(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
12 June 2014 (12.06.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/087324 A1

(51) International Patent Classification:
A61B 6/12 (2006.01) *A61B 8/12* (2006.01)
A61B 6/00 (2006.01) *A61B 8/14* (2006.01)
A61B 8/08 (2006.01) *A61B 8/00* (2006.01)

(21) International Application Number:
PCT/IB2013/060582

(22) International Filing Date:
3 December 2013 (03.12.2013)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
12306503.9 3 December 2012 (03.12.2012) EP

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available):* AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available):* ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(H))*

[Continued on next page]

(54) Title: INTEGRATION OF ULTRASOUND AND X-RAY MODALITIES

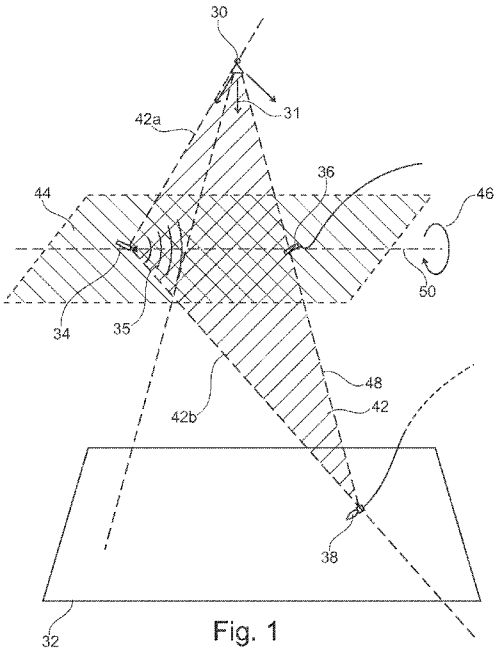

Fig. 1

(57) Abstract: The present invention relates to image acquisition technology. In particular, the present invention relates to tracking of an object of interest in ultrasound image information. For interventional procedures, an object of interest, e.g. the tool by which a procedure is performed, is depicted in image information acquired by a certain imaging modality. However, e.g. during transcatheter intracardiac procedures, tools are employed, which are rather narrow objects that may experience substantive passive motion due to heartbeat and blood flow as well as active motion due to the interventionist steering the tool. The present invention to allows steering two-dimensional ultrasound image acquisition, in particular steering of an imaging plane of an ultrasound image acquisition device, so that an object of interest remains visible in the acquired images, in particular without continuous readjustment of imaging parameters. Accordingly, a method for ultrasound image acquisition, in particular for tracking an object of interest in ultrasound image information, is provided comprising receiving (12) X-ray image information (40) and ultrasound image information (42), detecting (14) an object of interest (36) in the X-ray image information (40) and steering (16) two-dimensional ultrasound image acquisition such that the object of interest (36) is within a first ultrasound image plane (42).

WO 2014/087324 A1

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published.

— *with international search report (Art. 21(3))*

Integration Of Ultrasound And X-Ray Modalities

FIELD OF THE INVENTION

The present invention relates to image acquisition technology. In particular, the present invention relates to tracking of an object of interest in ultrasound image information. More particularly, the present invention relates to a method for ultrasound image acquisition, a system for ultrasound image acquisition, a computer-readable medium as well as a program element for ultrasound image acquisition.

BACKGROUND OF THE INVENTION

A current trend in interventional procedures is a tighter integration of ultrasound and X-ray modalities. In other words, different image modalities are not employed separately but rather conjointly during a specific procedure. Thereby, drawbacks of certain modalities may be compensated by advantages of other modalities.

E.g., although modern interventional ultrasound solutions offer the possibility of 3D imaging, it is often relied upon two-dimensional ultrasound imaging for various reasons. Amongst those reasons may be a higher image quality, a higher frame rate and no need for cropping, volume orientation or rendering parameter tuning when employing two-dimensional ultrasound images versus 3D imaging.

For interventional procedures, an object of interest, e.g. the tool by which the procedure is performed, is depicted in the image information acquired by the respective modalities. By depicting said object or overlaying image information of said object and the image information of a respective modality, a person performing the procedure readily obtains visual information about the location and/or orientation of the object of interest with regard to anatomic structures shown in the modality's image information. E.g., the path of a tool tip through tissue, may be tracked in the respective image information, i.e. visually followed by the person performing the procedure. Such tracking thus allows to reconfirm the correctness of a procedure, i.e. whether the procedure is correctly conducted.

However, during transcatheter intracardiac procedures, such as mitral clip or arterial fibrillation ablation, transcatheter tools being employed, e.g. a mitral clip or ablation

catheter, are rather narrow objects that may experience substantive passive motion due to breathing, heartbeat and blood flow as well as active motion due to the interventionist steering the tool.

In such procedures, ultrasound images are regularly acquired by employing a transesophageal echocardiogram or TEE. The TEE is performed by a specialized probe being inserted into a patient's esophagus, which contains an ultrasound transducer at its tip. The ultrasound transducer is adapted for image acquisition and Doppler evaluation of ultrasound images. TEEs regularly provide clearer images, especially with regard to tissue structures that are difficult to view transthoracically, i.e. through the chest wall by employing an external ultrasound transducer.

Since the TEE itself lies in the esophagus, it experiences very low levels of motion. In particular for transcatheter procedures, the motion of the TEE probe regularly is below the motion of transcatheter tools previously described. In other words, the spatial relationship and/or the distance between the transcatheter tool and the TEE transducer is non-constant and consequently, when considering 2D image acquisition of a particular ultrasound plane, the tool tip periodically goes out of an ultrasound plane currently under observation.

To make the tool tip appear again in the imaging plane, readjustment of the imaging plane is required. This in turn requires a tedious coordination between the interventionist operating the transcatheter tool and the echographer operating in particular the ultrasound image acquisition device.

SUMMARY OF THE INVENTION

It is an object of the invention to allow steering of two-dimensional ultrasound image acquisition, in particular steering of an imaging plane of an ultrasound image acquisition device, so that an object of interest remains visible, in particular without continuous readjustment of imaging parameters.

Accordingly, a method for ultrasound image acquisition, in particular for tracking an object of interest in ultrasound image information, a system for ultrasound image acquisition, a computer-readable medium as well as a program element for ultrasound image acquisition according to the independent claims are provided. Preferred embodiments may be taken from the dependent claims.

These and other aspects of the present invention will become apparent from and elucidated with reference to the embodiments described hereinafter. Exemplary

embodiments of the present invention will be described below with reference to the following drawings.

The illustration in the drawings is schematic. In different drawings, similar or identical elements are provided with similar or identical reference numerals.

The figures are not drawn to scale, however may depict qualitative proportions.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig 1 shows an exemplary embodiment of the relationship between ultrasound image information and X-ray image information according to the present invention;

Fig. 2 shows an exemplary embodiment of a system for ultrasound image acquisition according to the present invention; and

Fig. 3 shows an exemplary embodiment of a method for ultrasound image acquisition according to the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS

One aspect of the present invention pertains to steering and/or aligning an imaging plane of an ultrasound image so that an object of interest remains visible, i.e. within the imaging plane, without the requirement of, in particular constant, readjustment of imaging parameters, in particular ultrasound plane position and orientation.

During a certain interventional procedure, both an X-ray imaging modality e.g. by using a C-arc, as well as an ultrasound imaging modality like TEE may be employed, with each modality generating in particular two-dimensional image information.

Regularly, the ultrasound transducer comprises a transducer array for obtaining image information of a particular, two-dimensional ultrasound image plane, which can be adjusted in 3D by varying the ultrasound emissions of the transducer array.

One aspect of the present invention is that the orientation of an ultrasound plane is steered such that the ultrasound plane comprises the X-ray source. Further, in case the ultrasound imaging plane also contains the projection of an object of interest, e.g. a tool tip of a transcatheter tool, on the X-ray detector, said spatial information is sufficient to establish an ultrasound imaging plane, in which the tool tip of a transcatheter tool may move without being able to leave the ultrasound plane. In other words, in case the ultrasound plane is steered to (always) contain the X-ray source as well as the projection of the tool tip visible

in the X-ray image information, which projection however is non-static on the X-ray detector and may thus move, thereby requiring adjustment of the imaging plane, the tool tip of the transcatheter tool will remain visible within the ultrasound plane. Thereby, the ultrasound plane is automatically steered such that the object of interest lies within the image. No additional use of three-dimensional images is required, which in this case would only be used for tracking the tool tip while degrading the frame rate of the ultrasound image acquisition.

The steering of the ultrasound plane according to the present invention allows to present a moving object of interest inside the ultrasound plane, thereby avoiding a repetitive appearance and disappearance of the object due to out of plane movement, either due to active motion of the object of interest or passive motion e.g. due to the cardiac beats.

To allow the implementation of the method for ultrasound image acquisition according to the present invention, it is first assumed that the ultrasound image information and X-ray image information are registered. In other words, the spatial relationship between the ultrasound image information and C-arm imaging information, in particular comprising further information such as the relative position of an X-ray source, is known. E.g., when considering a two-dimensional X-ray image as well as a two-dimensional ultrasound image, the angle and position of both images with respect to each other is assumed to be known in case said data is registered. Also, a common coordinate system or reference coordinate system may be established and subsequently employed, thereby spatially linking the C-arm imaging information and the ultrasound image information. Further, particular image information visible in either two-dimensional image is also assumed to be known. One example of registering ultrasound image information and X-ray image information is described in international patent application WO 2011/070477 of the instant applicant.

Further, it is assumed that the imaging plane of the ultrasound image information may be steered electronically, e.g. by employing a suitable ultrasound transducer array as known in the art.

Also, it is assumed that the object of interest can be tracked, i.e. is visual and detectable within the X-ray image information. In other words, the X-ray image shall contain a projection of the object of interest, e.g. the tool tip of the transcatheter tool.

Subsequently, the ultrasound plane is steered such that both the X-ray source as well as the tracked/projected object of interest in the X-ray image is contained in the ultrasound plane. In other words, the X-ray source as well as the tracked object of interest in the X-ray image describe two independent and precisely defined points of the ultrasound

imaging plane. Since the ultrasound imaging plane also passes through the ultrasound probe or the ultrasound transducer, which therefore provides a third defined point, the ultrasound plane is completely and precisely determined. Since the ultrasound plane is thus readjusted continuously so that the X-ray source as well as the tracked object of interest in the X-ray image remains within the ultrasound plane, also the object of interest itself remains within the ultrasound imaging plane, since the object of interest naturally is situated on the line between the X-ray source and the projection of the object of interest. Indeed, the ultrasound plane is determined by the object of interest itself as well as the X-ray source, however with the object of interest being visualized by its projection on the X-ray detector. Thereby, it is ensured that the object of interest is also present in the ultrasound imaging plane. Inaccuracies in the imaging system, e.g. due to X-ray/ultrasound data registration errors or inaccuracies in the object of interest localization in the X-ray image, may require to tune the ultrasound slice thickness accordingly. Regularly, a slice thickness of 1, 2 or 3 mm is employed.

According to the present invention, a first ultrasound image plane is thus determinable by employing three points in space, i.e. the ultrasound transducer tip, the X-ray source as well as the projection of the object of interest on the X-ray detector. Using said information, a further, second ultrasound image plane may be set up, which contains the vector or line between the ultrasound transducer and the object of interest itself in 3D space within the reference coordinate system, which position itself is known from the first ultrasound image information under particular consideration of the registration between the ultrasound image data and the X-ray image data. Consequently, a second two-dimensional ultrasound image may be acquired containing said vector between the transducer tip and the object of interest, leaving a further degree of freedom, which can be arbitrarily adjusted. In other words, a second two-dimensional ultrasound plane may be turned about the line or vector between the transducer tip and the object of interest located within patient tissue. Often, such a second two-dimensional ultrasound plane can be placed orthogonally to the first ultrasound image plane, thereby acquiring at least some three-dimensional information, while still only using (two) two-dimensional images.

Put another way, assuming that the object of interest is also tracked in the first ultrasound plane, the second ultrasound image plane may be placed so that it passes through the object of interest. This leaves an extra degree of freedom for the interventionist to choose the orientation of the second ultrasound image plane freely, while still showing the object of interest. The tracking in the first ultrasound plane is greatly helped by the fact that the object

of interest position is already known in the X-ray image and therefore the object of interest is constrained to lie on the corresponding epipolar line in the ultrasound image.

Now referring to Fig. 1, an exemplary embodiment of the relationship between ultrasound image information and X-ray image information according to the present invention is depicted.

In Fig. 1, a schematic of an imaging system employing both X-ray image acquisition as well as ultrasound image acquisition is depicted. An X-ray source 30 generates X-radiation 31, which is exemplarily embodied as a cone-beam directed towards an X-ray detector 32. X-ray detector 32 is exemplarity embodied as a two-dimensional X-ray detector, comprising a plurality of individual detector pixel elements arranged in a pixel array, which however is not depicted in detail in Fig. 1. In the path of X-radiation 31, an object of interest 36, the tool tip of a transcatheter tool, is depicted. The object of interest 36 generates a projection 38 on the two-dimensional X-ray detector 32. Accordingly, a vector or line 48 between the X-ray source 30 and the projection 38 of the object of interest 36 on X-ray detector 32 is established, on which line 48 also the object of interest 36 is required to be arranged.

Further, an ultrasound imaging apparatus embodied exemplarily as an ultrasound transducer 34 is shown in Fig. 1. Ultrasound transducer 34 is generating an ultrasound transmission 35, here directed towards the object of interest 36. A first line or vector 42a from the ultrasound transducer 34 to the X-ray source 30 as well as a second vector or line 42b from the ultrasound transducer 34 to the projection 38 of the object of interest 36 is depicted in Fig. 1. The first ultrasound plane 42 is thus established by the points in space of the ultrasound transducer 34, the X-ray source 30 and the projection 38 of the object of interest 36. Put another way, the ultrasound plane is established by paths or vectors 42a,b, and 48.

Establishing the first ultrasound plane 42 requires a known spatial relationship between the X-ray image information 40 and the ultrasound image information 42, which may be performed by a registration operation of the C-arm acquisition geometry information and the ultrasound image information for obtaining a spatial relationship between said two image information. Known image processing techniques or further means like electromagnetic tracking unsing EM tracker elements may be employed for said registering operation. With said first ultrasound plane 42, also a location in space of the object of interest 36 is known. Subsequently, for a second ultrasound plane 44, this known location of the

object of interest 36 together with the location of the ultrasound transducer 34 establishes a line or vector 50 between the ultrasound transducer 34 and the object of interest 36. The second ultrasound plane 44 thus comprises always the object of interest 36 by assuming that said second ultrasound plane 44 always comprises line 50, thereby allowing a degree of freedom 46, which can be chosen arbitrarily, e.g. by an operator of the imaging system 54. In other words, a further ultrasound image plane 44 may be turned about line 50 between the ultrasound transducer 34 and the object of interest 36. One preferred alignment of the first ultrasound plane 42 and the second ultrasound plane 44 is arranging both planes perpendicular to each another to establish some three-dimensional reference frame for an interventionist.

Now referring to Fig. 2, an exemplary embodiment of a system for ultrasound image acquisition according to the present invention is depicted.

An exemplarily application scenario employs a C-arc 33 comprising an X-ray source 30 as well as an X-ray detector 32 with X-radiation 31 being generated by the X-ray source 30 and being directed towards the X-ray detector 32. An object to be examined 52 is arranged in the path of X-radiation 31, which is subject to a transcatheter procedure with an object of interest 36, e.g. a transcatheter tool being inserted appropriately into object 52. An ultrasound transducer 34 is arranged in the vicinity of the object to be examined 52, in particular in the esophagus, embodied as a TEE ultrasound source. Said particular embodiment however is not depicted in Fig. 2, which is rather referring to a general ultrasound transducer 34.

A first ultrasound plane 42 is established by the X-ray source 30, the projection 38 of the object of interest 36 and the ultrasound transducer 34 in three-dimensional space.

Imaging system 54 comprises a processing element 56 with control elements 58, exemplarily embodied as keyboard and manual input devices, as well as a display unit 60 for displaying at least some image information of the X-ray image information and the first and second ultrasound image information. The operator of the imaging system 54 may provide a suitable image information on display 60a to the interventionist operating to assist in the procedure. By determining the three-dimensional position in space of the object of interest 36, a line 50 between the transducer 34 and the object of interest 36 may be established, allowing a second ultrasound plane 44, not depicted in Fig. 2 to be established, which may be turned about line 50 at the discrtion of one of the operator and the

interventionist.

Now referring to Fig. 3, an exemplary embodiment of a method for ultrasound image acquisition according to the present invention is depicted.

Fig. 3 describes a method 10 for ultrasound image acquisition, in particular for tracking an object of interest in ultrasound image information comprising receiving 12 X-ray image information and ultrasound image information, detecting 14 an object of interest in the X-ray image information and steering 16 two-dimensional ultrasound image acquisition such that the object of interest is within the first ultrasound image plane. A registering procedure 18 aids in obtaining a spatial relation between the X-ray image information and the ultrasound image information. The determined first ultrasound image plane may be visualized 20. A second ultrasound image information corresponding to a second ultrasound image plane may be obtainable 22, which may also be visualized separately or conjointly with at least one of the first ultrasound image plane and the X-ray image information. An operator may adjust 24 the thickness of at least one of the first ultrasound image plane and the second ultrasound image plane to aid in having the object of interest within at least one of the respective image planes.

LIST OF REFERENCE SIGNS:

10	method for ultrasound image acquisition
12	receiving X-ray image information and ultrasound image information
14	detecting an object of interest in the X-ray image information
16	steering two-dimensional ultrasound image acquisition
18	registering X-ray image information and ultrasound image information
20	visualizing
22	obtaining second ultrasound image information
24	adjusting slice thickness of ultrasound image plane
30	X-ray source
31	X-radiation
32	X-ray detector
33	C-arc
34	ultrasound transducer
35	ultrasound transmission
36	object of interest
38	projection
40	X-ray image information
42	first ultrasound image plane
44	second ultrasound image plane
46	degree of freedom
48	line X-ray source - projection object of interest
50	line ultrasound transducer - object of interest
52	object to be examined
54	imaging system
56	processing element
58	control element
60	display unit

CLAIMS:

1. Method (10) for ultrasound image acquisition, in particular for tracking an object of interest (36) in ultrasound image information, comprising

receiving (12) X-ray image information (40) and ultrasound image information (42);

detecting (14) an object of interest (36) in the X-ray image information (40); and

steering (16) two-dimensional ultrasound image acquisition such that the object of interest (36) is within a first ultrasound image plane (42).

2. Method according to the preceding claim, further comprising

registering (18) the X-ray image information (40) and the ultrasound image information (42) for obtaining a spatial relation between the X-ray image information (40) and the ultrasound image information (42).

3. Method according to one of the preceding claim,

wherein the first ultrasound image plane (42) comprises the X-ray source (30), the ultrasound source (34) and the projection (38) of the object of interest (36) in the X-ray image information (40).

4. Method according to one of the preceding claims, further comprising

visualizing (20) the two-dimensional ultrasound image information of the first ultrasound image plane (42).

5. Method to one of the preceding claims,

wherein the ultrasound source (34) is a TEE ultrasound source; and/or

wherein the object of interest (36) is an interventional device.

6. Method to one of the preceding claims, further comprising

obtaining (22) second ultrasound image information (44) corresponding to a second ultrasound image plane (44) comprising the ultrasound source (34) and the object of interest (36) such that a degree of freedom is available for orienting the second ultrasound image plane (44).

7. Method to one of the preceding claims, further comprising

adjusting (24) the thickness of at least one of the first ultrasound image plane (42) and the second ultrasound image plane (44) so that the object of interest (36) is within at least one of the respective image planes (42,44).

8. System (54) for ultrasound image acquisition, in particular for tracking an object of interest in ultrasound image information comprising

an X-ray system (33) having an X-ray source (30) and an X-ray detector (32);

an ultrasound system (34);

wherein the system (54) is adapted to carry out the method (10) according to one of the preceding claims.

9. System according to claim 8, further comprising

a processing element (56);

a control element (58); and

a display unit (60).

10. Computer-readable medium, in which a computer program for ultrasound image acquisition, in particular for tracking an object of interest in ultrasound image information is stored, which computer program, when being executed by a processing element, is adapted to carry out the method (10) according to at least one of claims 1 to 7.

11. Program element for ultrasound image acquisition, in particular for tracking an object of interest in ultrasound image information, which program element, when being executed by a processing element, is adapted to carry out the method (10) according to at least one of claims 1 to 7.

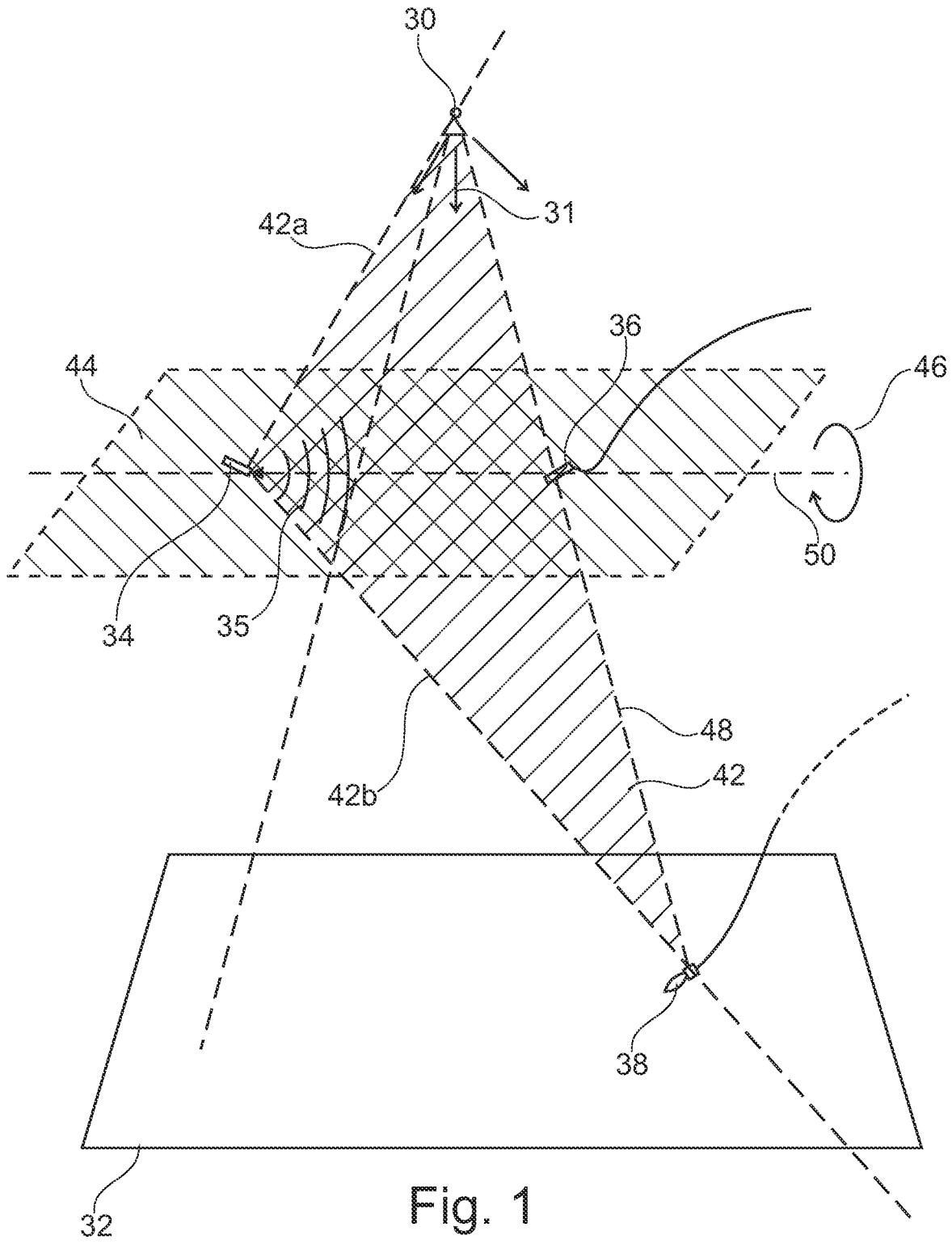

Fig. 1

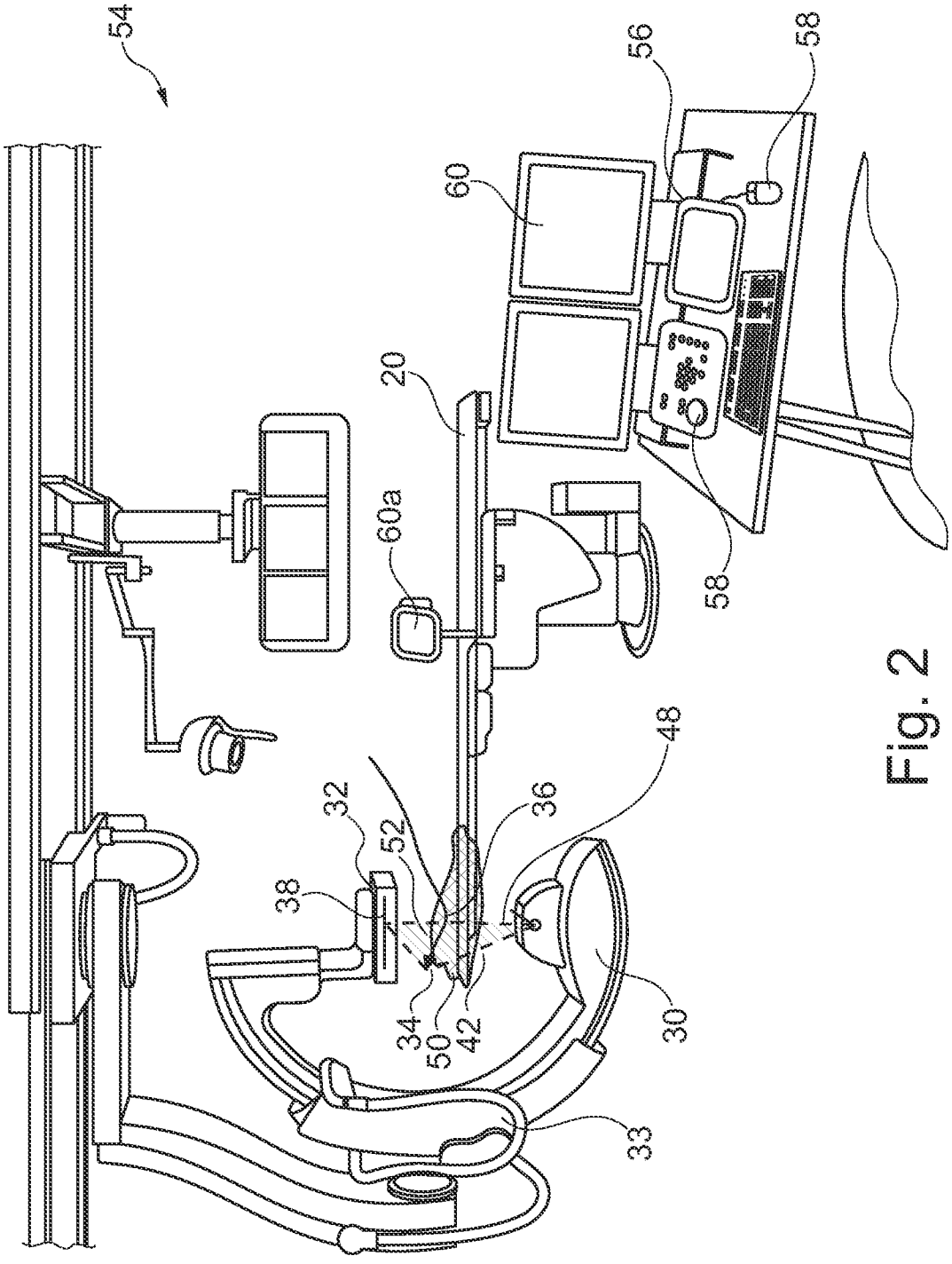

Fig. 2

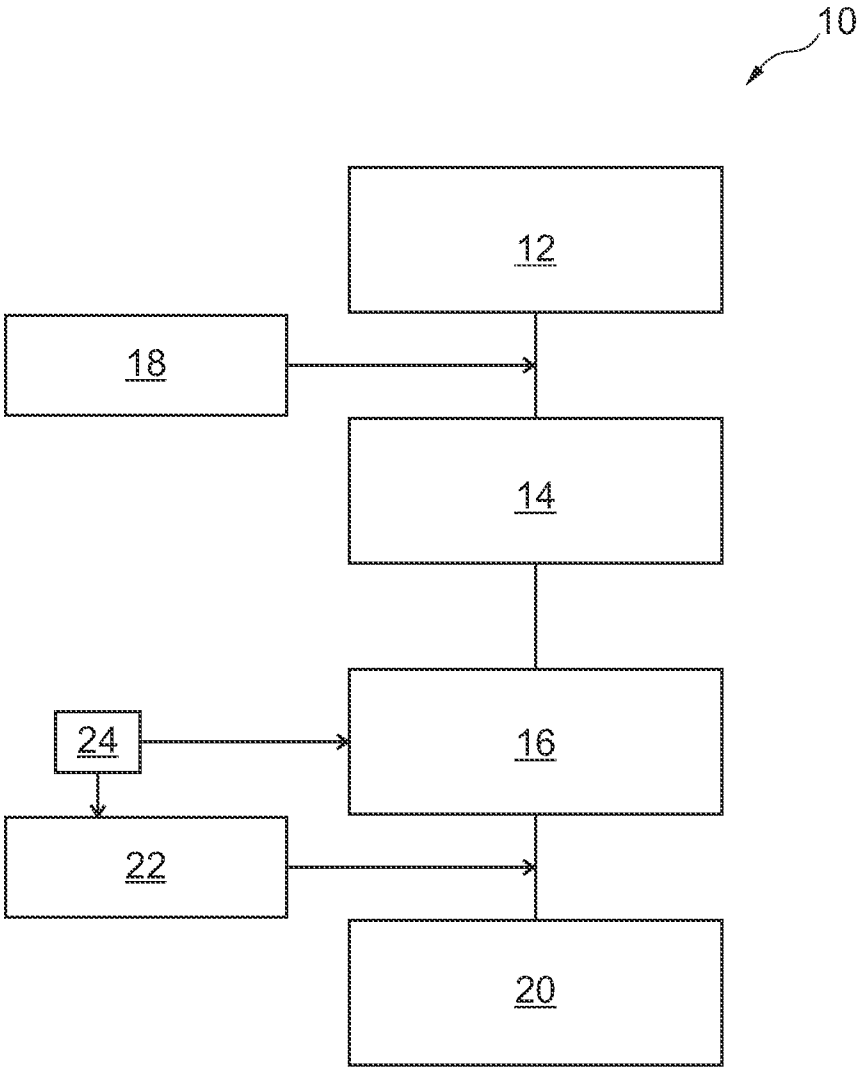

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2O13/06G582

A. CLASSIFICATION OF SUBJECT MATTER

INV. A61B6/12 A61B6/00 A61B8/G8 A61B8/12 A61B8/14
A61B8/00

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	WO 2011/070477 Al (KONINKL PHI LI PS ELECTRONICS NV [NL] ; GOGIN NICOLAS P B [FR] ; FLORENT R) 16 June 2011 (2011-06-16) cited in the application page 1, lines 1-10; claims; figures page 2, line 8 - page 9, line 20	8-11
Y	US 2010/166147 Al (ABENAIM DANI EL [US]) 1 July 2010 (2010-07-01) paragraphs [0001] , [0007] , [0019] , [0024] - [0036] , [0039] ; claims ; figures	8-11
Y	W0 2006/109219 Al (PHI LI PS INTELLECTUAL PROPERTY [DE] ; KONINKL PHI LI PS ELECTRONICS NV [NL) 19 October 2006 (2006-10-19) page 2, line 5 - page 8, line 6; claims; figures	8-11

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[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" documentwhich may throw doubts on priority claimfs) orwhich 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
18 February 2014	26/02/2014

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	Mundakapadam, S

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2013/060582

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2012/296202 A1 (MOUNTNEY PETER [US] ET AL) 22 November 2012 (2012-11-22) paragraphs [0005], [0006], [0019] - [0040]; claims; figures	8-11
Y	US 2009/185657 A1 (KLINGENBECK-REGN KLAUS [DE]) 23 July 2009 (2009-07-23) paragraphs [0004] - [0008], [0017] - [0018]; claims; figures	8-11
Y	US 2002/173719 A1 (ZHAO DANHUA [US] ET AL) 21 November 2002 (2002-11-21) paragraphs [0013] - [0017]; claims; figures	8-11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ I B2013/060582

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. [X] Claims Nos.: \-~)
because they relate to subject matter not required to be searched by this Authority, namely:

see FURTHER INFORMATION sheet PCT/ ISA/2 10

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 64(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:

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.:

Remark on Protest

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

[ ] TThhee aaddddiittiioonnaall sseeaarrcchh fees were accompanied by the applicant's protest but the applicable protest ffeeee wwaass nnoott ppaaiidd wwiitthhiin the time limit specified in the invitation.

[ ] No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box III.1

Claims Nos.: 1-7

Claims 1-7 are directed to methods for an ultrasound image acquisition for tracking an object of interest. It is clear from the description and drawings, that the ultrasound image acquisition is a TEE image acquisition and the object of interest is an interventional device. The methods require the insertion of the TEE in esophagus and as well as the placement of the interventional device inside the body and thus correspond to methods of treatment of the human body by surgery (Rule 39.1(iv) PCT).

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2013/060582

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专利名称(译)	整合超声和X射线模态		
公开(公告)号	EP2925232A1	公开(公告)日	2015-10-07
申请号	EP2013812160	申请日	2013-12-03
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IPC分类号	A61B6/12 A61B6/00 A61B8/08 A61B8/12 A61B8/14 A61B8/00		
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优先权	2012306503 2012-12-03 EP		
外部链接	Espacenet		

摘要(译)

本发明涉及图像采集技术。特别地，本发明涉及在超声图像信息中跟踪感兴趣对象。对于介入程序，感兴趣的对象，例如在由特定成像模态获取的图像信息中描绘了执行过程的工具。但是，例如在经导管心内手术期间，使用工具，这些工具是相当狭窄的物体，由于心跳和血流以及由于干预者操纵工具而主动运动可能经历实质性的被动运动。本发明允许转向二维超声图像采集，特别是超声图像采集装置的成像平面的转向，使得感兴趣的物体在采集的图像中保持可见，特别是不连续地重新调整成像参数。因此，提供了一种用于超声图像获取的方法，特别是用于跟踪超声图像信息中的感兴趣对象，包括接收（12）X射线图像信息（40）和超声图像信息（42），检测（14）和感兴趣对象（36）在X射线图像信息（40）和转向（16）中进行二维超声图像采集，使得感兴趣对象（36）在第一超声图像平面（42）内。