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(54) AUTOMATIC POSITIONING OF IMAGING PLANE IN ULTRASONIC IMAGING

AUTOMATISCHE POSITIONIERUNG EINER BILDGEBUNGSEBENE IN DER ULTRASCHALLBILDGEBUNG

POSITIONNEMENT AUTOMATIQUE DE PLAN D'IMAGERIE DANS UNE IMAGERIE ULTRASONORE

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(73) Proprietor: **Koninklijke Philips N.V.**
5656 AE Eindhoven (NL)

(72) Inventors:
- **GAUTHIER, Thomas, Patrice, Jean, Arsene**
NL-5656 AE Eindhoven (NL)
- **JAGO, James, R.**
NL-5656 AE Eindhoven (NL)

(74) Representative: **van Velzen, Maaike Mathilde**
Philips
Intellectual Property & Standards
P.O. Box 220
5600 AE Eindhoven (NL)

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Description

FIELD OF THE INVENTION

[0001] The invention relates to a method for ultrasonic imaging using at least two two-dimensional images intersecting each other, an ultrasonic imaging device adapted to conduct such a method, a system containing such an ultrasonic imaging device, a computer program for executing such a method and a computer readable medium for storing such a computer program.

BACKGROUND OF THE INVENTION

[0002] Real-time ultrasound is routinely used to guide interventional procedures, such as biopsies and local ablative therapies (incl. radio-frequency ablation). With the recent introduction of real-time Multi-Planar Reconstruction (MPR) and bi-plane ultrasound on mechanical and matrix transducers it is now possible to gather in real-time anatomical information in any arbitrary planes. In bi-plane ultrasound imaging, two imaging planes are generated both of which intersect the transducer active aperture. MPR is a method for reconstructing two-dimensional images from a set of raw image data, i.e. from a set of transversal cross-sectional images arbitrary images with different orientation can be calculated, such as frontal, sagittal or oblique cross-sectional images. In MPR, a so determined imaging plane which does not intersect the transducer aperture is called C-plane.

[0003] US 2007/0073155 A1 describes a compact ultrasound needle guidance system and method for adjustably target a needle's destination in the imaging plane of a two-dimensional ultrasound image before insertion of a needle into a patient. In this system a needle holder is provided at an ultrasound probe for acquiring a two-dimensional image of a subject of examination. Knowing the position of the needle holder and thus the orientation of the needle, an intersection point of the needle with the two-dimensional image can be determined, assuming that the orientation of the needle is not changed during insertion. This intersection point can be marked when displaying the two-dimensional image on a display. However, this system is not very flexible in use such that there is a need for alternative imaging methods and systems.

[0004] EP 2147636 A1 describes a three-dimensional (2D) ultrasound system for guiding surgical tools adapted to acquire a time sequence of 3D ultrasonic image of a target area with further generation of a 2D image defined by an image plane that intersects the corresponding real-time 3D image of said time sequence.

SUMMARY OF THE INVENTION

[0005] The object of the present invention is to provide an alternative method and system for ultrasonic imaging.

[0006] This object is solved with the method and system according to the independent claims. Further advantageous developments are subject of the dependent claims.

[0007] According to an embodiment of the invention a method for ultrasonic imaging is provided, in which a first two-dimensional image is acquired which is aligned with a longitudinal direction of an interventional object to be moved, preferably a needle, towards a target area within a subject of examination, such as a patient. This alignment means that the longitudinal axis of the interventional object lies substantially or exactly within the imaging plane of the first image. Further, the position and orientation of the interventional object is automatically determined before or after the first two-dimensional image is acquired. This order depends on which way the position and orientation is determined, preferably this could be done by means of an image feature analysis or by electromagnetic tracking of the interventional object, or by determining the position by optical sensors. In case of using the image feature analysis or the determining by optical sensors, the position of the interventional object can be determined prior to acquiring any image. When using the image feature analysis, at least one image has to be acquired as basis for determining the position of the interventional object. Based on the position and orientation of the interventional object, a positioning of a second two-dimensional image is automatically determined and then the second two-dimensional image is acquired. The second two-dimensional image intersects the longitudinal direction of the interventional object, and preferably the imaging planes of the first and second images are perpendicular to each other. In case, MPR is used, the C-plane is chosen such that it is also normal to the longitudinal axis of the interventional object. The term "acquiring" may include the acquisition of images by means of a transducer and a data processor in case of bi-plane ultrasound, and may include the acquisition of desired images from an available data base in case of MPR. Similarly, the term "acquisition device" may include a transducer as well as a computer or module of a data processor for acquiring desired images from an available data base. The step of determining the position and orientation of the interventional object includes the determining of the position of a leading end of the interventional object, in particular a needle tip, and wherein the position of the second image is determined such that the second image is distanced a predetermined distance forward of the leading end. In accordance with principles of the present invention this predetermined distance is automatically determined depending on the type of the interventional object, the moving speed of the interventional object, the subject of examination and/or a type of the target area.

[0008] This embodiment enables that the movement of the interventional object to be moved is automatically tracked such that a desired imaging of the subject under examination can be displayed wherein this imaging is fixed to the movement of the interventional object. This way the handling of the imaging system needs less attendance and the user, such as a surgeon, can be more focused on other tasks. Ultrasound presents an advantage over Computed Tomography (CT) in that it provides a true real-time imaging modality for guidance, thereby providing the interventional radiologist with more confidence when guiding the needle to the target area. The inventors of this invention realized that, with prior art methods and systems the user does not get a good overview of which obstacles the interventional object may encounter along its trajectory. Thus, a "virtual endoscope" is provided with an ultrasonic imaging device. Preferably, this method involves adjusting a C-plane (when MPR is used) or a transverse plane (when using bi-plane ultrasound) so that it is always slightly forward of the needle tip. When using MPR, the needle shaft is preferably always normal to the C-plane. This imaging plane configuration notably provides the user with information on immediate landscape forward of the needle tip, allowing the user to anticipate and adjust the needle trajectory if needed, in order to avoid for example the hitting of a major vessel.

[0009] According to a yet further embodiment, the position and orientation of the interventional object is determining repeatedly, and the positioning of the second image is adapted to a changing position and/or orientation of the interventional object. Thus, the position of the interventional object and performing said adjustment is tracked regularly such that the distance is kept constant while the interventional object is moved. This way, the user gets an update of the landscape information while the interventional object is inserted. The update can be done in real time within defined time intervals.

[0010] According to a yet further embodiment, the method comprises acquiring and displaying more transverse planes positioned at different distances in front of the needle tip. The user can then get an additional overview of what is in the path in front of the needle assuming that he will keep the needle in the current orientation.

[0011] Further, the invention provides an ultrasonic imaging device adapted to perform at least one of the above methods, a computer program for executing such a method, and a computer readable medium for storing such a computer program, all of which provide the same advantages as the above mentioned embodiments.

[0012] It may be seen as the gist of the invention to provide a method in which ultrasound signals are acquired that enable the display of at least two imaging planes including a region of interest, one of them being aligned with the needle main axis, the other being transverse thereto and positioned at a predetermined distance in front of the needle tip.

[0013] These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Fig. 1a schematically shows an imaging system with a three-dimensional illustration of two imaging planes;

Fig. 1b is a top view of the imaging planes of Fig. 1a; and

Fig. 2 is a flowchart illustrating the method for ultrasonic imaging according to an embodiment of the invention.

DETAILED DESCRIPTION OF EMBODIMENTS

[0015] Fig. 1a schematically shows an imaging system 1 according an embodiment of the invention. Fig. 1a further illustrates two imaging planes in a three-dimensional view and Fig. 1b shows a top view projection, as seen from the transducer active aperture, of these imaging planes along a plane containing the longitudinal axis of the needle. Fig. la and 1b exemplary show the case of bi-plane ultrasound imaging, however, the teaching of this invention is equally applicable in Multi-Planar Reconstruction (MPR). In MPR and in bi-plane ultrasound imaging, it is possible to display simultaneously at least two perpendicular imaging planes, one of which lying along the main axis of an interventional device, such as a medical needle, the other of which lying, in the top view of Fig. 1b, perpendicularly to the main axis of the interventional device. Such a configuration is useful when guiding an interventional device to a target lesion under real-time ultrasound guidance.

[0016] Fig. 1a shows a transducer 2 for sending and receiving ultrasound signals within a first imaging plane 8, such as an azimuthal plane. Further, the transducer 2 is provided for sending and receiving ultrasound signals within a second imaging plane 9, such as a transversal plane or bi-plane in case of bi-plane ultrasound and a C-plane in case MPR is used. The transducer 2 is preferably a 2D array matrix transducer. Such a 2D array matrix transducer comprises, on a surface facing the subject to be examined, an array of transducer elements arranged for example in a chessboard or segmented ring like fashion. Each of these transducer elements is provided with its own transmit-receive-channel, thus the individual transducer elements can be controlled individually. By driving them accordingly, the resulting ultrasonic beam can be tilted, rotated (about a vertical axis or an axis along the center beam of the transducer) and focused electronically without requiring physically rotating transducers as in prior devices. The transducer 2 is connected with a data processor 4 which is adapted to control the transducer 2. Further, the data processor 4 reconstructs two-dimensional images 10 and 11 within the imaging planes 8 and 9, respectively, corresponding to the ultrasound signals acquired by the transducer 2. The images 10 and 11 provide reconstructions of a subject of examination, such as a patient (not shown). A specific target area 7, such as a target lesion, of the subject is crossed by at least the first imaging plane 8. These images 10 and 11 are displayable by a display 5 which is in connection with the data processor 4. Also, the imaging system 1 comprises a user interface 6 provided for a user to manipulate the imaging system 1.

[0017] Fig. 1a further shows a needle 13 which could also be any other interventional device. The first imaging plane 8 is positioned such as to be aligned with a longitudinal axis 14 of the needle 13, i.e. the longitudinal axis lies within the first imaging plane 8. By applying an image feature analysis on at least the first image 10, such as a shape recognition algorithm well known in the art, the position and orientation of the needle 13, in particular a shaft orientation and the position of the needle tip 15, can be automatically recognized in the image 10. For this purpose the data processor 4 can execute the feature analysis method and thus function as a detection device.

[0018] In an alternative way, the position and orientation of the needle 13, in particular the shaft orientation and the position of the needle tip 15, is automatically recognized by electromagnetic tracking, such as an electromagnetic needle tip tracking introduced by Traxtal, Inc. realizing an automatic tip tracking capability. For this purpose, a separate electromagnetic tracking device would have to be provided as known from the state of the art, which would be connected with the data processor 4.

[0019] This information is then used in real-time to position and/or orient the second imaging plane 9 such that it is slightly forward of the needle tip 15 by a distance 16 which is the distance along the longitudinal axis 14 between the needle tip 15 and the intersection point of the longitudinal axis 14 with the second imaging plane 9. In Fig. 1b a projection of the distance 16 into the top view is shown, wherein also such a projection could be used as relevant distance. This distance 16 can be set by controlling the individual transducer elements of the transducer 2 such that the resulting ultrasonic beam is rotated about a vertical axis or an axis along the center beam of the transducer and tilted about an axis 12 such that a tilting movement is achieved as indicated by an arrow marked with reference numeral 17. Reference numeral 18 indicates an intersection line of the first and second imaging plane. In case of using MPR, the second imaging plane 9 may additionally be chosen to be normal to the longitudinal axis 14. The preferred distance between the needle tip 15 and the second imaging plane 9 should be such that it allows the user enough time to make adjustments to the needle trajectory if necessary. The preferred distance is anywhere between a few millimeters to a few centimeters. The distance is more preferably in the range of 1 - 5mm, and is either determined automatically and repeatedly by the imaging system or determined automatically once and kept constant during an imaging procedure. The distance is determined automatically depending on the type of the interventional object, the moving speed of the interventional object, the subject of examination and/or a type of the target area.

[0020] Having the position and/or orientation of the needle 13, the intersection point of the longitudinal axis 16 with the second imaging plane 9 can be marked in the acquired second image 11 when displayed on the display 5, accordingly. In use, the imaging planes 8 and 9 will follow the movement of the needle in order to achieve a live ultrasound image or images. A marker is superimposed on the live ultrasound image for example by crosshairs or by circling the intersection point. Thus, the expected path of the needle can be displayed.

[0021] In this embodiment, information on the needle tip 15 and the shaft orientation drives the transducer 2 (ultrasound scanner or beamformer) in real-time and determines how the second imaging plane 9 (transverse plane) is being created. When the ultrasound imaging system 1 is operating in the MPR mode (which is capable of a four-dimensional or C-plane mode), the transducer need not be positioned / oriented since all of the imaging planes are being collected. In this case, the adjustments are applied to the MPR image reconstruction step, which may be either on the ultrasound system imaging system or on an external computing device.

[0022] A refinement to the above might be to allow the user or operator to quickly slide the second imaging plane 9 along the needle shaft to either bring it back to the needle tip 15 or to lead it away from the needle tip 15 to be able to anticipate what the needle trajectory is going to be with respect to the subject of examination, such as a surrounding anatomy.

[0023] Fig. 2 is a flowchart illustrating the above described method for automatic positioning of the second imaging plane 9 with reference to the shown method steps. In this Figure, the case is illustrated in which the position and orientation of the needle 13 is determined by means of an image feature analysis when conducting bi-plane imaging. In a first step S100, a user aligns the first imaging plane 8 along the shaft of the needle 13. For this purpose, the first image 10 is displayed on the display 5. This first imaging plane 8 also shows the needle tip 15, such that in the next step S101 due to the application of an image feature analysis the position and orientation of the needle 13 is determined. More exact position and orientation data may be achieved when initially an additional image which is perpendicular to the first image 8 (and perpendicular to the needle shaft in a top view as seen from the transducer active aperture), is positioned at the needle tip 15 by the user. Alternatively, to the alignment of the first imaging plane 8 by the user, this alignment could be realized automatically by acquiring an image, analyzing the image by a feature analysis method with respect to presence, position and orientation of the needle, updating the position of the first imaging plane 8 and repeating this until the needle 13 is exactly aligned with the longitudinal axis 14.

[0024] Based on the determined position and orientation of the needle 13, and in particular based on the shaft orientation and the position of the needle tip 15, in step S102, the position of the second imaging plane 9 is determined automatically. Based on this information, the second transducer 3 can be positioned (e.g. tilted) as mentioned above. In step S103, an image within the second imaging plane 9 can be acquired, which shows the expected path of the needle 13, i.e. the image which is a predetermined distance forward of the needle tip 15. In step S104, this second image 9 is then displayed on the display 5, wherein the intersection of the second image with the longitudinal direction of the interventional object is marked. At least steps S101 to S104 are repeatedly executed in order to trace a movement of the needle 13 and to adapt the positioning of the second imaging plane 9 accordingly. Also the first step S100 can be included into the repeated loop every time, every few times or when changing the orientation of the needle, in order to ensure that the first image 10 is kept aligned with the first imaging plane 10.

[0025] When using electromagnetic tracking of the needle 13, the execution order of the steps S100 and S101 is interchanged. In this case, the position and orientation of the needle 13 is determined first. Based on this information the first and second image 10 and 11 may be acquired substantially simultaneously wherein the first image is aligned with the needle 13 and the second image 11 is distanced a predetermined distance in front of the needle tip 15.

[0026] According to a modification of this embodiment, and preferably in connection with MPR imaging, multiple C-planes are displayed simultaneously to provide the user with more information on what the needle will encounter should its trajectory remain the same. For example, each C-plane may be normal to the needle shaft and located at a given distance forward of the needle tip 15, e.g. a first C-plane located 2mm forward of the needle tip 15, a second C-plane located 5mm forward of the needle tip 15 and a third C-plane located 20mm, etc. The additional information provided to the user on structures of the subject under examination present forward of the needle tip 15 may be of additional help in correcting early the needle trajectory, e.g. to avoid hitting a major vessel. This may also be achieved with bi-plane ultrasound imaging, wherein in this case multiple transversal planes would be provided instead of C-planes.

[0027] These multiple images in front of the needle tip 15 can be displayed on the display 5 wherein markers, such as crosshairs or a circle, show the intersection of the longitudinal axis of the needle 15 with the individual view intersecting the longitudinal axis of the needle 15, respectively. In this connection, the longitudinal axis of the needle or a projected needle tip trajectory may be displayed on the multiple C-planes as a red dot or a red circle which gets smaller as the needle tip 15 actually approaches a given C-plane.

[0028] These multiple images in front of the needle tip 15 could be merged to a video sequence. This way the surgeon could interrupt the interventional procedure and play the video sequence of the images in front of the needle tip 15. This way, the operator may have the ability to record a sequence of C-planes located forward of the needle tip 15 and then play the sequence back to plan the needle trajectory. In other words, the size and or illustration of the marker could be dependent on the distance 16. Thus, if the acquisition of the C-planes is repeated every few seconds (e.g. 3 seconds) when moving the needle, the marker circle becomes smaller continuously and is enlarged abrupt when the acquisition is repeated.

[0029] The above embodiment was explained by referring to 2D array matrix transducer. However, the present invention could also be implemented by using a mechanical transducer in which the array of piezoelectric elements is mechanically scanned back and forth over a volume of interest. Also, a separate transducer for each imaging plane might be possible.

[0030] It is explicitly intended that the teaching of this invention covers any combination of the above described embodiments or modifications.

[0031] While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive and it is not intended to limit the invention to the disclosed embodiments. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used advantageously. Any reference signs in the claims should not be construed as limiting the scope of the invention.

Claims

1. Method for ultrasonic imaging, comprising the steps of:

acquiring a first two-dimensional image (10) which is aligned with a longitudinal direction of an interventional object (13) to be moved towards a target area (7) within a subject of examination; and

acquiring a second two-dimensional image (11) intersecting the longitudinal direction of the interventional object (13), wherein a positioning of the second image (11) is automatically determined dependent on an automatically determined position and orientation of the interventional object (13),

wherein the step of determining the position and orientation of the interventional object (13) includes the determining of the position of a leading end (15) of the interventional object (13), and wherein the position of the second image (11) is determined such that the second image (11) is distanced a predetermined distance (16) forward of the leading end (15); and **characterized in that**

the distance (16) is automatically determined depending on the type of the interventional object (13), the moving speed of the interventional object (13), the subject of examination and/or a type of the target area (7).

2. Method according to claim 1, wherein the position and orientation of the interventional object (13) is determined repeatedly, and the positioning of the second image (11) is adapted to a changing position and/or orientation of the interventional object (13).

3. Method according to claim 1, acquiring at least one further two-dimensional image intersecting the longitudinal direction of the interventional object (13); wherein the at least one further image is positioned such that it is distanced a predetermined interval from the second image (11).

4. Method according to claim 1, wherein the position and orientation of the interventional object (13) is determined by an image feature analysis.

5. Method according to claim 1, wherein the position and orientation of the interventional object (13) is determined by electromagnetic tracking of the interventional object.

6. Method according to claim 1, wherein the first two-dimensional image (10) which is aligned with a longitudinal direction of an interventional object (13) to be moved towards a target area (7) within a subject of examination is displayed on a display screen (5); and the second two-dimensional image (11) intersecting the longitudinal direction of the interventional object (13) is displayed on the display screen (5).

7. Method according to claim 6, wherein an intersection of the second image (11) with the longitudinal direction of the interventional object (13) is marked in the displayed image.

8. Ultrasonic imaging device (1) comprising:

an acquisition device for acquiring a first and second two-dimensional image (10, 11);
a detection device (4) for determining a position and orientation of an interventional object to be moved to a target area (7) within a subject of examination;
wherein the first two-dimensional image (10) is aligned with a longitudinal direction of the interventional object (13),
wherein the second two-dimensional image (11) intersects the longitudinal direction of the interventional object (13), and
wherein the acquisition device is adapted to acquire the second image (11) at a position dependent on the position and orientation of the interventional object (13),
wherein the detection device (4) is adapted to determine the position of the leading end (15) of the interventional object (13), and

wherein the acquisition device is adapted to acquire the second image (11) such that the second image (11) is distanced a predetermined distance (16) forward of the leading end (15); **characterized in that** the detection device (4) is adapted to automatically determine the distance (16) depending on the type of the interventional object (13), the moving speed of the interventional object (13), the subject of examination and/or a type of the target area (7),

9. System comprising an ultrasonic imaging device (1) according to claim 8 and an interventional object (13).

10. Computer program for executing the method according to claim 1.

11. Computer readable medium for storing the computer program according to claim 10.

Patentansprüche

1. Verfahren zur Ultraschallbildgebung, das die folgenden Schritte umfasst:

- Erfassen eines ersten zweidimensionalen Bildes (10), das zu einer Längsrichtung eines interventionellen Objekts (13) ausgerichtet ist, das in einem Untersuchungsobjekt hin zu einem Zielbereich (7) zu bewegen ist, und
- Erfassen eines zweiten zweidimensionalen Bildes (11), das die Längsrichtung des interventionellen Objekts (13) schneidet, wobei eine Positionierung des zweiten Bildes (11) automatisch in Abhängigkeit von einer automatisch ermittelten Position und Ausrichtung des interventionellen Objekts (13) ermittelt wird,
wobei der Schritt des Ermittelns der Position und Ausrichtung des interventionellen Objekts (13) die Ermittlung der Position eines vorderen Endes (15) des interventionellen Objekts (13) umfasst und
wobei die Position des zweiten Bildes (11) derart ermittelt wird, dass das zweite Bild (11) mit einem vorbestimmten Abstand (16) vor dem vorderen Ende (15) liegt,
und **dadurch gekennzeichnet, dass**
- der Abstand (16) automatisch in Abhängigkeit von der Art des interventionellen Objekts (13), der Bewegungsgeschwindigkeit des interventionellen Objekts (13), dem Untersuchungsobjekt

und/oder einer Art des Zielbereichs (7) ermittelt wird.

2. Verfahren nach Anspruch 1,
wobei die Position und Ausrichtung des interventionellen Objekts (13) wiederholt ermittelt wird und die Positionierung des zweiten Bildes (11) an eine sich verändernde Position und/oder Ausrichtung des interventionellen Objekts (13) angepasst wird.

3. Verfahren nach Anspruch 1,
wobei zumindest ein weiteres zweidimensionales Bild erfasst wird, das die Längsrichtung des interventionellen Objekts (13) schneidet,
wobei das zumindest eine weitere Bild so positioniert wird, dass es einen vorbestimmten Abstand zu dem zweiten Bild (11) hat.

4. Verfahren nach Anspruch 1,
wobei die Position und Ausrichtung des interventionellen Objekts (13) durch eine Analyse der Bildmerkmale ermittelt wird.

5. Verfahren nach Anspruch 1,
wobei die Position und Ausrichtung des interventionellen Objekts (13) durch elektromagnetisches Tracking des interventionellen Objekts ermittelt wird.

6. Verfahren nach Anspruch 1, wobei

- das erste zweidimensionale Bild (10), das zu einer Längsrichtung eines interventionellen Objekts (13) ausgerichtet ist, das in einem Untersuchungsobjekt hin zu einem Zielbereich (7) zu bewegen ist, auf einem Anzeigebildschirm (5) angezeigt wird, und
- das zweite zweidimensionale Bild (11), das die Längsrichtung des interventionellen Objekts (13) schneidet, auf dem Anzeigebildschirm (5) angezeigt wird.

7. Verfahren nach Anspruch 6, wobei ein Schnittpunkt des zweiten Bildes (11) mit der Längsrichtung des interventionellen Objekts (13) in dem angezeigten Bild gekennzeichnet wird.

8. Ultraschall-Bildgebungsgerät (1), das Folgendes umfasst:

- eine Erfassungsvorrichtung zum Erfassen eines ersten und eines zweiten zweidimensionalen Bildes (10, 11),
- eine Erkennungsvorrichtung (4) zum Ermitteln der Position und Ausrichtung eines interventionellen Objekts, das in einem Untersuchungsobjekt hin zu einem Zielbereich (7) zu bewegen ist, wobei das erste zweidimensionale Bild (10) zu einer Längsrichtung des interventionellen Objekts (13) ausgerichtet ist,
wobei das zweite zweidimensionale Bild (11) die Längsrichtung des interventionellen Objekts (13) schneidet, und
wobei die Erfassungsvorrichtung so ausgelegt ist, dass sie das zweite Bild (11) an einer Position erfasst, die von der Position und Ausrichtung des interventionellen Objekts (13) abhängt,
wobei die Erkennungsvorrichtung (4) so ausgelegt ist, dass sie die Position des vorderen Endes (15) des interventionellen Objekts (13) ermittelt, und
wobei die Erfassungsvorrichtung so ausgelegt ist, dass sie das zweite Bild (11) derart ermittelt, dass das zweite Bild (11) einen vorbestimmten Abstand (16) vor dem vorderen Ende (15) liegt,
<u>dadurch gekennzeichnet,</u> dass
- die Erkennungsvorrichtung (4) so ausgelegt ist, dass sie den Abstand (16) automatisch in Abhängigkeit von der Art des interventionellen Objekts (13), der Bewegungsgeschwindigkeit des interventionellen Objekts (13), dem Untersuchungsobjekt und/oder einer Art des Zielbereichs (7) ermittelt.

9. System, dass ein Ultraschall-Bildgebungsgerät (1) nach Anspruch 8 und ein interventionelles Objekt (13) umfasst.

10. Computerprogramm zur Ausführung des Verfahrens nach Anspruch 1.

11. Computerlesbares Medium zur Speicherung des Computerprogramms nach Anspruch 10.

Revendications

1. Procédé d’imagerie par ultrasons, comprenant les étapes suivantes :

- l’acquisition d’une première image bidimensionnelle (10) qui est alignée avec une direction longitudinale d’un objet d’intervention (13) à déplacer vers une zone cible (7) au sein d’un sujet d’examen ; et
- l’acquisition d’une seconde image bidimensionnelle (11) croisant la direction longitudinale de l’objet d’intervention (13), dans laquelle le positionnement de la seconde image (11) est déterminé automatiquement en fonction d’une position et d’une orientation déterminées automatiquement de l’objet d’intervention (13),
dans lequel l’étape de détermination de la position et de l’orientation de l’objet d’intervention (13) comprend la détermination de la position d’une extrémité avant (15) de l’objet d’intervention (13), et

dans lequel la position de la seconde image (11) est déterminée de façon que la seconde image (11) soit éloignée d'une distance prédéterminée (16) vers l'avant de l'extrémité avant (15) ;
et **caractérisé en ce que**
- la distance (16) est déterminée automatiquement en fonction du type de l'objet d'intervention (13), de la vitesse de déplacement de l'objet d'intervention (13), du sujet d'examen et/ou du type de la zone cible (7).

2. Procédé selon la revendication 1, dans lequel la position et l'orientation de l'objet d'intervention (13) sont déterminées à plusieurs reprises, et le positionnement de la seconde image (11) est adapté à un changement de position et/ou d'orientation de l'objet d'intervention (13).

3. Procédé selon la revendication 1, l'acquisition d'au moins une image bidimensionnelle supplémentaire croisant la direction longitudinale de l'objet d'intervention (13) ;
dans lequel la au moins une image supplémentaire est positionnée de façon qu'elle soit éloignée d'un intervalle prédéterminé de la seconde image (11).

4. Procédé selon la revendication 1, dans lequel la position et l'orientation de l'objet d'intervention (13) sont déterminées par une analyse de caractéristique d'image.

5. Procédé selon la revendication 1, dans lequel la position et l'orientation de l'objet d'intervention (13) sont déterminées par pistage électromagnétique de l'objet d'intervention.

6. Procédé selon la revendication 1, dans lequel

- la première image bidimensionnelle (10) qui est aligné avec une direction longitudinale d'un objet d'intervention (13) à déplacer vers une zone cible (7) au sein d'un sujet d'examen est affichée sur un écran d'affichage (5) ; et
- la seconde image bidimensionnelle (11) croisant la direction longitudinale de l'objet d'intervention (13) est affichée sur l'écran d'affichage (5).

7. Procédé selon la revendication 6, dans lequel une intersection de la seconde image (11) avec la direction longitudinale de l'objet d'intervention (13) est marquée sur l'image affichée.

8. Dispositif d'imagerie par ultrasons (1), comprenant :

- un dispositif d'acquisition servant à acquérir une première et une seconde image bidimensionnelle (10, 11) ;
- un dispositif de détection (4) servant à déterminer la position et l'orientation d'un objet d'intervention à déplacer vers une zone cible (7) au sein d'un sujet d'examen ;

dans lequel la première image bidimensionnelle (10) est alignée avec une direction longitudinale de l'objet d'intervention (13),
dans lequel la seconde image bidimensionnelle (11) croise la direction longitudinale de l'objet d'intervention (13), et
dans lequel le dispositif d'acquisition est conçu pour acquérir la seconde image (11) à une position qui dépend de la position et de l'orientation de l'objet d'intervention (13),
dans lequel le dispositif de détection (4) est conçu pour déterminer la position de l'extrémité avant (15) de l'objet d'intervention (13), et
dans lequel le dispositif d'acquisition est conçu pour acquérir la seconde image (11) de façon que la seconde image (11) soit éloignée d'une distance prédéterminée (16) vers l'avant de l'extrémité avant (15) ;
caractérisé en ce que
- le dispositif de détection (4) est conçu pour déterminer automatiquement la distance (16) en fonction du type de l'objet d'intervention (13), de la vitesse de déplacement de l'objet d'intervention (13), du sujet d'examen et/ou du type de la zone cible (7).

9. Système comprenant un dispositif d'imagerie par ultrasons (1) selon la revendication 8 et un objet d'intervention (13).

10. Programme informatique, permettant de mettre en oeuvre le procédé selon la revendication 1.

11. Support pouvant être lu par un ordinateur, servant à stocker le programme informatique selon la revendication 10.

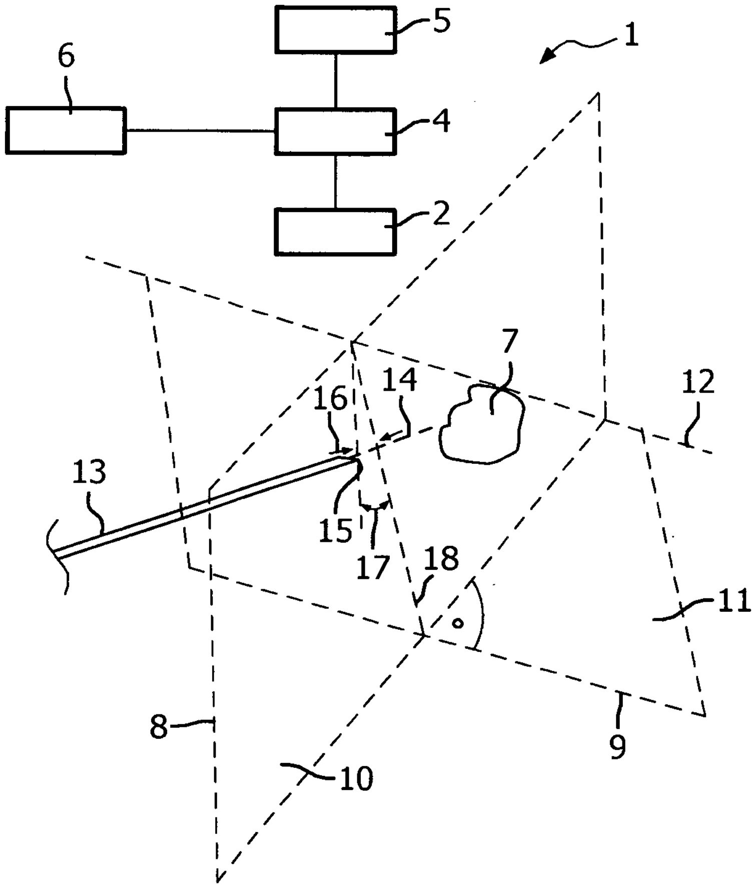

FIG. 1a

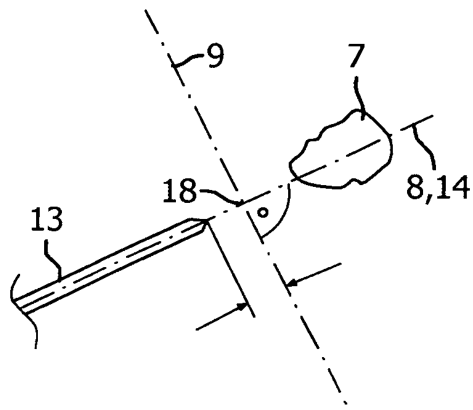

FIG. 1b

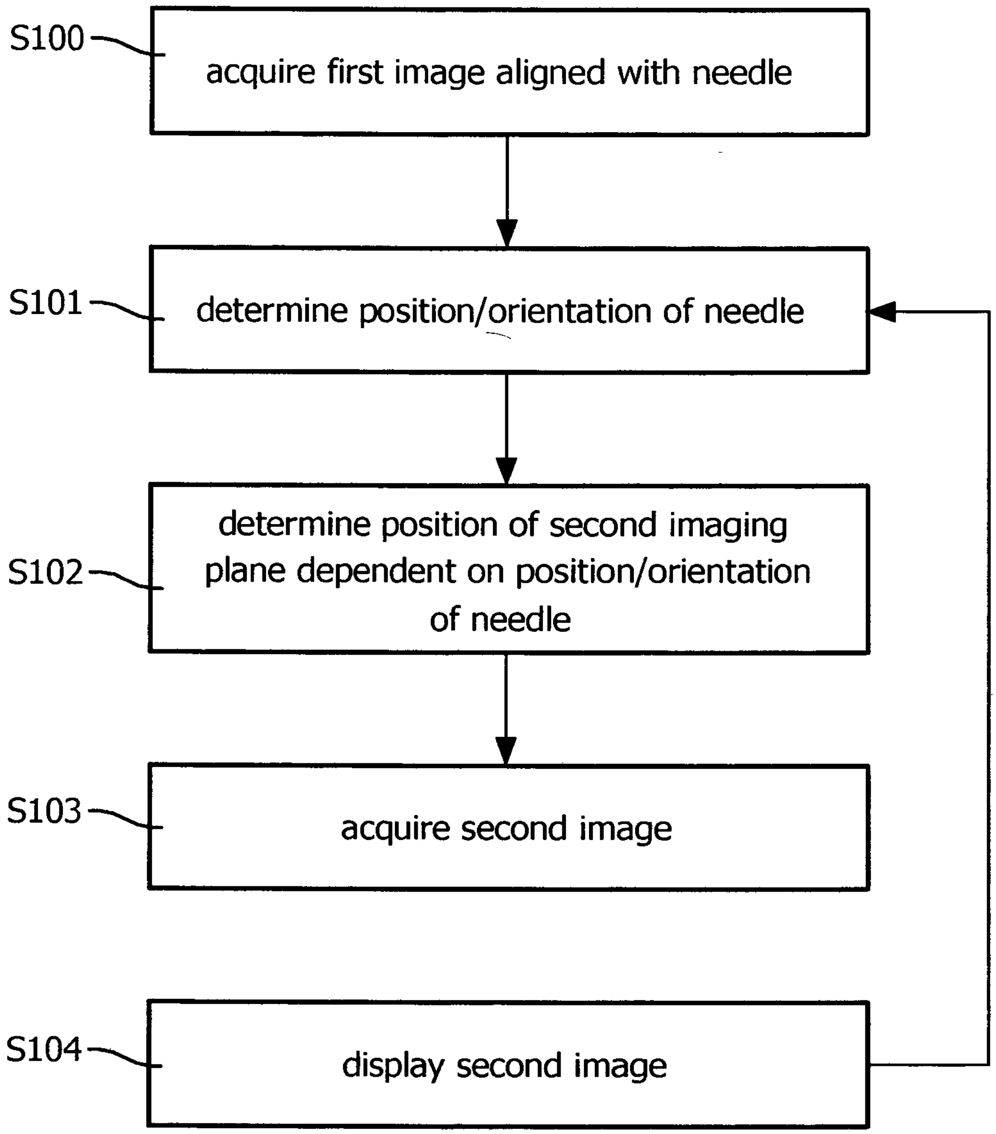
S100
acquire first image aligned with needle
S101
determine position/orientation of needle
S102
determine position of second imaging plane dependent on position/orientation of needle
S103
acquire second image
S104
display second image

FIG. 2

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20070073155 A1 **[0003]**
- EP 2147636 A1 **[0004]**

专利名称(译)	超声成像中成像平面的自动定位		
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[标]申请(专利权)人(译)	皇家飞利浦电子股份有限公司		
申请(专利权)人(译)	皇家飞利浦电子N.V.		
当前申请(专利权)人(译)	皇家飞利浦N.V.		
[标]发明人	GAUTHIER THOMAS PATRICE JEAN ARSENE JAGO JAMES R		
发明人	GAUTHIER, THOMAS, PATRICE, JEAN, ARSENE JAGO, JAMES, R.		
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优先权	61/315515 2010-03-19 US		
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外部链接	Espacenet		

摘要(译)

本发明涉及一种用于超声成像的方法，其中获取二维图像（10,11），其中一个图像与介入物体（例如针）（13）的纵向方向对齐以朝向检查对象内的目标区域（7）和另一个与介入对象（13）的纵向相交且根据介入对象（13）的自动确定的位置和方向自动定位。此外，本发明涉及一种适于进行这种方法的超声成像装置（1）。

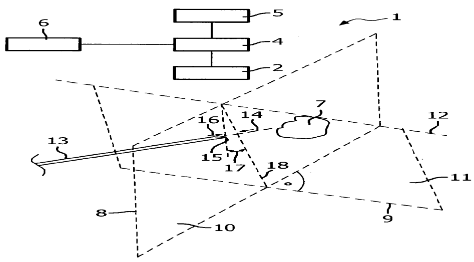

FIG. 1a

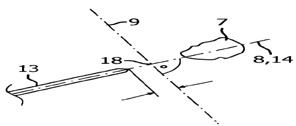

FIG. 1b