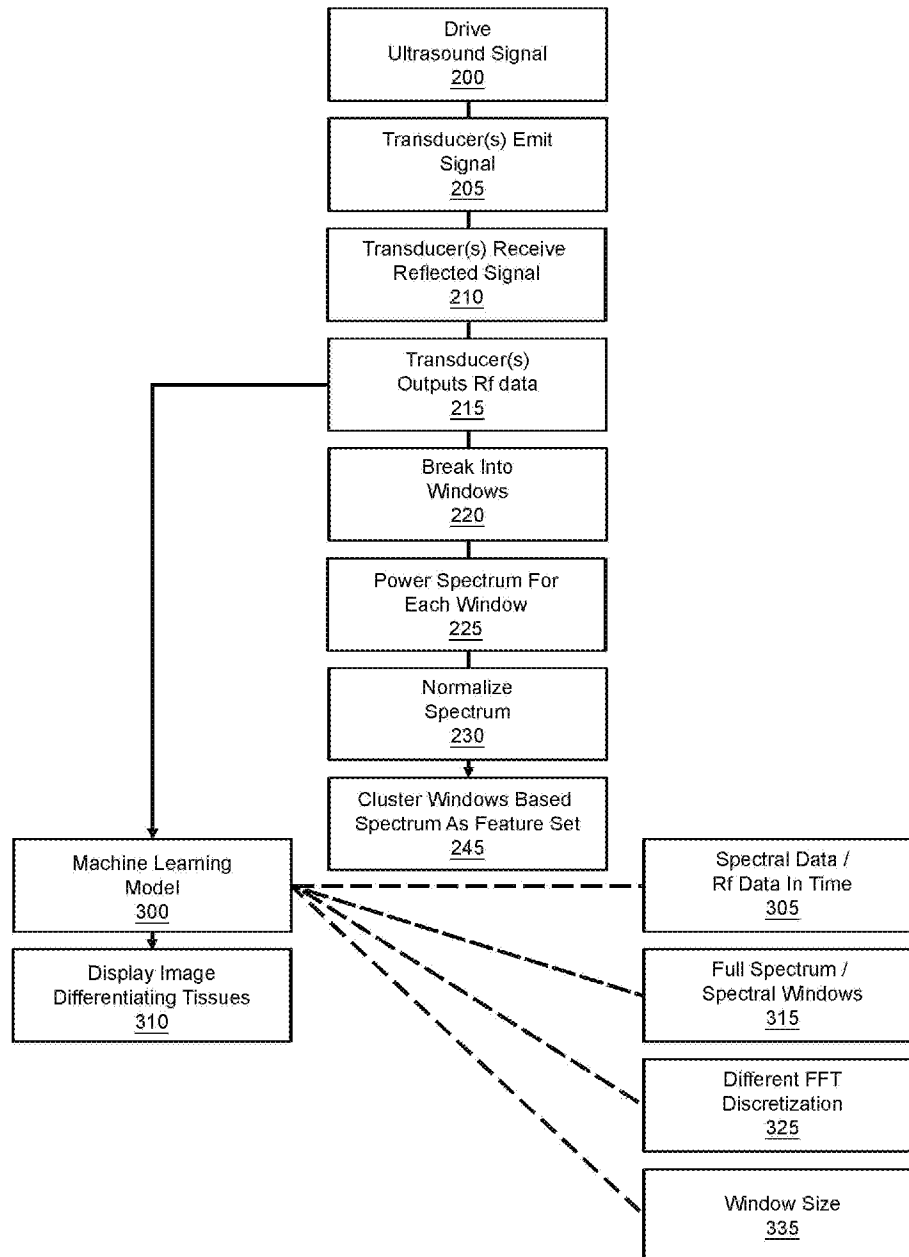


FIG. 3

FIG. 4A

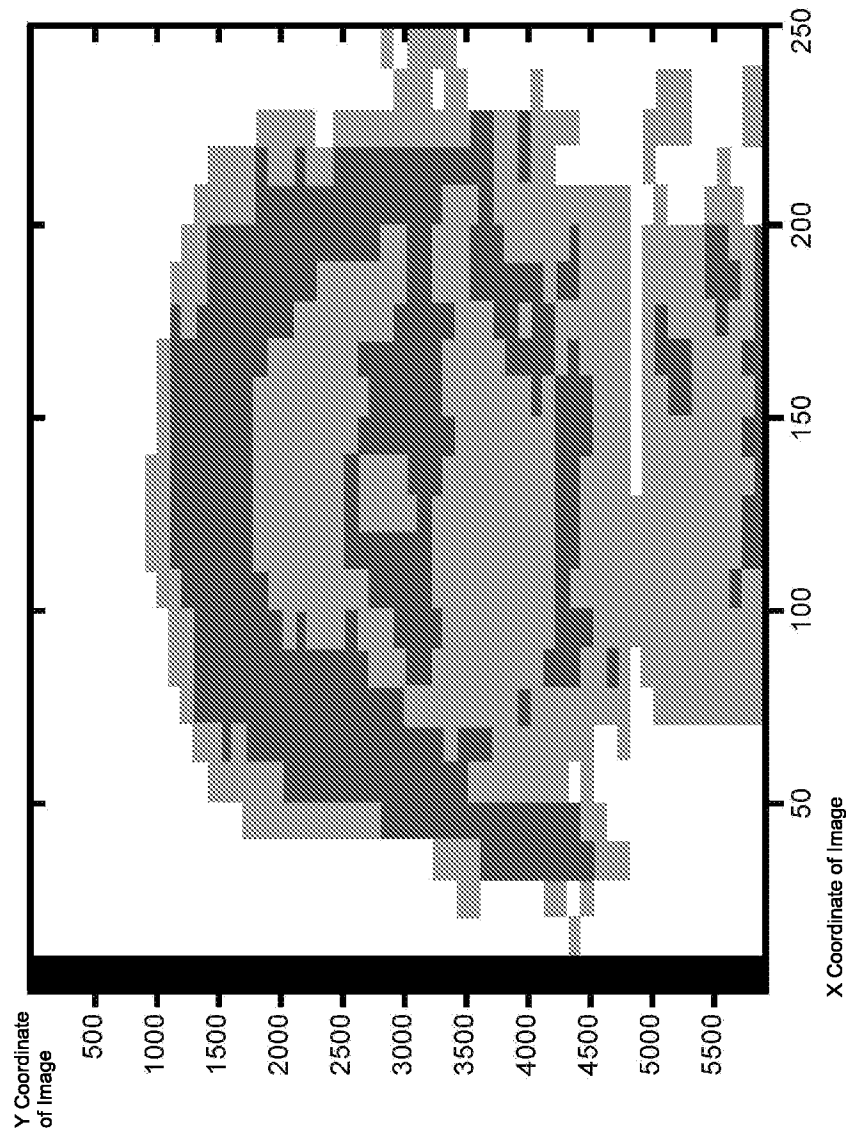
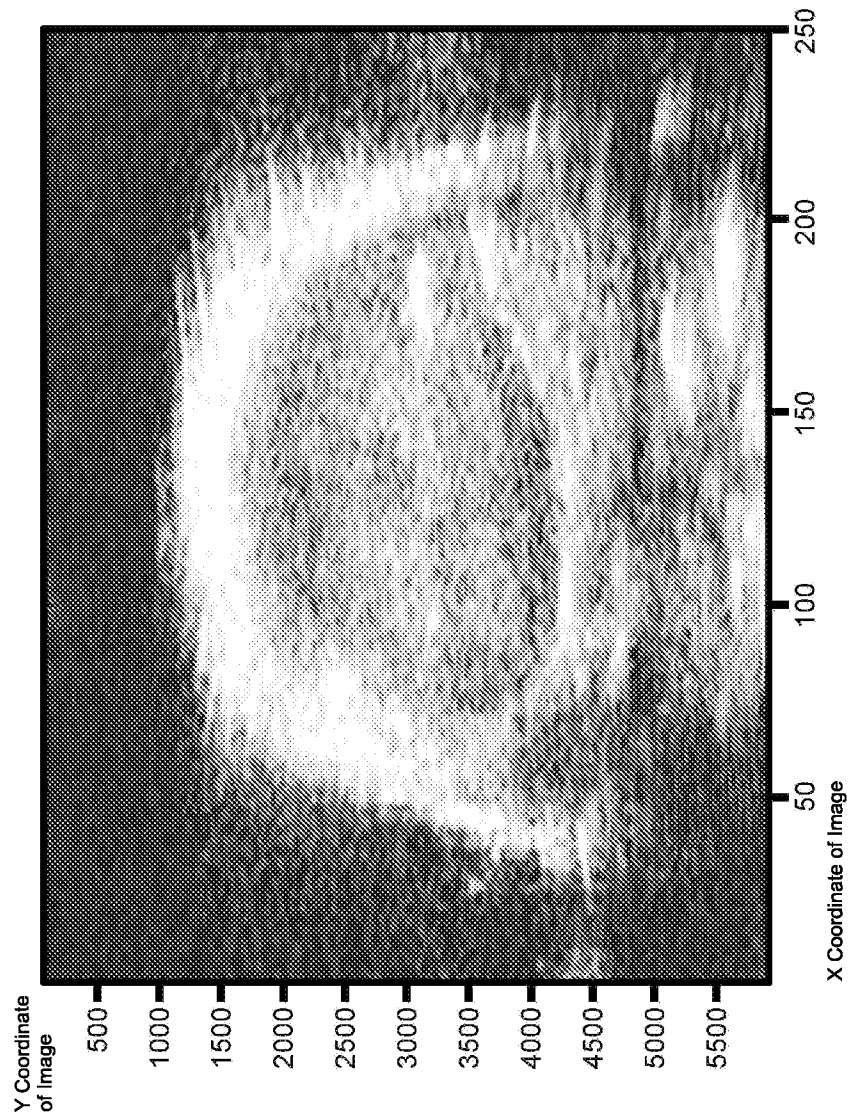


FIG. 4B



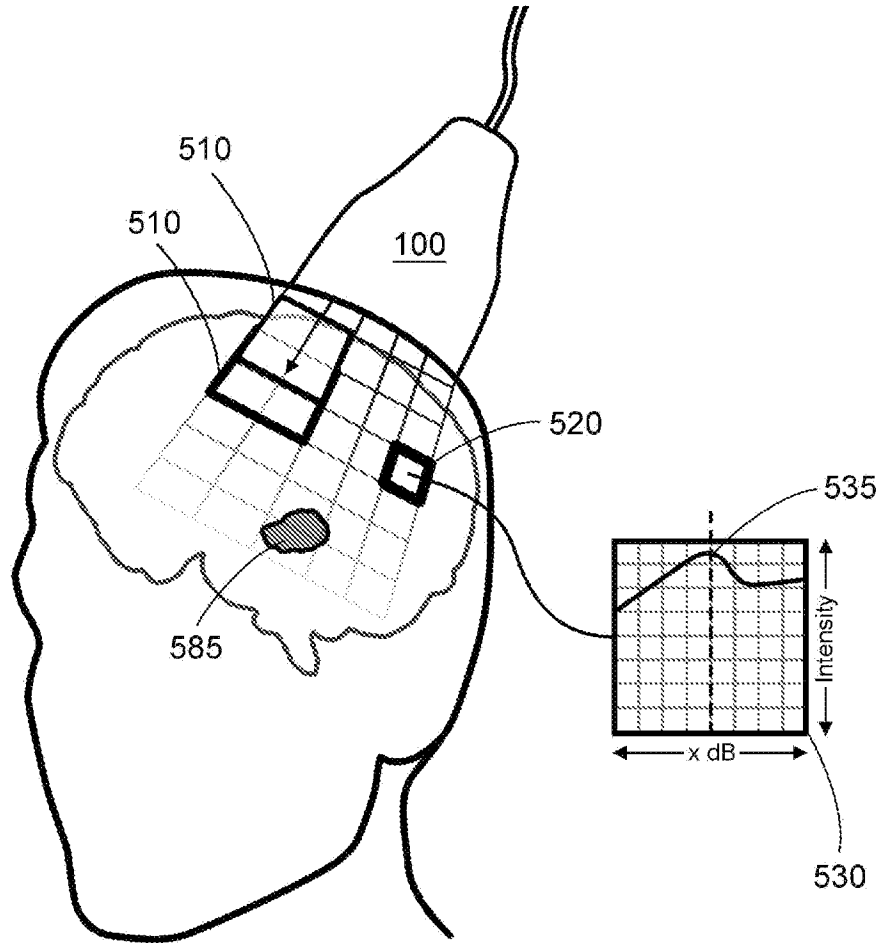


FIG. 5

REMARKS/ARGUMENTS

The November 16, 2022 Notice indicated that replacement drawings were required. In view of the foregoing, Applicant believes the replacement figures are acceptable and are in condition for allowance and an action to that end is respectfully requested.

The November 18, 2022 Notice required a corrected Application Data Sheet with the proper residence of the inventor indicated as California. Applicant is submitting a corrected Application Data Sheet herewith.

CONCLUSION

Except for the issue fees payable under 37 C.F.R. §1.18, the Director is authorized to charge any additional fees during the pendency of this application, or credit any overpayment, to Deposit Account Number 50-4181.

If the Examiner believes that a telephone call would help advance prosecution, the Examiner is kindly invited to call the undersigned attorney at (312) 425-8641.

Respectfully submitted,

/Wayne L. Tang—Reg. No. 36028/
Wayne L. Tang
Reg. No. 36,028

Date: November 18, 2022
Customer No. 106303
NIXON PEABODY LLP
300 South Grand Avenue, Suite 4100
Los Angeles, CA 90071

AMENDMENT TO THE DRAWINGS

Applicant is submitting replacement formal drawings wherein the figure labels for Figs. 4A and 4B are oriented in the same direction as the figures.



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/772,304	06/12/2020	Ahmed EL KAFFAS	079633-000001US00	3673
106303	7590	11/18/2022	EXAMINER	
Nixon Peabody LLP 300 South Grand Avenue, Suite 4100 Los Angeles, CA 90071			SHIN, SOO JUNG	
			ART UNIT	PAPER NUMBER
			2667	
			NOTIFICATION DATE	DELIVERY MODE
			11/18/2022	ELECTRONIC

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ipairlink@nixonpeabody.com
lapatentmb@nixonpeabody.com
slevy@nixonpeabody.com



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

Application No. : 16772304
Applicant : El Kaffas
Filing Date : 06/12/2020
Date Mailed : 11/18/2022

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,
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/Kam Sin/
Publication Branch
Office of Data Management
(571) 272-4200

Application No. 16772304

**IDENTIFICATION OF APPLICATION DEFICIENCIES
IN APPLICATION FILED ON OR AFTER SEPTEMBER 16, 2012**

- ☐ Applicant must provide legible text for the following item(s).
- ☐ Specification filed , page(s) .
- ☐ Claims filed , claim(s) .
- ☐ Other: .
- ☐ Applicant must provide missing information on the following page(s) of the specification by amending the specification to add the missing text. No new matter may be added.
Page/line no(s).
- ☐ The specification refers to one or more applications by attorney docket number and does not show the U.S. application number(s). Applicant must supply the U.S. application number in place of each attorney docket number.
Page/line no(s).
- ☐ Applicant must provide an Abstract of the Disclosure.
- ☒ The Application Data Sheet (ADS dated 06/12/2020) does not supply the inventor's city and/or does not supply the inventor's U.S. state and/or does not supply the inventor's country. Applicant must submit a signed, in accordance with 37 CFR 1.76(e) and 1.33(b), application data sheet that corrects this deficiency. To be in compliance with 37 CFR 1.76, the corrected application data sheet must identify the information being changed by using underlining for additions and strikethroughs or brackets for deletions.
- ☒ Other: inventor has country "CA" instead of state "CA"

The response to this notice should contain only amended papers, as the waiver of 37 CFR 1.312 is limited to corrections of documents specifically requested in the notice.



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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
16/772,304	06/12/2020	2667	840	079633-000001US00	12	3

CONFIRMATION NO. 3673
CORRECTED FILING RECEIPT

106303
Nixon Peabody LLP
300 South Grand Avenue, Suite 4100
Los Angeles, CA 90071



Date Mailed: 11/22/2022

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)

Ahmed EL KAFFAS, Palo Alto, CA;

Applicant(s)

ONCOUSTICS INC., Toronto, Ontario, CANADA;
Ahmed EL KAFFAS, Palo Alto, CA

Assignment For Published Patent Application

ONCOUSTICS INC., Toronto, Ontario, CANADA

Power of Attorney: The patent practitioners associated with Customer Number 106303

Domestic Priority data as claimed by applicant

This application is a 371 of PCT/US2018/065226 12/12/2018
which claims benefit of 62/597,537 12/12/2017

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: 12/03/2020

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/772,304**

Projected Publication Date: Not Applicable

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS

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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NOT GRANTED

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Document Description: Issue Fee Payment (PTO-85B)

Issue Fee Transmittal Form

Application Number	Filing Date	First Named Inventor	Atty. Docket No.	Confirmation No.
16772304	12-Jun-2020	Ahmed EL KAFFAS	079633-000001US00	3673

TITLE OF INVENTION :

MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS

Entity Status	Application Type	Art Unit	Class - Subclass	EXAMINER
Small	U.S. National Stage under 35 USC 371	2667	408000	SOO SHIN
Issue Fee Due	Publication Due	Total Fee(s) Due	Date Due	Prev. Paid Fee
\$600	\$0	\$600	10-Feb-2023	\$0

1.Change of Correspondence Address and/or Indication Of Fee Address (37 CFR 1.33 & 1.363)

Current Correspondence Address:	Current Indicated Fee Address :
106303 Nixon Peabody LLP 300 South Grand Avenue, Suite 4100 Los Angeles CA 90071 UNITED STATES 213-629-6000 ipairlink@nixonpeabody.com	
☐ Change of correspondence address requested, system generated AIA/122-EFS form attached	☐ Fee Address indication requested, system generated SB/47-EFS form attached

2.Entity Status**Change in Entity Status**

Applicant certifying micro entity status; system generated Micro Entity certification form attached. See 37 CFR 1.29.

Note: Absent a valid certification of micro entity status, issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment. If this box is checked, you will be prompted to choose a micro entity status on the gross income basis (37 CFR 1.29(a)) or the institution of higher education basis (37 CFR 1.29(d)), and make the applicable certification online.



Applicant asserting small entity status. See 37 CFR 1.27.

Note: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.



Applicant changing to regular undiscounted fee status.

Note: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.



Document Description: Issue Fee Payment (PTO-85B)

3.The Following Fee(s) Are Submitted:

☒ Issue Fee

☐ I authorize USPTO to apply my previously paid issue fee to the current fees due

☐ Publication Fee

☐ The Director is hereby authorized to apply my previously paid issue fee to the current fee due and to charge deficient fees to Deposit Account Number _____

☐ Advance Order - # of copies _____

☐ If in **addition** to the payment of the issue fee amount submitted with this form, there are any discrepancies in any amount(s) due, the Director is authorized to charge any deficiency, or credit any overpayment, to Deposit Account Number _____.
The **issue fee must be submitted** with this form. **If payment of the issue fee does not accompany this form, checking this box and providing a deposit account number will NOT be effective to satisfy full payment of the fee(s) due.**

4.Firm and/or Attorney Names To Be Printed

NOTE: If no name is listed, no name will be printed
For printing on the patent front page, list to be displayed as entered

1. NIXON PEABODY LLP
2.
3.

5.Assignee Name(s) and Residence Data To Be Printed

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

Name	City	State	Country	Category
ONCOUSTICS INC.	Toronto, Ontario		CANADA	corporation

6.Signature

I certify, in accordance with 37 CFR 1.4(d)(4) that I am an attorney or agent registered to practice before the Patent and Trademark Office who has filed and has been granted power of attorney in this application. I also certify that this Fee(s) Transmittal form is being transmitted to the USPTO via EFS-WEB on the date indicated below.

Signature	/Wayne L. Tang/	Date	02-09-2023
Name	Wayne L. Tang.	Registration Number	36028

Electronic Patent Application Fee Transmittal

Application Number:	16772304			
Filing Date:	12-Jun-2020			
Title of Invention:	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS			
First Named Inventor/Applicant Name:	Ahmed EL KAFFAS			
Filer:	Wayne L. Tang./Linda Stewart			
Attorney Docket Number:	079633-000001US00			
Filed as Small Entity				
Filing Fees for U.S. National Stage under 35 USC 371				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
UTILITY APPL ISSUE FEE	2501	1	600	600
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				600

Electronic Acknowledgement Receipt

EFS ID:	47508920
Application Number:	16772304
International Application Number:	
Confirmation Number:	3673
Title of Invention:	MACHINE LEARNING TO EXTRACT QUANTITATIVE BIOMARKERS FROM RF SPECTRUMS
First Named Inventor/Applicant Name:	Ahmed EL KAFFAS
Customer Number:	106303
Filer:	Wayne L. Tang./Linda Stewart
Filer Authorized By:	Wayne L. Tang.
Attorney Docket Number:	079633-000001US00
Receipt Date:	09-FEB-2023
Filing Date:	12-JUN-2020
Time Stamp:	16:04:57
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	\$ 600
RAM confirmation Number	E202329G04559503
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	Issue Fee Payment (PTO-85B)	Web85b.pdf	62684	no	2
			936c32efc958383b77a55e054a90d7a62962266d		
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	40504	no	2
			bf01234f5509cbeeb0a0104af7c0d3e928a481407		
Warnings:					
Information:					
Total Files Size (in bytes):			103188		
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.					



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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/772,304	03/14/2023	11602330	079633-000001US00	3673

106303 7590 02/22/2023
Nixon Peabody LLP
300 South Grand Avenue, Suite 4100
Los Angeles, CA 90071

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

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

The Patent Term Adjustment is 275 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

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

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

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Patents Stakeholder Experience (OPSE), Stakeholder Support Division (SSD) at (571)-272-4200.

INVENTOR(s) (Please see PAIR WEB site <http://pair.uspto.gov> for additional inventors):

Ahmed EL KAFFAS, Palo Alto, CA;

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

ONCOUSTICS INC., Toronto, Ontario, CANADA;
Ahmed EL KAFFAS, Palo Alto, CA

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