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VIGNON et al.

(54) **ULTRASOUND ACQUISITION FEEDBACK GUIDANCE TO A TARGET VIEW**

(71) Applicant: **KONINKLIJKE PHILIPS N.V.**, Eindhoven (NL)

(72) Inventors: **FRANCOIS GUY GERARD MARIE VIGNON**, CROTON ON HUDSON, NY (US); **VIJAY PARTHASARATHY**, MOUNT KISCO, NY (US); **AJAY ANAND**, FISHKILL, NY (US); **AMEET KUMAR JAIN**, NEW YORK, NY (US)

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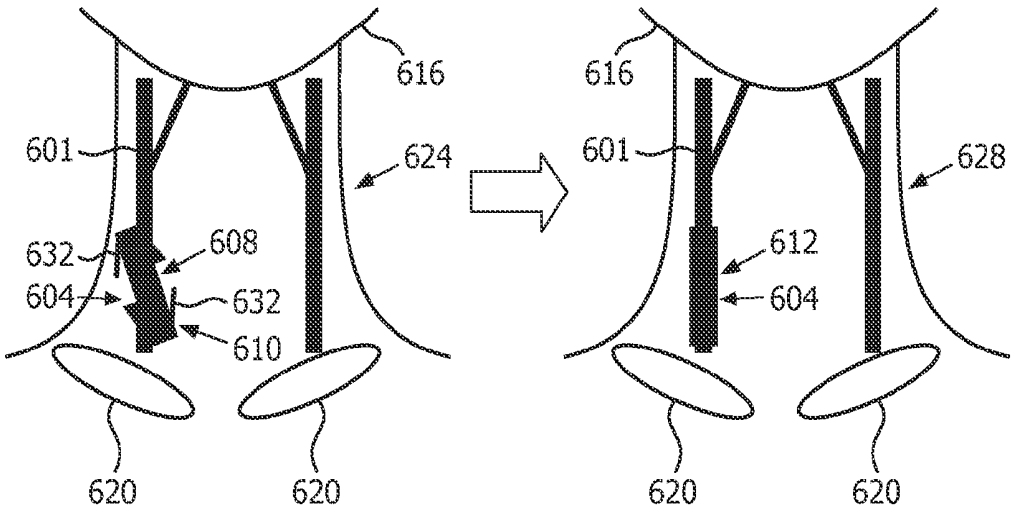
(57) **ABSTRACT**

Guidance in acquiring ultrasound imaging of a subject to achieve a target view, such as a standard view, entails emitting ultrasound to the subject and receiving, in response, a current ultrasound view (**502**);matching the received image to a pre-existing image, such as a three-dimensional reference image (**503**); and, for user assistance, generating, based on the matching, feedback (**514-528**) for the guidance. The reference image may be a statistical atlas or it may be derived from patient-specific CT or MR scans. The pre-existing image may instead stead be a database image corresponding to a state in a state space. The feedback can be an image derived from the reference image;a graphic indication (**508**) of a plane of the target view; the received view fused (**512**) to an image derived from the reference image; or the received view and an image derived from said reference image, the derived image appearing concurrently and enhanced to spatially indicate where the received view registers to the reference image. The target view (**510**) may be a view of a body organ, or vessel,of the subject. Both the atlas and database can be specialized for imaging of an organ,or vessel, and its surrounding tissue.



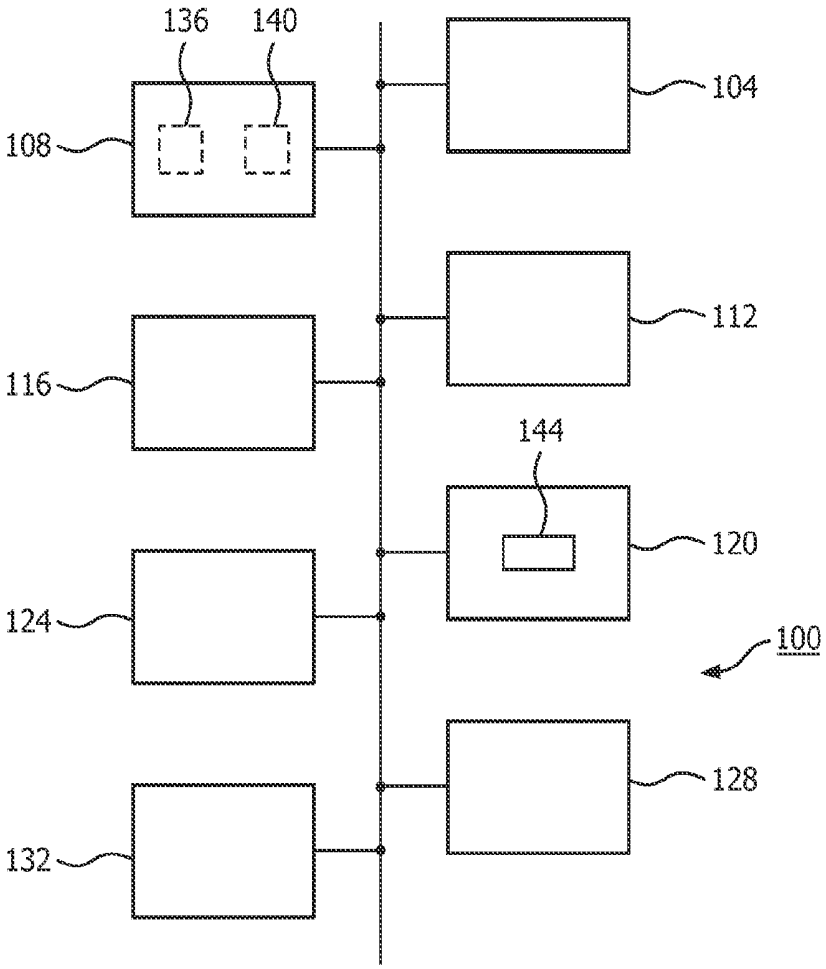


FIG. 1

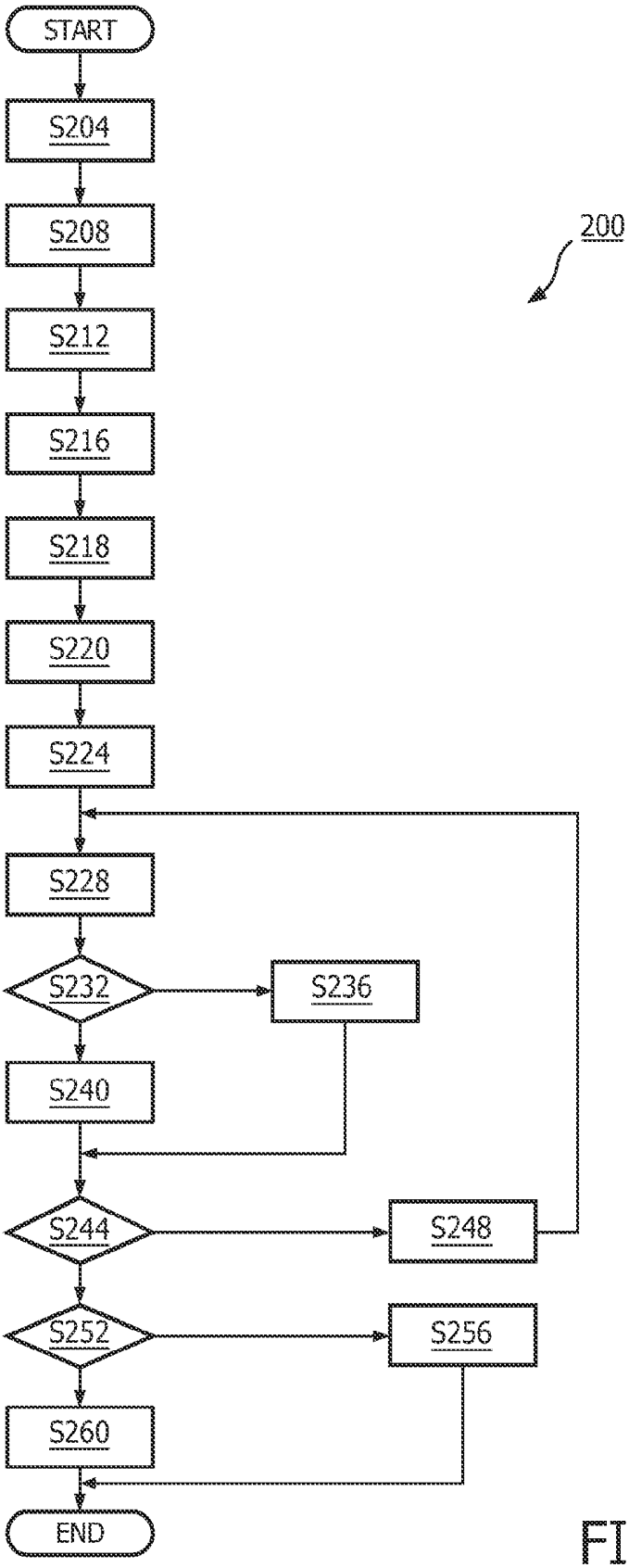

START
S204
S208
S212
S216
S218
S220
S224
S228
S232
S236
S240
S244
S248
S252
S256
S260
END
200

FIG. 2

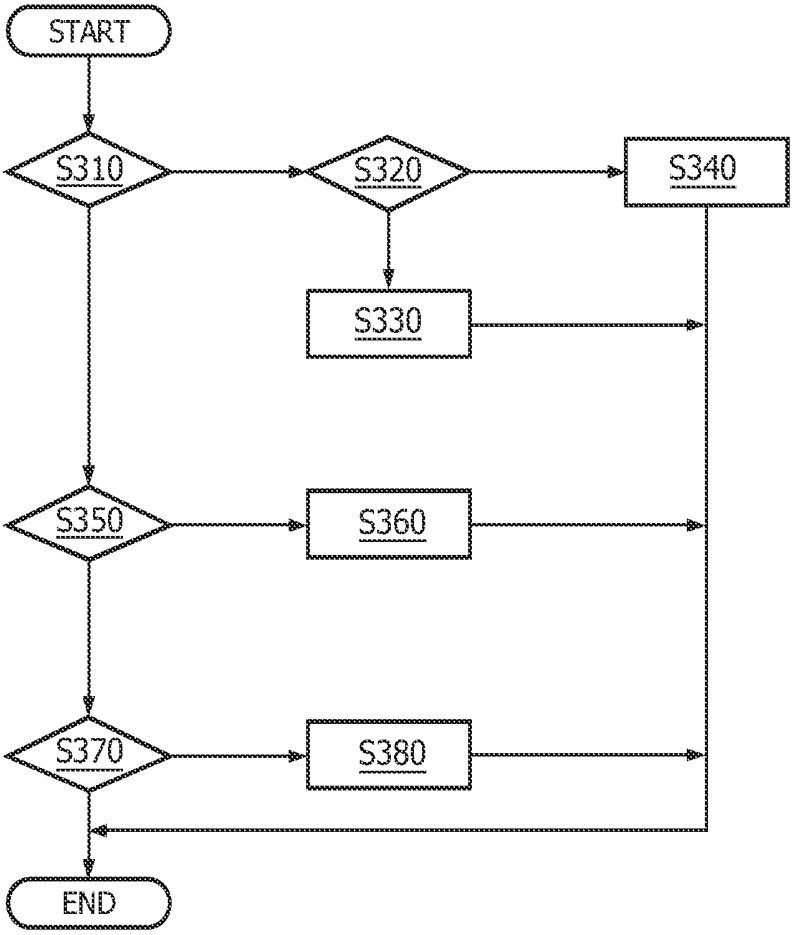


FIG. 3

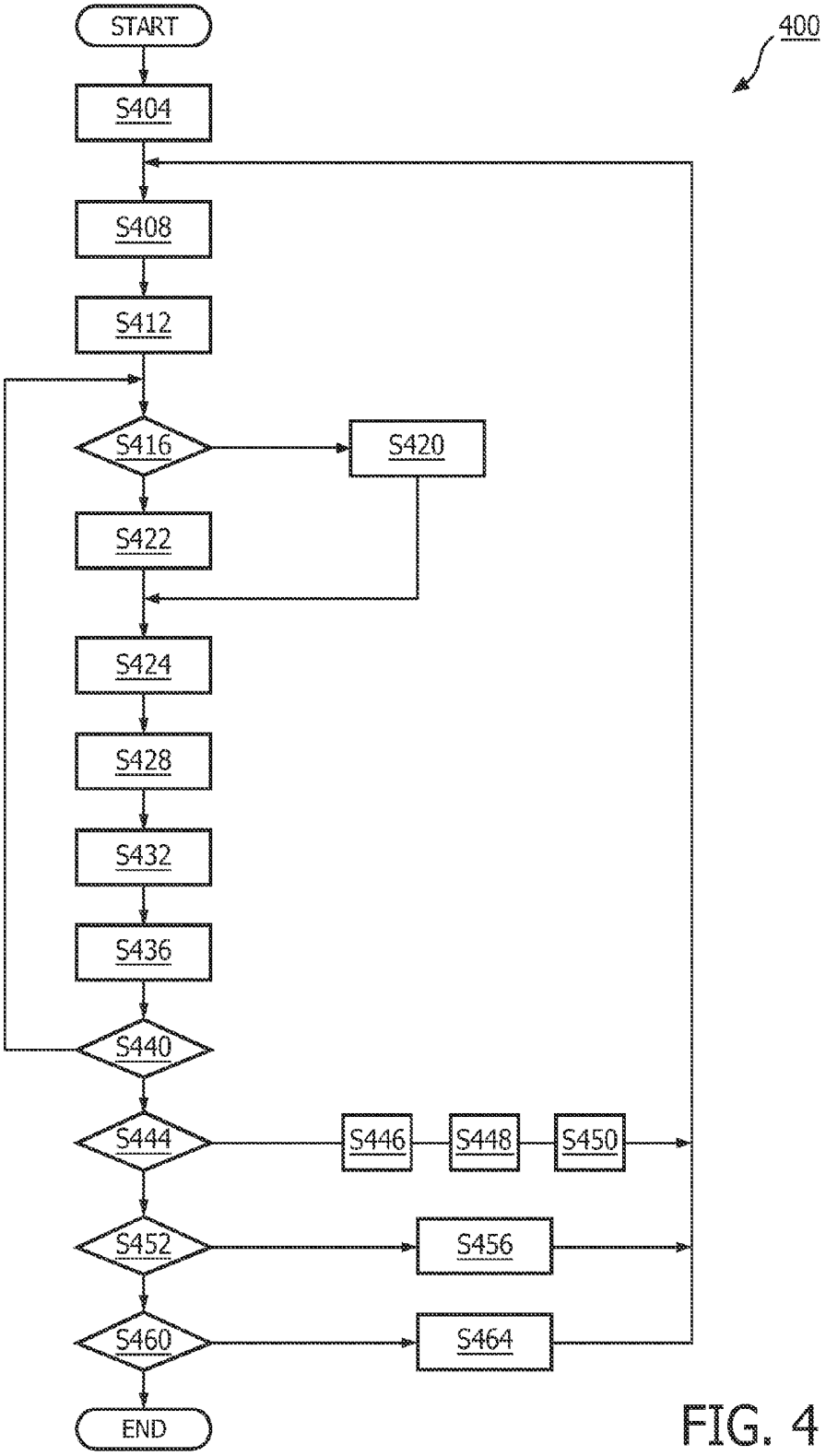

400
START
S404
S408
S412
S416
S420
S422
S424
S428
S432
S436
S440
S444
S446
S448
S450
S452
S456
S460
S464
END

FIG. 4

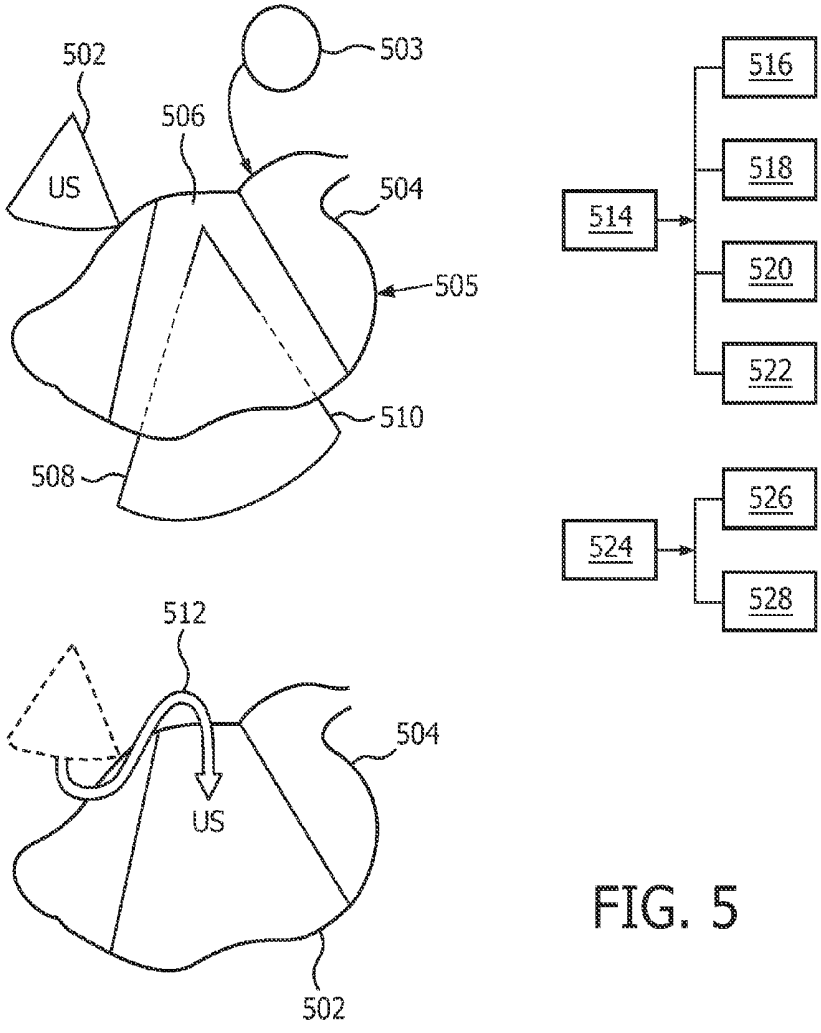

502
503
506
US
504
505
510
508
512
504
US
502
514
516
518
520
522
524
526
528

FIG. 5

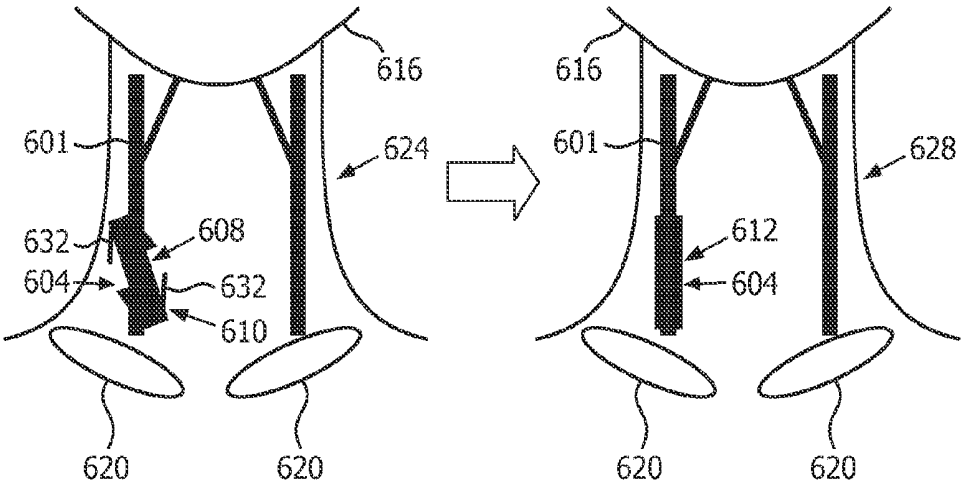

616
601
624
632
608
604
632
610
620
620
616
601
628
612
604
620
620

FIG. 6

ULTRASOUND ACQUISITION FEEDBACK GUIDANCE TO A TARGET VIEW

FIELD OF THE INVENTION

[0001] The present invention relates to ultrasound image matching for user guidance and, more particularly, to such matching to a pre-existing image to achieve a target view.

BACKGROUND OF THE INVENTION

[0002] Successful ultrasound scanning relies strongly on the training and experience of the user. To avoid artifacts, the user has to place the probe in the right position, i.e., to find a good acoustic window, for imaging. Conventionally, this is done solely based on real-time ultrasound images displayed onscreen. Although experienced users are usually capable of recognizing image degradation, and of improving image quality accordingly by moving the probe to a better position, less experienced users might acquire compromised images because of inferior hand-eye coordination and less awareness of artifacts. Acquisition of a set of standard views of a body organ of interest is a challenging task for healthcare workers having little or no background in radiology.

[0003] "Real-Time Scan Assistant for Echocardiography", Snare, S. R. et al., IEEE Transactions in Ultrasonics, Ferroelectrics, and Frequency Control (2012) (hereinafter "the Snare publication") describes an image-processing approach applied to two-dimensional (2D) four-chamber cardiac images to output a metric of the quality of the obtained view.

SUMMARY OF THE INVENTION

[0004] What is proposed herein below is directed to addressing one or more of the above concerns.

[0005] The Snare publication rates the current view, but does not guide the user toward a target view.

[0006] A means by which the clinician can be automatically guided along a path to achieving a target view is needed.

[0007] In accordance with an aspect of the present invention, guidance in acquiring ultrasound imaging of a subject to achieve a target view includes emitting, via an imaging probe, ultrasound to the subject and, in response, receiving a current ultrasound view; matching the received image to a pre-existing image; and, via a user assistance module, generating, based on the matching, feedback for the guidance.

[0008] In a sub-aspect, the target view is a view of a body organ, or vessel, of the subject.

[0009] In another sub-aspect, the generating is performed dynamically or continually.

[0010] In a different sub-aspect, the probe has a current placement, and at least one of showing and instructing occurs on how to move the probe from its current placement so as to thereby realize the achieving of the target view.

[0011] In one sub-aspect, a match between the target view and the received view is detected.

[0012] As a further sub-aspect, an apparatus automatically, and without need for user intervention, performing either or both a) user notification responsive to the detecting of the match; and by acquiring image data, via the probe, responsive to the detecting of the match.

[0013] In one other sub-aspect, the target view is a standard anatomical view that, prior to a time of the guidance, has already been set by an authoritative medical entity.

[0014] In yet another sub-aspect, the feedback is presented.

[0015] As a further sub-aspect of this, the presenting is performed dynamically or continually.

[0016] In still another sub-aspect, the received view is registered to a three-dimensional reference image.

[0017] In a sub-aspect, the registering is performed dynamically or continually.

[0018] In one different sub-aspect, the reference image includes an atlas, an image acquired of the subject via medical imaging, or both the atlas and the image.

[0019] In a further sub-aspect, the atlas includes a statistical atlas.

[0020] As a further sub-aspect with regard to the view registering, an image derived from the reference image, and a graphic indication of a plane of the target view, are concurrently visualized.

[0021] In an additional or complementary sub-aspect of the view registering, there exists concurrent visualization of one or both of the following: the received view fused to an image derived from the reference image; and the received view and an image derived from the reference image, the derived image appearing concurrently and enhanced to spatially indicate where the received view registers to the reference image.

[0022] In another variation as a sub-aspect of the view registering, instruction is provided on how to move the probe for the achieving of the target view. A speaker for the instructing issues audible language instructions, instructions are issued on a display, or both the speaker and the display are provided for these purposes.

[0023] In a particular version of the above-mentioned aspect, a location of the received view in a state space is estimated.

[0024] In a particular sub-version of this, Doppler settings are, automatically by default, initialized according to those that were pre-set for the target view in building a database organized as the state space.

[0025] As a sub-version of this, a selection is made, based on the current ultrasound view, of a respective trajectory in the state space toward the target view.

[0026] As a further sub-version, the feedback is based on the selection.

[0027] In one added sub-version, the selection is made of an optimal trajectory in the state space toward the target view.

[0028] In a specific sub-version, a scanner configured for forming the state space does so by steps that include: acquiring, via the scanner and from multiple imaging subjects, images specialized for a specific body organ or vessel such that the organ or vessel, and/or surrounding tissue, are depicted in all of the plural images; and labeling the images with respective attributes.

[0029] In a further sub-version, forming the state space includes linking, to particular images such as those other than target, i.e., standard, images, respective instructions on how to navigate the probe from the particular image to another one of the images.

[0030] Details of the novel, real-time, interactive visual guidance technology are set forth further below, with the aid of the following drawings, which are not drawn to scale.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031] FIG. **1** is a schematic diagram of an ultrasound clinician interactive guidance apparatus in accordance with the present invention;

[0032] FIG. **2** is a flow chart of overall operation of one implementation of the apparatus of FIG. **1**, in accordance with the present invention;

[0033] FIG. **3** is a flow chart of an example of image matching preparation, in accordance with the present invention;

[0034] FIG. **4** is a flow chart of state space preparation, in accordance with the present invention; and

[0035] FIG. **5** is a conceptual and screen display diagram of examples of user feedback, in accordance with the present invention; and

[0036] FIG. **6** is a conceptual illustration of examples of user feedback and feedback generation, in accordance with the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS

[0037] FIG. **1** depicts, by way of illustrative and non-limitative example, an ultrasound clinician interactive guidance apparatus **100**. The apparatus **100** includes, among other component devices, a controller **104**, an image matching module **108**, a user assistance module **112**, a memory **116**, a scanner **120**, a display **124**, a speaker **128** and user controls **132**. The image matching module **108** includes an image registering module **136** and/or a state space processing module **140**. The scanner includes, among other component devices, an imaging probe **144**.

[0038] Operationally, an overall procedure **200** for ultrasound clinician interactive guidance is as follows, as shown in FIG. **2**. As a preliminary step, an authoritative medical entity such as a physician, medical board, medical standards organization, or hospital sets standard ultrasound views for the body organ, or vessel, of interest (step S**204**). The set of standard views is specified for use on the apparatus **100** (step S**208**). One or more image matching references are prepared (step S**212**) which is explained in more detail below with reference to FIG. **3**. The clinician selects a scan type, which may be for a particular body organ such as the heart, or vessel such a particular artery (step S**216**). The apparatus **100** pulls up the corresponding image matching reference (step S**218**). The apparatus **100** determines which target view from among the standard views is to be acquired next. The apparatus **100** also now loads Doppler settings that have been pre-selected for the target view, as discussed below in connection with FIG. **4**. In short, Doppler settings are, automatically by default, initialized according to those that were pre-set for the target view in building a database organized as the state space (step S**220**). The apparatus **100** indicates to the user how, based on textbook guidelines for example, to place the imaging probe **144** on the superficial anatomy of the imaging subject, such as an animal or human patient (step S**224**). The user, i.e., clinician, positions the probe **144** (step S**228**). If the user guidance function apparatus **100** operates based on a state space (step S**232**), the state space processing module **140** is implemented and makes an estimate of the location, in the state space, of the current, or "live", view acquired via the probe **144** (step S**236**). If, on the other hand, the state space processing module **140** is not implemented (step S**232**) but the image registering module **136** is implemented, the current view is registered to a corresponding position, and orientation, in a three-dimensional (3D) reference image (step S**240**). If it is now determined that the current view does not match, or sufficiently represent, the target view (step S**244**), the apparatus **100** gives user feedback that instructs, or shows, how to proceed toward the goal of achieving the target view (step S**248**), and processing branches back to the user positioning step S**228**. Description in more detail of the feedback is provided further below in the discussion accompanying FIGS. **5** and **6**. If, instead, a match has been attained (step S**244**) and automatic acquisition is to be performed (step S**252**), the current view is recorded for further analysis, e.g., by a physician (step S**256**). If, on the other hand, a match has been attained (step S**244**) and user-actuated acquisition is to be performed (step S**252**), a green light is lit on the probe **144** or elsewhere on the scanner, such as on a console that houses the user controls **132** (step S**260**).

[0039] The image matching reference preparation step (S**212**) is described in more detail in the flow chart of FIG. **3**. With reference to FIG. **3**, if image matching is to be based on a three-dimensional (3D) anatomical atlas as the image matching reference (step S**310**), and the atlas is to be a statistical atlas (step S**320**), a statistical atlas is prepared (step S**330**). The statistical atlas is built based on the computed tomography (CT) and/or magnetic resonance imaging (MR) scans of a wide variety of subjects to cover anatomical variation. It may be stored on a hard drive which is part of the memory **116**. Per voxel, the atlas includes a distribution of image intensities reflective of individual members of the population. Neighboring information is also included for each voxel. Image matching to achieve registration is performed quicker due to the statistical nature of the statistical atlas. If, on the other hand, image matching is to be based on an anatomical atlas that is not a statistical atlas (steps S**310**, S**320**), the anatomical atlas is prepared as the 3D image matching reference, typically via CT and/or MR scans from a wide variety of subjects (step S**340**). If, instead of an atlas (step S**310**), CT and/or MR scans of the same patient are to be used to build the 3D image matching reference (step S**350**), the "same-patient" reference is prepared (step S**360**). If, on the other hand, the same-patient CT/MR scans are not available or are otherwise not to be used (step S**350**), and a state space is to be used (step S**370**), a state space is prepared (step S**380**). Preparation of the state space is described in more detail immediately below in connection with FIG. **4**.

[0040] A state space preparation process **400** involves building a statistical database of a set of hundreds of scans of and around the organ, or vessel, of interest from multiple imaging subjects. The database is organized as a state space. Images to be incorporated into the state space are labeled with attributes such as viewed image anatomy, image quality, and corresponding probe position and orientation on the superficial anatomy. A subset of this set of images is the set of goal states, corresponding to the standard ultrasound views with good image quality. The images of the database can be described as points within a state space whose dimensions are the image attributes. Within the state space, it is possible to define a spatial relationship between ultrasound images, and in particular a trajectory between any ultrasound image and any of the goal images.

[0041] The images to be acquired for incorporation into the state space are specialized for a specific body organ, or vessel, such that the organ or vessel, and/or surrounding tissue, are depicted in each image. The process **400** is initialized to a first imaging subject, a first target view, a first trajectory and a first image (step S**404**). Thus, the respective pointers or counters are zeroed out. A current image is acquired via the imaging probe **144** (step S**408**). Attributes of the image are recorded and the current image is labeled with its attributes (step S**412**). The recording can be done in part automatically and in part via entry by the person building the database. The current

image may be labeled according to: the viewed anatomy (e.g., carotid (left, right, common, internal, external, bulb, bifurcation, proximal, medial, distal, longitudinal, transverse, oblique, etc.) such as jugular vein, thyroid gland, vertebral bodies, vertebral artery, vertebral vein, subclavian artery, etc.; the position and orientation of the probe **144** with respect to the superficial anatomy to obtain these images (e.g., anterior, anterior, posterior, cranial, caudal, lateral, medial, neck, clavicle, mandible, Adam's apple, horizontal, vertical, oblique); optionally the current imaging mode and settings (e.g., for B-mode, power, focal depth, harmonics, spatial compounding; for color flow, gain, maximum velocity, color box orientation, sample volume size; and for spectral Doppler, maximum velocity and Doppler angle); and optionally the presence of artifacts and a measure of image quality (e.g., contact artifacts, good ultrasound contact and average image contrast). Labeling of the current imaging mode and settings is done automatically. Since navigation toward a target view ordinarily would proceed B-mode image to B-mode image, modes such as Doppler can ordinarily be, in effect, withdrawn from the navigation process. For example, these settings can be supplied by default automatically at the outset, as in step S**220** above. The setting values were created according to control adjustments made by the database builder specifically for the target view during database build up. If, in the course of user navigation, the user inadvertently or for whatever reason, changes these settings, the resulting state space distance would automatically at some point of time, or points of time, during navigation, result in feedback offering user instruction for effectively restoring these settings. Alternatively, the target view Doppler settings need not be supplied by default upon initialization; instead, user feedback due to the resulting state space distance would, in the course of user navigation or at the outset, instruct the appropriate adjustments to the settings.

[0042] The current image acquired may have been acquired via ultrasound contact that is less than good. This would be done intentionally, so that matching to this image, once it is in the database, allows the deficient contact to be detected. If the contact is deficient (step S**416**), the person building the database applies or reapplies acoustic coupling medium, such as gel, restores the probe **144** to the same position and orientation with respect to the imaging subject for an improved image (step S**420**). Otherwise, if the contact was not deficient (step S**416**), the database builder, via probe movement or adjustment of imaging settings, prepares for a next image acquisition (step S**422**). The movement or adjustment is made so as to navigate toward the target image.

[0043] In either event, i.e., whether or not contact was sufficient, processing now points to that next image (step S**424**). The image is acquired (step S**428**). The attributes are recorded in part manually and in part automatically (step S**432**). The most recent probe movement, contact adjustment or imaging setting adjustment, ordinarily for B-mode, made in the corresponding above steps S**420**, S**422** is entered or selected by the database builder, or automatically, and linked to the previous image, i.e., the image acquired just prior to step S**428** (step S**436**). The entry could be, with respect to probe position, "left", "right", "up" or "down." Here, "up" would be mean generally in the head to toe direction. The entry could instead or in addition be, with respect orientation, i.e., tilting, "left", "right", "up", or "down." The entry could additionally or instead be, with respect in place rotation of the probe **144**, "clockwise" or "counterclockwise." In each of these options, distance or magnitude need not be recorded, because the updating of the feedback loop in steps S**228** to S**248** occurs in real time. In particular, the database image having the location closest, according to Euclidean distance for example, to the estimate made in step S**236** dynamically keeps the user on a trajectory toward the target view. Even if, during operation, a user wanders into another trajectory, that other trajectory will similary navigate toward the target view. With regard to probe contact, the entry or selection by the database builder may be "reapply gel to probe and return to same position and orientation." For imaging setting changes, the automatic selection may be, for example, "increase imaging depth."

[0044] If the current view is not the target view (step S**440**), processing returns to step S**416**. Otherwise, if the current view is the target view as evidenced by actuation of the appropriate user control **132** by the database builder (step S**440**), and another trajectory is to be recorded for the current target view of the current imaging subject (step S**444**), the database builder is advised, via an onscreen message, to enter Doppler mode settings (step S**446**). Interactively, according to a series of screen prompts and responsive actuations by the database builder, the Doppler settings are stored as attributes of the target view (step S**448**). The trajectory pointer is incremented (step S**450**) and return is made to step S**408**. If, on the other hand, no such further trajectory is to be recorded (step S**444**), but another target view for the current imaging subject is to be used in building up the database (step S**452**), the view pointer is incremented (step S**456**) and return is likewise made to step S**408**. If, however, no target view for the current imaging subject remains in terms of building up the database (step S**452**), but a next imaging subject is to be used in building the database (step S**460**), the subject pointer is incremented (step S**464**) and return is likewise made to step S**408**.

[0045] FIG. **5** provides examples of the user feedback of step S**248**, which can take the form of onscreen illustrations or messages, or audible language.

[0046] An ultrasound image representative of a current view **502** such as a B-mode image can be displayed alongside a cross-sectional image **504** derived from a 3D reference image **503** stored on a hard drive, i.e., from an atlas or from a 3D image constructed from patient-specific CT and/or MR scans. The cross-sectional image **504**, here of a body organ **505**, i.e., the heart, has been sectioned and enhanced to spatially indicate where the received (or "live") view registers to the reference image. Thus an enhanced region **506**, that is colored for example, corresponds spatially with where the current image would cut into the atlas. To show the clinician how to proceed in navigating toward a current target view, a graphic indication **508** of the plane of the current target view **510** can be added to the onscreen presentation. Also, instead of showing the current view **502** as a separate image, the ultrasound image can be fused **512** to the cross-sectional image **504** such as by a pixel for pixel replacement. Here too, the graphic indication **508** can be added.

[0047] Alternatively or in addition, screen messages or audible language instructions can guide the clinician. Thus, for the position/tilt **514** of the probe **144**, four possible indications **516-522** are "right", "left", "up" and "down", just as in the state space based embodiment. Likewise, as in the state space based embodiment, in-place rotation **524** can be "clockwise" **526** or "counterclockwise" **528**.

[0048] The registration in step S**240** involves image-based pattern matching of the current view **502** to the 3D reference image and a coordinate transformation on the current view to

bring it into registration with the 3D image in accordance with the matching. The feedback instructions, based on the transformation, can be representative of a single kind, or more than one kind, of suggested probe movement **514**, **524**.

[0049] For the state space based embodiment, the estimate in step S**236** is made as a result of pattern recognition from comparisons between the current view **502** and the database images acquired in the acquisition steps S**408**, S**428**. The one or more types of feedback instructions (i.e., probe movement, probe contact and imaging settings) linked to the current database image are presented.

[0050] FIG. **6** is a specific example of user feedback and feedback generation. This example relates to the left medial common carotid artery **601** and acquiring a standard view of the artery. A transducer array face graphic **604** is shown in an oblique position **608**, representative of a current placement **610** of the probe **144**, and in a non-oblique position **612**. The transducer array may be a linear array or a matrix array. Mandible graphics **616** and clavicle graphics **620** are also shown in FIG. **6**. A current graphic **624** corresponds conceptually to the current view **502**, and a target graphic **628** corresponds conceptually to the target view **510**. In addition, both graphics **624**, **628** may be displayed onscreen in addition to, or in place of, any other graphic or ultrasound image representative of the current view **502**.

[0051] In the state space embodiment, the viewed anatomy label for a matched database image is "left medial common carotid artery, oblique view." The probe position label is "midway between clavicle and mandible." The clavicle and mandible graphics **616**, **620** represent surrounding tissue. The probe orientation label is "oblique." The imaging mode label is "B-mode." An imaging setting label is "spatial compounding." An artifact label is "artifact-free." An image quality label is "good image contrast", based for example on average pixel intensity. All of the labels can be displayed, on the display **124**, upon matching to the database image **604**.

[0052] If an image quality attribute of the matched database image indicated lack of good probe contact, rather than the actual indication here of "good" probe contact by virtue of good image quality, this current imaging condition could interfere with further matching to database images in navigating a trajectory toward a standard view. Accordingly, improvement of the contact would predominate over other navigational considerations. This would then constitute an example of selecting an optimal trajectory in the state space, and is evidenced by the issuance of a user feedback message like "reapply gel and restore probe to the same location and orientation" that was linked to the current database image in the linking step S**436**.

[0053] However, since the image quality label indicates that contact is good, a different instruction, that was stored during database building in step S**436**, is sent for viewing on the display **124**. The instruction here would be the instruction **526** to "rotate in-place clockwise." This is indicated by illustrative arrows **632**. The resulting movement of the probe **144** by the clinician is, as mentioned herein above, monitored in real time via the feedback loop in steps S**228** to S**248**. The instruction is resent for display repeatedly, but will change in the event of the current view **502** matching to a new database image, such as that corresponding to the target view **510**.

[0054] In the case of the 3D image embodiment, the instruction **526** "rotate clockwise" is derivable almost by definition, since the only transformation involved in registering the current view **502** to the 3D reference image is, in fact, the clockwise rotation. In a less clearcut case, where reaching the target view **510** entails, for instance, probe in-place rotation and translation, whether rotation or translation predominates is decided by the apparatus **100**. The criteria can involve thresholds selected based on empirical experience, although, for example, location will ordinarily dominate over tilting until the probe location is close to that needed for a target view **510**.

[0055] Guidance in acquiring ultrasound imaging of a subject to achieve a target view, such as a standard view, entails emitting ultrasound to the subject and receiving, in response, a current ultrasound view; matching the received image to a pre-existing image, such as a three-dimensional reference image; and, for user assistance, generating, based on the matching, feedback for the guidance. The reference image may be a statistical atlas or it may be derived from patient-specific CT or MR scans. The pre-existing image may instead be a database image corresponding to a state in a state space. The feedback can be an image derived from the reference image; a graphic indication of a plane of the target view; the received view fused to an image derived from the reference image; or the received view and an image derived from said reference image, the derived image appearing concurrently and enhanced to spatially indicate where the received view registers to the reference image. The target view may be a view of a body organ, or vessel, of the subject. Both the atlas and database can be specialized for imaging of a user selected organ, or vessel, and its surrounding tissue.

[0056] In addition to making diagnostic cardiac examination performable by nurses or other clinicians who may be untrained specifically in sonography, the interactive visual guidance apparatus **100** can guide novice sonographers. Alternatively, the novel visual feedback of the apparatus **100** can speed up the work flow of trained or experienced sonographers.

[0057] 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; the invention is not limited to the disclosed embodiments.

[0058] For example, the probe **144** may alternatively or additionally use tactile feedback on the appropriate probe movement toward a standard view.

[0059] Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. Any reference signs in the claims should not be construed as limiting the scope.

[0060] A computer program can be stored momentarily, temporarily or for a longer period of time on a suitable computer-readable medium, such as an optical storage medium or a solid-state medium. Such a medium is non-transitory only in the sense of not being a transitory, propagating signal, but includes other forms of computer-readable media such as register memory, processor cache, RAM and other volatile memory.

[0061] A single processor or other unit may fulfill the functions of several items recited in the claims. 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 to advantage.

1. An apparatus configured for guidance in acquiring ultrasound imaging of a subject to achieve a target view, said apparatus comprising:

an imaging probe for emitting ultrasound to said subject and for, in response, receiving a current ultrasound view;

an image matching module configured for matching the received view to a pre-existing image, wherein said matching estimates a location of said received view in a state space having dimensions that are image attributes; and

wherein said apparatus further includes a user assistance module configured for, responsive to said matching, accessing, relative to said location, a database organized as said state space the accessing to retrieve user feedback for outputting in said guidance.

2. The apparatus of claim **1**, said target view being a view of a body organ, or vessel, of said subject.

3. (canceled)

4. The apparatus of claim **1**, said probe having a current placement, said apparatus configured for, by displaying an outline of a body organ in relation to said received view and said target view, visually showing how to move said probe from its current placement so as to thereby realize the achieving of said target view.

5. (canceled)

6. The apparatus of claim **1**, configured for automatically, and without need for user intervention, acquiring image data, via said probe, responsive to detecting a match between said target view and the received view.

7. The apparatus of claim **1**, said target view being a standard anatomical view that, prior to a time of said guidance, has already been set by an authoritative medical entity.

8. (canceled)

9. (canceled)

10. The apparatus of claim **1**, said image matching module being configured for registering the received view to a three-dimensional reference image (S**240**).

11. The apparatus of claim **10**, configured for performing said registering, dynamically or continually.

12. The apparatus of claim **10**, said reference image comprising an atlas (S**310**), an image acquired of said subject via medical imaging, or both said atlas and said image.

13. The apparatus of claim **12**, said reference image comprising said atlas, said atlas comprising a statistical atlas.

14. The apparatus of claim **10**, configured for concurrently visualizing a) an image derived from said reference image; and b) a graphic indication of a plane of said target view.

15. The apparatus of claim **10**, configured for one or more of visualizing: said received view fused to an image derived from said reference image; and said received view and an image derived from said reference image, the derived image appearing concurrently and enhanced to spatially indicate where said received view registers to said reference image.

16. The apparatus of claim **10**, configured for instructing how to move the probe for the achieving of said target view said apparatus further comprising a speaker for said instructing by issuing audible language instructions, a display for said instructing by issuing instructions on said display, or both said speaker and said display.

17. The apparatus of claim **1**, said image matching module being configured for estimating a location of said received view in a state space.

18. The apparatus of claim **17**, further configured for, automatically by default, initializing Doppler settings according to those that were pre-set for said target view in building a database organized as said state space.

19. The apparatus of claim **17**, said user assistance module being configured for selecting, based on said current ultrasound view, a respective trajectory in said state space toward said target view.

20. The apparatus of claim **19**, said feedback being based on the selection.

21. The apparatus of claim **19**, further configured for said selecting of an optimal trajectory in said state space toward said target view.

22. The apparatus of claim **17**, further comprising a scanner, configured for forming said state space, said forming comprising:

acquiring, via said scanner and from multiple imaging subjects, a plurality of images specialized for a specific body organ, or vessel, such that said organ or vessel, and/or surrounding tissue, are depicted in all of the plural images; and

labeling the plural images with respective attributes.

23. The apparatus of claim **22**, said forming further comprising linking, to particular images from among said plural images, respective instructions on how to navigate said probe from said particular image to another one of said plural images.

24. A computer readable medium embodying a computer program for guidance in acquiring ultrasound imaging of a subject to achieve a target view, said program having instructions executable by a processor for performing a plurality of acts, from among said acts being the acts of:

emitting ultrasound to said subject;

in response,receiving, via an imaging probe, a current ultrasound view;

matching the received view to a pre-existing image (**503**); and,

based on said matching, generating feedback for said guidance.

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专利名称(译)	超声采集反馈指导到目标视图		
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[标]发明人	VIGNON FRANCOIS GUY GERARD MARIE PARTHASARATHY VIJAY ANAND AJAY JAIN AMEET KUMAR		
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摘要(译)

获取对象的超声成像以获得目标视图（例如标准视图）的指导需要向对象发射超声并且响应于接收当前超声视图（ 502 ）;匹配所接收的图像到预先存在的图像，例如三维参考图像（ 503 ）;并且，对于用户协助，基于匹配生成指导的反馈（ 514 - 528 ）。参考图像可以是统计图谱，或者可以源自患者特异性CT或MR扫描。相反，预先存在的图像可以是与状态空间中的状态相对应的数据库图像。反馈可以是从参考图像导出的图像;目标视图的平面的图形指示（ 508 ）;接收的视图融合（ 512 ）到从参考图像导出的图像;或者，所接收的视图和从所述参考图像导出的图像，所导出的图像同时出现并且被增强以在空间上指示所接收的视图在何处登记到参考图像。目标视图（ 510 ）可以是受试者的身体器官或血管的视图。地图集和数据库都可以专门用于器官或血管及其周围组织的成像。