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[Continued on next page]

(54) Title: CT SYSTEMS FOR IMAGING OF THE BREAST

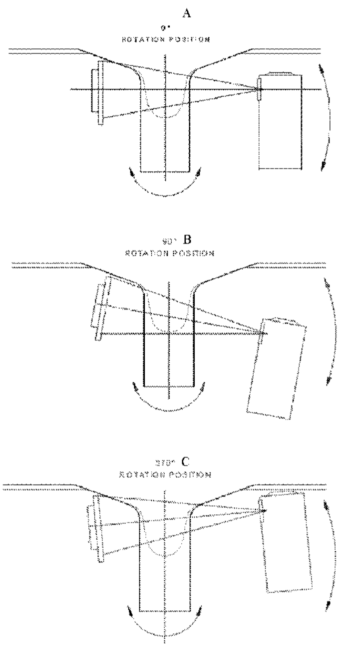

Figure 2

(57) Abstract: In example embodiments, a CT imaging system is provided comprising opposing x-ray generation and x-ray detector assemblies and a motion mechanism configured for simultaneously rotationally orbiting the x-ray generation and x-ray detector assemblies around a patient's anatomy along a main axis of rotation of the imaging system while rotationally oscillating the x-ray generation and x-ray detector assemblies about a spinning oscillation axis which is perpendicular to both the main axis of rotation and to a transmission axis extending between the x ray generation and detector assemblies. Further improvements related to a patient support platform and a biopsy attachment are also described herein.

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— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

CT Systems for Imaging of the Breast

Cross-Reference to Related Sections:

[0001] The subject application claims the benefit of U.S. Provisional Application Serial No. 62/322,256 filed April 14, 2016 and entitled "CT Systems for Imaging of the Breast," the contents of which are hereby incorporated herein in their entirety.

Background:

[0002] The subject application relates to computerized tomography (CT) imaging. In particular, new and improved CT imaging systems are presented which improve the ability to use CT imaging on the breast, e.g., for diagnostic, biopsy, and cancer screening applications.

[0003] Example improvements disclosed herein include. The improved CT systems presented herein have many uses across a number of different settings.

[0004] Breast cancer is the most common diagnosed cancer among women worldwide. 1 in 8 women will acquire breast cancer in their lifetime. While the death rate has been declining since the 1990's due to screening, early detection, and early treatment, the death rate is still high. 40,000 women died last year in the USA due to breast cancer.

[0005] However, breast cancer screening still is still lacking in quality and efficacy. In particular, current cancer screening techniques result in a great number of false positives, and false negatives (in fact, a recent study showed that $4.8B was wasted last year in the USA on false positives and the cost of life is much greater on the false negative front).

[0006] One of the main reasons for these deficiencies is that conventional breast cancer screening technologies still utilize 2D imaging. Thus, traditional mammography requires that the breast (a 3D object) be painfully compressed using what essentially amounts to a vice to render it more two dimensional so as to conform to 2D x-ray imaging standards. Beyond obvious discomfort (which can lead, inter alia, to reduced patient compliance) such compression can often result in reduced image reliability, quality and coverage. These deficiencies are particularly evident for women with smaller/denser breasts which can be extremely difficult to image using conventional mammography techniques. Ironically, woman with smaller/denser breasts are already at greater risk with a much higher incidence of cancer.

[0007] Thus, there are significant advantages to developing technologies which would enable 3D type scanning of the preset. Unfortunately, traditional 3D scanning machines like MRI and CT have lacked the high spatial resolution to see the smallest malignancies.

[0008] Devising an effective and accurate breast CT system is not as simple as it sounds. There are several major problems, which a designer must deal with. First is that ordinarily cone beam CT, whereby a transmission trajectory is made around an object in one plane, is plagued by the fact that all tissue does not get irradiated the same, nor spatial sampled/reconstructed the same. This means that lesions in different parts of the field of view will be imaged with much different accuracy. A second problem is in physically rotating in a coronal plane around one breast, but yet getting deep enough to image the breast to the chest wall. This compounded by the fact that patients come in many different sizes. It is not good enough to scan the majority of the breast while omitting the chest wall as many suspicious and malignant lesions are found there. It is not good enough to only be able to scan 50% of the population. An effective product should be able to scan up to 95% or greater of the population.

[0009] The subject application relates to U.S. Patent No. 7,609,808 to Martin P. Tornai et al., entitled “Application specific emission and transmission tomography” and issued October 27, 2009, the entire contents of which are incorporated herein by reference. In particular Tornai teaches a compact and mobile gantry for 3-dimensional imaging of the breast. In Tornai, the imaging device is mounted a support support so as to be selectively movable during imaging in three dimensions, including radial movement relative to a rotation axis, rotational movement about the rotation axis, vertical movement parallel to the rotation axis, and pivoting movement about a pivot axis perpendicular to said rotation axis.

[0010] While the imaging device disclosed in Tornai represents some advancement in the optimization and specialization of a 3D type imaging system for the breast, in many ways it is limited by its overly complex and unrefined design intended more as a proof of concept than a viable commercial product. Thus there remains a need for a 3D type imaging system for the breast that can improve upon the initial Tornai design. These and other needs are addressed by way of the present disclosure.

Summary:

[0011] In example embodiments, a CT imaging system is provided comprising opposing x-ray generation and x-ray detector assemblies and a motion mechanism configured for simultaneously rotationally orbiting the x-ray generation and x-ray detector assemblies around a patient's anatomy along a main axis of rotation of the imaging system while rotationally oscillating the x-ray generation and x-ray detector assemblies about a spinning oscillation axis which is perpendicular to both the main axis of rotation and to a transmission axis extending between the x-ray generation and detector assemblies. While in some embodiments the orbiting and the oscillating motion are independent, in preferred embodiments, the oscillating motion are dependent. Thus, in example embodiments, an orbital position may be determinative of a corresponding oscillation position. Furthermore, the motion mechanism may be configured to result in fixed number of oscillations per orbital rotation (e.g., two or more oscillations per rotation). One possible mechanism for combining the orbital and oscillation motions is using a rotating angled slip ring and bearings. The angles surface of the slip ring can be used to drive the

oscillations of the gantry holding the x-ray generation and detector assemblies. In other embodiments, a rotational slip ring can be combined with an oscillating actuator to generate the desired motion. In some embodiments, the x-ray detector assembly may include a high resolution flat-panel x-ray detector.

[0012] In example embodiments, the main axis of rotation may be configured to correspond with a longitudinal axis of a cavity configured for receiving a portion of a patient's anatomy to be imaged. In some embodiments, a patient support structure, e.g., made of a radiolucent material, may define the cavity. Advantageously, the patient support structure may include graduated or angled support walls leading to the cavity. For example, the graduated or angled support walls may define a conical or funnel type configuration. In some embodiments, an angle of the support walls may be configured to correspond with a position or orientation of the x-ray generation assembly or the x-ray detection assembly during peak oscillation. In further embodiments, the support walls may also define undulations corresponding with the oscillating motion of the x-ray generation assembly and the x-ray detection assembly. Thus, the undulations may advantageously drive the oscillating motion of the x-ray generation assembly and the x-ray detection assembly. In some embodiments, the cavity may be configured to function as a sealed volumetric cavity once a patient's anatomy is received therein. In example embodiments, the cavity may further include a changeable lining for enabling quick cleaning and sterilization of the cavity. In other embodiments, the patient support structure may include a semi-flexible or elastic support sheath or netting over an opening to the cavity (e.g., configured to stretch and mold to a shape of the patient's anatomy while still providing for support). In yet further embodiments, the patient support structure may include an interchangeable negative mold corresponding to a shape of the patient's anatomy fitted into the cavity and enabling the patient's anatomy to be held in a volumetrically secured position. In some embodiments, the patient support structure may include motorized means for positioning the patient into the supine position.

[0013] In example embodiments, the system may also include an integrated biopsy feature including a biopsy attachment. Advantageously, a gantry holding the x-ray generation and x-ray detection assemblies may therefore be configured to enable moving the x-ray generation and x-ray detection assemblies one or more of laterally, vertically or pivotally so as to allow for access for the biopsy attachment from multiple and opposite directions.

Brief Description of the Drawings:

[0014] The present disclosure is further described in the detailed description which follows, in reference to the noted plurality of drawings by way of non-limiting examples of embodiments of the present disclosure.

[0015] **Figure 1** depicts an example CT imaging system combining orbital and oscillating motion, according to embodiments of the present disclosure.

[0016] **Figures 2A-2C** illustrate the oscillating motion of the system in Figure 1, according to embodiments of the present disclosure.

[0017] **Figure 3** depicts an example biopsy attachment for use with the system of Figure 1, according to embodiments of the present disclosure.

[0018] **Figure 4** depicts an example mechanism for producing the orbital and oscillating motions for the imaging system in Figure 1, according to embodiments of the present disclosure.

Detailed Description:

[0019] As noted above, the systems presented herein seek to improve upon the Tornai design and to provide a viable commercial solution for 3D imaging of the breast. Similar to in Tornai, the systems disclosed herein utilize a cone beam breast CT imaging device intended to image a patient's breast while the patient is in a supine position on a support structure. In particular a patient's breast is inserted downward into a cavity formed into the support structure. The breast is thus, suspended along a dorsal-ventral axis of the patient which forms a main axis of rotation for imaging system.

[0020] In the imaging device in Tornai, an overly complex set of mechanisms is generally utilized to control the desired motion of the imaging device. For example, in several embodiment, the imaging device in Tornai includes (i) a rotating base platform for controlling rotational movement of the imaging device around a rotational axis (ii) a first translational mechanism for controlling vertical translational moment of the base parallel to the rotational axis (iii) a second translational mechanism for controlling radial translation of the imaging device relative to the base in a radial direction relative to the rotational axis, (iv) a third translational mechanism for controlling lateral translation of the imaging device relative to the base and (v) a pivoting mechanism for pivoting the imaging device relative to the base about a pivot axis. It is also noted that the proposed imaging device in Tornai is general single photon imaging emission system with a single imaging assembly that does not adequately accommodate imaging devices using opposing x-ray generation and x-ray detection assemblies. While a few embodiments in Tornai relate to imaging systems with dual opposing assemblies (see, Figs. 10A-13B) the proposed 3D movements of such disclosed imaging systems and corresponding control mechanisms are even more complex than other embodiments.

[0021] In contrast with the imaging device in Tornai, the subject application proposes a much simplified set of mechanism for controlling desired motion of a CT imaging system including opposing x-ray generation and x-ray detector assemblies (advantageously, the x-ray detector may include a standard high resolution flat-panel x-ray detector such as used in conventional x-ray or fluoroscopic applications). In particular, the proposed CT imaging system includes a simplified motion wherein (i) the opposing x-ray generation and x-ray detector assemblies rotate (orbit) around a main axis of rotation of the imaging system while (ii) the x-ray generation and detector assemblies simultaneously rotationally oscillate about a spinning oscillation axis which is perpendicular to both the main axis of rotation and to a transmission axis between the x-ray generation and detector assemblies. In essence the motion effected is like that of a see-saw mounted on a merry-go-round, wherein opposing ends of the see-saw represent the x-ray generation and detector assemblies. Notably, the rotating and oscillating motions can be independent (e.g., wherein rotational and oscillation positions are independently determined/controlled), or advantageously, in some embodiments, dependent (e.g., wherein rotational positional also determines/controls oscillation position). In some embodiments, the imaging system may be configured to affect a fixed number of oscillations per rotation. For example, in some embodiments, the imaging system may be configured to affect two or more oscillations per rotation. It is notable that many mechanisms may be utilized to affect the desired motion. For example, in some embodiments a bearing may be combined with a specially configured slip ring to create the combined rotational and oscillating motion. In other embodiments, a rotating slip ring may be used in conjunction with an oscillating actuator to produce the desired motion.

[0022] Figures 1 and 2 illustrate the proposed simplified motion of the imaging systems presented herein. With specific reference to Figure 1, an example imaging system 100 is depicted including opposing x-ray generation 110 and x-ray detector 120 assemblies. In operation, the imaging system 100 includes a simplified motion wherein (i) the opposing x-ray generation 110 and x-ray detector 120 assemblies rotate (orbit) around a main axis of rotation 132 of the imaging system (which is also a longitudinal axis of a cavity 154 for receiving a portion of a patient's anatomy 15, e.g., a patient's breast) while (ii) the x-ray generation 110 and detector 120 assemblies simultaneously rotationally oscillate 138 about a spinning oscillation axis which is perpendicular to both the main axis of rotation 132 and to a transmission axis 134 between the x-ray generation 110 and detector 120 assemblies (i.e., perpendicular to the plan view of Figure 1). Figures 2A-2C illustrated this oscillation motion, e.g., as the x-ray generation 110 and detector

120 assemblies are rotated between 0, 90 and 270 degree positions respectively.

[0023] Advantageously, improved CT imaging systems described herein also improve upon patient support structures for aligning and receiving a patient's anatomy. For example, as illustrated in Figure 1, in example embodiments, the improved CT imaging system 100 may include a patient support structure 150 which includes graduated or angled support walls 152 leading to the cavity 154 (e.g., a conical or funnel type design). Advantageously these support walls 152 may be constructed from radiolucent material. Moreover, the cavity 154 may be configured to function as a sealed volumetric cavity which is made from x-ray translucent material once a patient's anatomy is received therein. Notably, this cavity may further be configured for easy cleaning/sterilized (e.g., by changing out a disposable inner lining). In some embodiments the support walls 152 may correspond/correlate with a position/orientation of the x-ray generation assembly and/or the x-ray detection assembly during peak oscillation. For example, the support walls 152 may be angled similar to an orientation angle the x-ray generation assembly 110 and/or the x-ray detection assembly 120 during peak oscillation (see, e.g., Figure 2B). In yet further embodiments the support walls 152 may include built in undulations corresponding with the desired oscillations. Thus, in some embodiments a topography of the support walls 152 may define the oscillation path of the x-ray generation assembly 110 and/or the x-ray detection assembly 120. Thus, the support walls may advantageously drive the oscillations of the imaging system 100 as the s-ray generation assembly 110 and the x-ray detection assembly 120 are rotated around the primary rotational axis 132.

[0024] In some embodiments, the patient support structure 150 may further include a semi-flexible or elastic support sheath or netting over the cavity 154 opening which may add to the comfort of the patient by providing support for the breast when inserted into the cavity 154. Advantageously the semi-flexible or elastic support sheath may be configured to stretch/mold to the shape of the patient's anatomy 15 (e.g., breast) while still providing for support. Like the support walls, the support sheath may advantageously be constructed from a substantially radiolucent material. In further example embodiments, the system may be configured to provide (e.g., 3D print) a negative mold shaped like the anatomical feature which is to be imaged. This negative mold may be constructed of a radiolucent material and may in use be fitted into the cavity 154 thereby enabling the patient's anatomy 15 to be held in a volumetrically secured position. Other mechanisms of holding such as clamping or suction force may also be utilized.

[0025] In further example embodiments, the patient support structure 150 may also include a motorized means for positioning the patient into the supine position. Thus, e.g., the patient support structure 150 may be configured to pivot (and possibly translate) to move the patient into the supine position and then return the patient to an inclined or vertical position. In other embodiments, the patient support structure 150 may include a mechanism for raising/lowering the patient as well.

[0026] In example embodiments such as depicted in Figure 3, the improved CT imaging systems may further include a biopsy feature. Thus, for example, in some embodiments, a gantry 105 holding the x-ray generation 110 and the x-ray detection 120 assemblies can be configured to translate the x-ray generation 110 and x-ray detection assemblies, e.g., laterally, vertically, pivotally, etc., so as to allow for access for biopsy attachment 160 from multiple and opposite directions. In some embodiments, the biopsy feature 160 may include a biopsy device which may be controlled to provide access along a range of angles (e.g., 30-65 degrees) from either side. In further example embodiment, an integrated securing mechanism/feature may be included for securing the patient's anatomy for biopsy. In yet further embodiments, the improved CT imaging systems may further include a mechanism for automatically applying x-ray fiducial markers to the breast to facilitate surgical navigation, e.g., for a biopsy, based on acquired CT imaging data. In particular, the x-ray fiducial markers may be used to enable registration of surgical navigation imaging data with the acquired CT imaging data. In further example embodiments, the biopsy attachment 160 can be secured relative to the same gantry 105 holding the x-ray generation 110 and x-ray detection 120 assemblies. Thus, the biopsy attachment may be configured for automatic positioning based on the CT imaging data (which can be cross-registered to gantry position). Thus, the same gantry 105 for moving the x-ray generation 110 and x-ray detection 120 assemblies can be used to position the biopsy attachment.

[0027] With reference to Figure 3, an example embodiment of a mechanism for producing the orbital and oscillating motions for the imaging system 100 in Figure 1 is depicted. In particular a rotating slip ring 170 powered by an electric motor and timing belt drive 170 drive the orbital motion of gantry holding the x-ray generation and detection assemblies 110 and 120, while an oscillating actuator connecting the slip ring to the gantry drives the oscillation motion.

[0028] Whereas many alterations and modifications of the disclosure will no doubt become apparent to a person of ordinary skill in the art after having read the foregoing description, it is to be understood that the particular embodiments shown and described by way of illustration are in no way intended to be considered limiting. Further, the subject matter has been described with reference to particular embodiments, but variations within the spirit and scope of the disclosure will occur to those skilled in the art. It is noted that the foregoing examples have been provided merely for the purpose of explanation and are in no way to be construed as limiting of the present disclosure.

[0029] While the present inventive concept has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present inventive concept as defined by the following claims.

Claims:

1. A CT imaging system comprising opposing x-ray generation and x-ray detector assemblies and a motion mechanism configured for simultaneously rotationally orbiting the x-ray generation and x-ray detector assemblies around a patient's anatomy along a main axis of rotation of the imaging system while rotationally oscillating the x-ray generation and x-ray detector assemblies about a spinning oscillation axis which is perpendicular to both the main axis of rotation and to a transmission axis extending between the x-ray generation and detector assemblies.
2. The system of claim 1, wherein the orbiting and the oscillating motion are independent.
3. The system of claim 1, wherein the orbiting and the oscillating motion are dependent.
4. The system of claim 3, wherein an orbital position is determinative of a corresponding oscillation position.
5. The system of claim 3, wherein the motion mechanism is configured to result in fixed number of oscillations per orbital rotation.
6. The system of claim 5, wherein the motion mechanism is configured to result in two or more oscillations per rotation.
7. The system of claim 3, wherein the motion mechanism uses a rotating slip ring and oscillating actuator.
8. The system of claim 1, wherein the x-ray detector assembly includes a high resolution flat-panel x-ray detector.
9. The system of claim 1, wherein the main axis of rotation is configured to correspond with a longitudinal axis of a cavity configured for receiving a portion of a patient's anatomy to be imaged.
10. The system of claim 9 further including a patient support structure defining the cavity.
11. The system of claim 10, wherein the patient support structure includes graduated or angled support walls leading to the cavity.
12. The system of claim 11, wherein the graduated or angled support walls define a conical or funnel type configuration.

13. The system of claim 11 wherein an angle of the support walls is configured to correspond with a position or orientation of the x-ray generation assembly or the x-ray detection assembly during peak oscillation.
14. The system of claim 11, wherein the support walls further define undulations corresponding with the oscillating motion of the x-ray generation assembly and the x-ray detection assembly.
15. The system of claim 14, wherein the undulations drive the oscillating motion of the x-ray generation assembly and the x-ray detection assembly.
16. The system of claim 10, wherein the cavity is configured to function as a sealed volumetric cavity once a patient's anatomy is received therein.
17. The system of claim 10, wherein the patient support structure is constructed of a radiolucent material.
18. The system of claim 10, wherein the cavity further includes a changeable lining for enabling quick cleaning and sterilization of the cavity.
19. The system of claim 10 wherein the patient support structure further includes a semi-flexible or elastic support sheath or netting over an opening to the cavity.
20. The system of claim 19, wherein the semi-flexible or elastic support sheath or netting is configured to stretch and mold to a shape of the patient's anatomy while still providing for support.
21. The system of claim 10 wherein the patient support structure further includes an interchangeable negative mold corresponding to a shape of the patient's anatomy fitted into the cavity and enabling the patient's anatomy to be held in a volumetrically secured position.
22. The system of claim 10 wherein the patient support structure further includes motorized means for positioning the patient into the supine position.
23. The system of claim 1, further including an integrated biopsy feature including a biopsy attachment.
24. The system of claim 1, wherein a gantry holding the x-ray generation and x-ray detection assemblies is configured to enable moving the x-ray generation and x-ray detection assemblies one or more of laterally, vertically or pivotally so as to allow for access for the biopsy attachment from multiple and opposite directions.

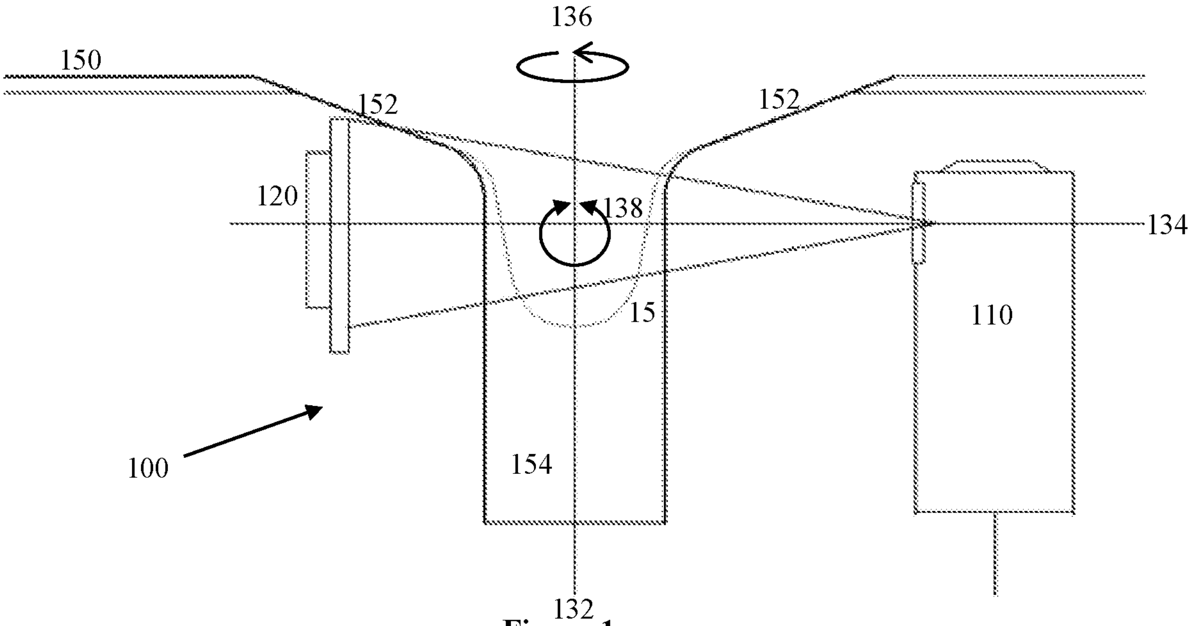
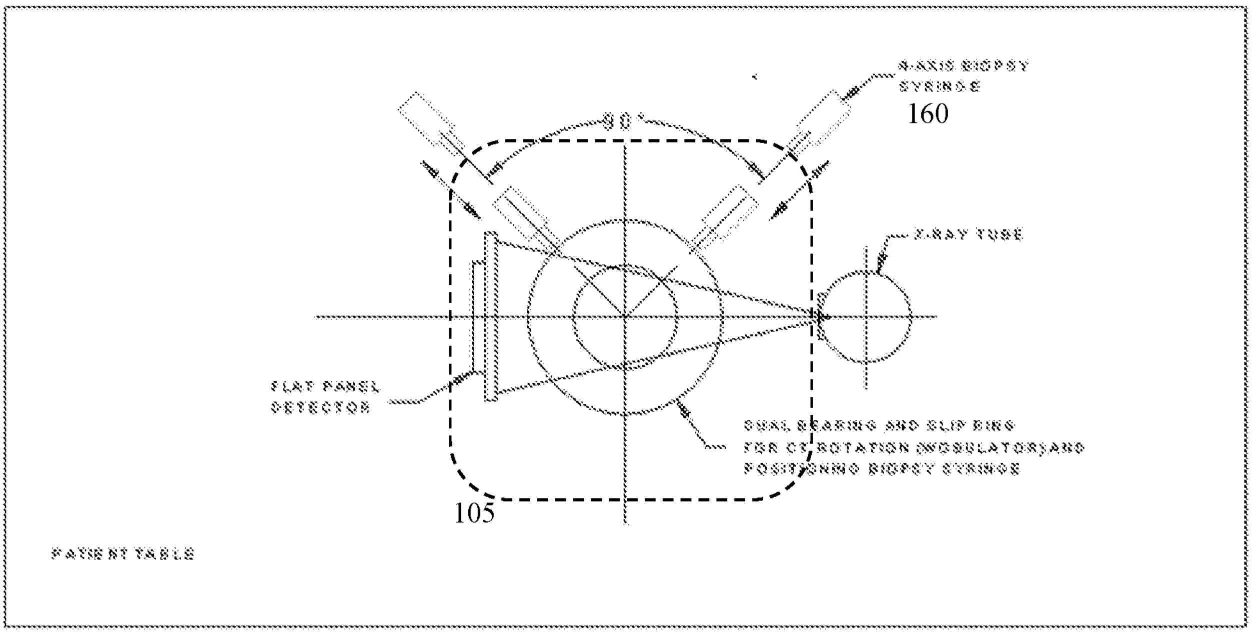


Figure 1



BREST CT WITH IMAGE-GUIDED BIOPSY PROCEDURES

Figure 3

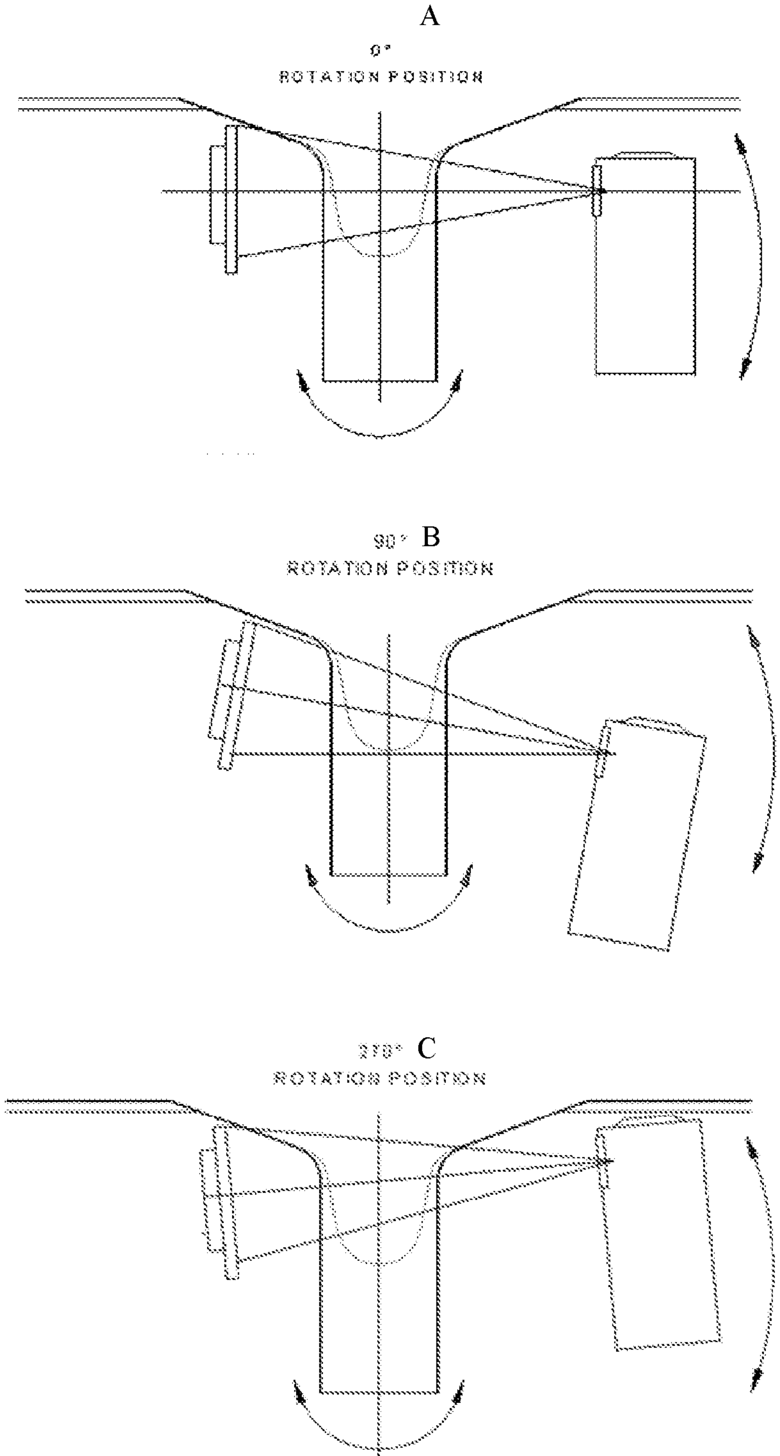

A
0°
ROTATION POSITION
90° B
ROTATION POSITION
270° C
ROTATION POSITION

Figure 2

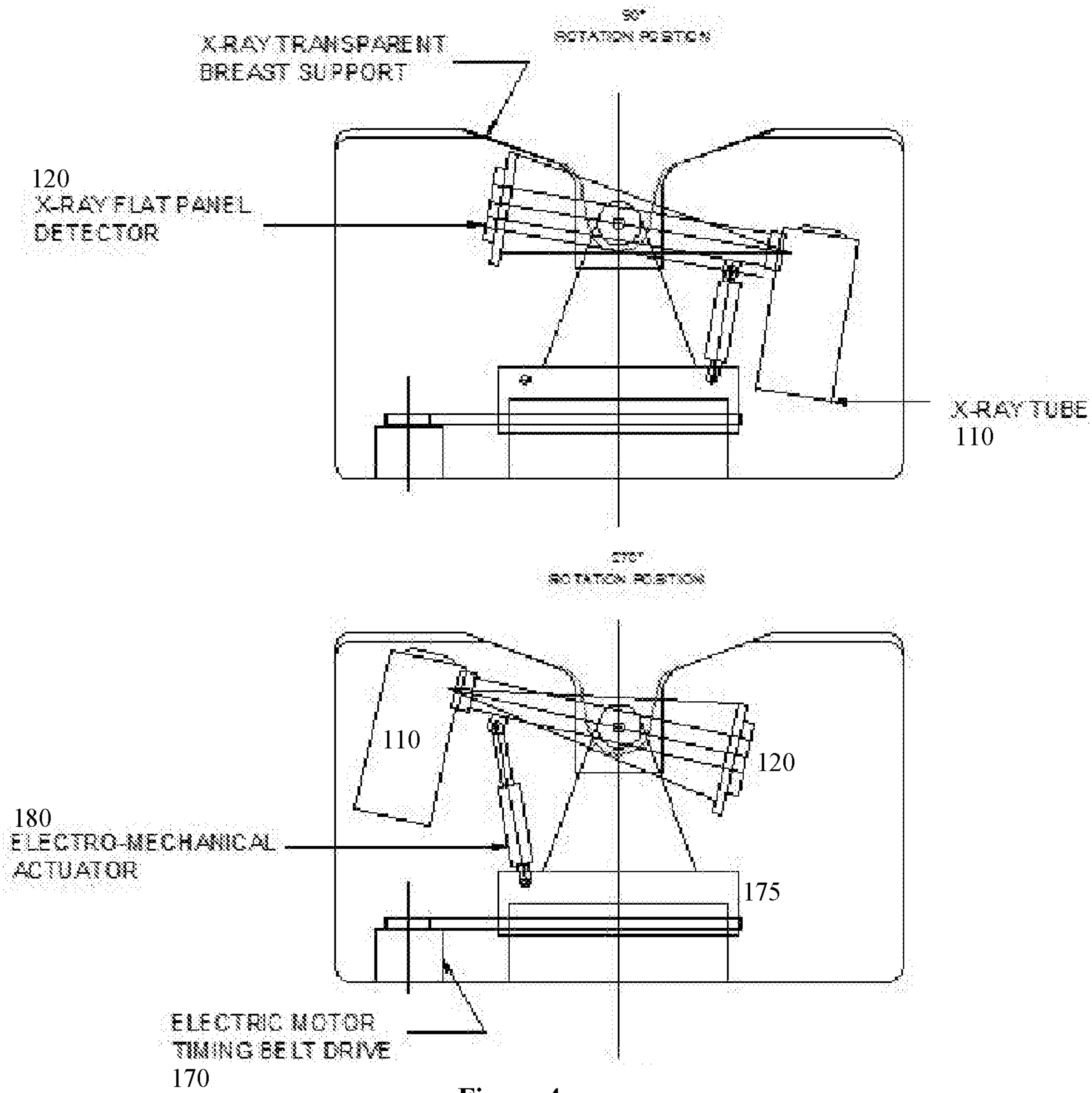

90°
ROTATION POSITION
X-RAY TRANSPARENT
BREAST SUPPORT
120
X-RAY FLAT PANEL
DETECTOR
X-RAY TUBE
110
270°
ROTATION POSITION
110
120
180
ELECTRO-MECHANICAL
ACTUATOR
175
ELECTRIC MOTOR
TIMING BELT DRIVE
170

Figure 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/026923

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B6/00 A61B6/03 A61B6/02 A61B6/04
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/036418 A1 (PAN XIAOCHUAN [US] ET AL) 15 February 2007 (2007-02-15) paragraph [0200] - paragraph [0240]; figures 3,28A paragraph [0407] - paragraph [0408] paragraph [0829] -----	1-8
X	SHAH JAINIL P ET AL: "Design of a nested SPECT-CT system with fully suspended CT sub-system for dedicated breast imaging", PROGRESS IN BIOMEDICAL OPTICS AND IMAGING, SPIE - INTERNATIONAL SOCIETY FOR OPTICAL ENGINEERING, BELLINGHAM, WA, US, vol. 9033, 19 March 2014 (2014-03-19), pages 903350-903350, XP060031659, ISSN: 1605-7422, DOI: 10.1117/12.2043739 ISBN: 978-1-5106-0027-0 page 1 - page 6; figures 1-8 -----	1-8
	-/--	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 June 2017	17/08/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Martinez Möller, A

1

Form PCT/ISA/210 (second sheet) (April 2005)

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SHAH JAINIL P ET AL: "Implementation and first results of the fully suspended cone beam CT and SPECT system for dedicated breast imaging", 2015 IEEE NUCLEAR SCIENCE SYMPOSIUM AND MEDICAL IMAGING CONFERENCE (NSS/MIC), IEEE, 31 October 2015 (2015-10-31), pages 1-4, XP032973999, DOI: 10.1109/NSSMIC.2015.7582132 page 1 - page 3; figures 1-3 -----	1-8
X	US 2011/033024 A1 (DAFNI EHUD [IL] ET AL) 10 February 2011 (2011-02-10) paragraph [0014]; figures 1-11 paragraph [0077] - paragraph [0095] -----	1-8

1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2017/026923

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-8

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-8

   Details of the acquisition orbit and associated motion mechanism, thus allowing to achieve a desired acquisition trajectory.

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2. claims: 9-22

   Details of the patient support structure comprising a cavity for receiving a portion of a patient's anatomy, thus allowing to adequately support the patient for imaging, e.g. for breast imaging.

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3. claims: 23, 24

   Details of an integrated biopsy attachment, thus facilitating biopsy.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2017/026923

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007036418 A1	15-02-2007	NONE	
US 2011033024 A1	10-02-2011	US 2011033024 A1	10-02-2011
		WO 2009128063 A1	22-10-2009