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(54) **IMAGING SYSTEMS AND METHODS FOR POSITIONING A 3D ULTRASOUND VOLUME IN A DESIRED ORIENTATION**

BILDGEBUNGSSYSTEME UND VERFAHREN ZUM POSITIONIEREN EINES 3D-ULTRASCHALLVOLUMENS IN EINER GEWÜNSCHTEN RICHTUNG

SYSTÈMES ET PROCÉDÉS D'IMAGERIE POUR POSITIONNER UN VOLUME ÉCHOGRAPHIQUE 3D DANS UNE ORIENTATION SOUHAITÉE

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Description

[0001] This invention relates to medical diagnostic ultrasound systems and, in particular, to imaging systems and methods for displaying a 3D ultrasound image in a desired view orientation.

[0002] With the advent of high resolution 3D renderings of ultrasound data, diagnostic ultrasound applications have seen continued improvement with better 3D imaging and increased capabilities to identify tissue features not as easily recognized in traditional 2D scanning procedures. Nevertheless, the simplicity and efficiency for certain 3D ultrasound applications still need improvement. For example, an increasingly important expectation is being placed on routine obstetrical ultrasound examinations by mothers that want 3D rendering of their baby's face. Attempting to generate this image is necessary from a business standpoint for many clinicians whose patients will go elsewhere if the service is not available. Unfortunately, obtaining good quality 3D renderings of a baby's face can be a frustrating and time consuming exercise that also takes away from time that can be spent on ultrasound diagnostic scans having more clinical value.

[0003] Document US 2011/125016 A1 relates to fetal rendering in medical diagnostic ultrasound, in which a fetal skeleton in three dimensions is determined from acquired ultrasound data and displayed as a volumetric rendering, which may be visualized from different orientations and allows the addition of lighting queues to better indicate actual size and orientation of bones relative to each other on the rendered image.

[0004] Thus, there is need to arrive at the desired imaging result as quickly as possible and save time for clinically relevant screening of the fetus for various potential anomalies. More generally, there is a need for better methods to display a 3D ultrasound image in a desired view orientation according to settings that are optimal for viewing for a certain ultrasound application. The present invention provides this and more.

[0005] In accordance with the principles of the present invention, methods and systems are provided for displaying a 3D ultrasound image in a desired view orientation. The invention is defined by the independent claims. Advantageous embodiments are provided in the dependent claims. As described further herein, the present invention can include acquiring 3D ultrasound image data comprising an anatomical feature in a patient. In addition, an actual orientation of the anatomical feature can be determined in relation to a transducer probe or other point of interest. For instance, a fetus can be imaged using a 3D ultrasound system and the orientation of the fetus's face can be determined. The present invention further includes displaying the 3D ultrasound image data as a rendering of the anatomical feature such that the anatomical feature is positioned in a selected orientation that is different than the actual orientation. In addition, the anatomical features being rendered can be positioned in spatial relation to a lighting model such that lighting and shadowing regions on the anatomical features are displayed to a user, and in some embodiments, according to a stored setting on an ultrasound system.

[0006] In the drawings:

FIGURE 1 illustrates in block diagram form the use of three dimensional ultrasonic imaging to guide or monitor ablation in an embodiment of the present disclosure.

FIGURE 2 illustrates a workflow in accordance with the present disclosure for displaying 3D ultrasound data a selected orientation.

FIGURE 3 depicts an example ultrasound procedure for identifying anatomical features in a fetus to determine the actual orientation of the fetus in a mother's womb.

FIGURE 4 illustrates a display of different selected orientations of anatomical features that can be stored on an ultrasound system for quick and reproducible viewing by a user.

[0007] Referring to FIG. 1, an ultrasound imaging system 10 constructed in accordance with the principles of the present disclosure is shown in block diagram form. In the ultrasonic diagnostic imaging system of FIG. 1, an ultrasound probe 12 includes a transducer array 14 for transmitting ultrasonic waves and receiving echo information. The transducer array 14, for example, can include a two dimensional array (as shown) of transducer elements capable of scanning in both elevation and azimuth dimensions for 2D and/or 3D imaging. The transducer array 14 is coupled to a microbeamformer 16 in the probe 12 which controls transmission and reception of signals by the transducer elements in the array. In this example, the microbeamformer is coupled by the probe cable to a transmit/receive (T/R) switch 18, which switches between transmission and reception and protects the main beamformer 22 from high energy transmit signals. In some embodiments, the T/R switch 18 and other elements in the system can be included in the transducer probe rather than in a separate ultrasound system base. In some embodiments, the probe 12 can contain all of the components necessary for outputting a video signal that can be simply displayed by an external display. For example, a system may not include a main beamformer 22, and instead beamforming may be completed in the probe 12, and the probe can also include the signal processor 26, the B mode processor 28, and other electronics for processing ultrasound signals.

[0008] As shown, the transmission of ultrasonic beams from the transducer array 14 under control of the microbeamformer 16 is directed by the transmit controller 20 coupled to the T/R switch 18 and the beamformer 22, which receives input from the user's operation of the user interface or control panel 24. One of the functions controlled by the transmit controller 20 is the direction in which beams are steered. Beams may be steered straight ahead from (orthogonal to) the transducer array, or at different angles for a wider field of view. In this embodiment, the partially beamformed signals produced by the microbeamformer 16 are coupled to a main beamformer 22 where partially beamformed signals from individual patches of transducer elements are combined into a fully beamformed signal. Groups of adjacent transducer elements referred to as "patches" or "subarrays" are integrally operated by a microbeamformer (μBF) in the probe 12. Suitable two dimensional arrays are described in, e.g., U.S. Patent 6,419,633 (Robinson et al.) and in U.S. Patent 6,368,281 (Solomon et al.) Microbeamformers are described, e.g., in U.S. Patents 5,997,479 (Savord et al.) and 6,013,032 (Savord).

[0009] The beamformed signals are coupled to a signal processor 26. The signal processor 26 can process the received echo signals in various ways, such as bandpass filtering, decimation, I and Q component separation, and harmonic signal separation. The signal processor 26 may also perform additional signal enhancement such as speckle reduction, signal compounding, and noise elimination. The processed signals are coupled to a B mode processor 28, which can employ amplitude detection for the imaging of anatomical features, such as a baby's face in the mother. The signals produced by the B mode processor are coupled to a 3D image data processor 30, which is configured to generate 3D image datasets that can be rendered and processed by the volume rendering and light model processor 32. As will be described further herein, the volume rendering and light model processor 32 can render an imaged anatomical feature such that the anatomical feature is positioned in a selected orientation that is different than an actual orientation of the feature in relation to the transducer probe 12. The volume rendering and light model processor 32 also can position the orientation of the anatomical feature in spatial relation to a lighting model such that lighting and shadowing regions on the anatomical feature are displayed according to a stored setting on an ultrasound system. As such, the user interface or control panel 24 can be operated by a user to predefine the stored setting on the system and thereby generate the user's desired view of the anatomical feature along with an optimal lighting arrangement for generating renderings of the anatomical feature, such as a baby's face.

[0010] The methods of the present invention are carried out using ultrasound systems as described herein. For example, the ultrasound systems can operate to perform any of the following steps: acquire 3D ultrasound image data comprising an anatomical feature in a patient; determine an actual orientation of the anatomical feature in space; and/or display the 3D ultrasound image data as a rendering comprising the anatomical feature such that the anatomical feature is positioned (1) in a selected orientation that is different than the actual orientation and (2) in spatial relation to a lighting model such that lighting and shadowing regions on the anatomical feature are displayed according to a stored setting on an ultrasound system.

[0011] FIGURE 2 is a flow chart showing the workflow 40 of an implementation of the present disclosure. This workflow 40 begins with a step 42 that includes acquiring 3D ultrasound image data that includes at least a portion of an anatomical feature of interest. For example, as described further herein, a 3D ultrasound imaging system can be used to collect images of a fetus in a mother. The anatomical features of interest might include, but are not limited to, the nose, chin, eyes and/or skull of the fetus. In some embodiments, an anatomical feature of interest might include at least a portion of a patient's organ, such as a heart, kidney or liver.

[0012] In step 44, an ultrasound system can be used to process the 3D ultrasound data such that an actual orientation of the anatomical feature (e.g., a baby's face) can be determined and, optionally, displayed to a user on a screen. This step includes known techniques for performing 3D ultrasound imaging in which the probe transmits and receives echo data from the patient to show a 2D or 3D image of the patient's anatomy on a display. In some embodiments, automated detection of the orientation of the anatomical feature can be accomplished using structural modeling and anatomical landmark identification. In certain embodiments, the present invention can include identifying the actual orientation by applying structural models to define a surface orientation of the anatomical feature and/or identifying anatomical landmarks in the anatomical feature.

[0013] In one aspect, the method for determining the actual orientation of the anatomical feature (e.g., a fetus' face) follows the methods described in Cuignet et al., 2013 IEEE Symposium on Biomedical Imaging, pages 768-771. The method of determining actual orientation can include, for example, identifying anatomical features of a fetus that are echogenic independently of the probe position: the skull, the midsagittal plane and the orbits of the eyes. The skull can be detected and segmented using a shape model and a template deformation algorithm. An initial anatomical frame of reference can thus be defined. Then, the detection of both the midsagittal plane and orbits of the eyes allows to remove orientation ambiguities and eventually to refine this frame of reference.

[0014] Other features may also be detected and used to determine actual orientation. For example, the face and other landmarks can be detected. As shown in FIG. 3, an ultrasound image plane 50 corresponding to the sagittal plane can be acquired by traditional scanning of the mother 52 with an ultrasound probe 54. The forehead 56, the nose 58 and the chin 60 of the fetus can be identified using, e.g., learning-based algorithms or other models. In some embodiments, other structures such as the hypothalamus, the nasal bone end, the palatine bones, and/or the cheekbone can be identified and used to determine the fetal orientation. Upon identification of the relative positions of the various anatomical features of the fetus, the actual orientation of the fetus can be determined and, in some embodiments, displayed to the user. With respect to a fetal face, for example, embodiments of the present invention further include automated sculpting away of ultrasound data representing tissue that is not part of the facial tissue. This can be accomplished by different techniques, such as by application of the same structural model that can be applied to orient the fetal head.

[0015] As provided herein, the present invention in-part provides a quick and easy technique to display anatomical features at a desired orientation without time-consuming interaction by the sonographer during a scan. For example, instead of displaying the image of an anatomical feature in the actual orientation with respect to the probe, Step 46 of the workflow 40 includes displaying the 3D ultrasound data including the anatomical feature at a selected orientation that is different than the actual orientation. For example, a sonographer may image a fetus such that the fetus's face is actually oriented directly looking at the transducer probe. However, for better viewing of features of the fetus's face the sonographer may desire that the image be displayed at a different selected orientation in which the fetus's face is at an angle to the transducer probe. Moreover, as shown in Step 48, a lighting model can be used to add shadowing and/or lighting aspects to the 3D rendered ultrasound data displayed to the sonographer. In some embodiments, the lighting model can include one or more lights that are positioned in 3D space with respect to the rendered 3D volume of the anatomical feature, e.g., the fetus. The lights in the lighting model can be manually positioned by the user or they can be included in a standard set of positions that provide the optimal lighting and shadowing for a particular orientation of the 3D rendered ultrasound volume. In certain embodiments, relative intensities of the lighting and shadowing can be tuned by the user after displaying the 3D ultrasound image data. Furthermore, the selected orientation of the anatomical features as well as the lighting models can be saved on the system for later use and reference.

[0016] As described herein, the present invention includes displaying 3D ultrasound image data as a rendering that includes an anatomical feature of interest. In certain embodiments, the anatomical feature is positioned in a selected orientation that is different than the actual orientation, e.g. by the volume rendering and lighting model processor in FIG. 1. The anatomical feature can also be positioned in spatial relation to a lighting model such that lighting and shadowing regions on the anatomical feature are displayed according to a stored setting on an ultrasound system. In some embodiments, the stored setting for the positioning and lighting model details can be generated by a user selecting the selected orientation from a plurality of displayed orientation views. In addition, the stored setting can be configured to be used for a plurality of sequential ultrasound scans. For instance, the same selected orientation can be used for sequential patient scans such that each baby face ultrasound image has the same orientation and same lighting model for different patients. This aspect can improve throughput, for example, with scanning procedures such that a sonographer does not have to spend time orienting the rendering and lighting. Instead, the system of the present invention has a stored setting, which can be selected by a user, that initiates these steps automatically.

[0017] FIG. 4 illustrates an embodiment of the present invention in which an ultrasound system includes three stored settings that show selecte6d orientations of the baby's face rendered in 3D and having different lighting models to highlight certain features of the baby's face. The display 62, for example, includes three thumbnail images 64 that show real-time renderings of the 3D ultrasound image data acquired of a baby's face. Each of the selected orientations 66 of the baby's face can be displayed to a user and the user can select the desired orientation among the three. After selection, e.g., using a touchscreen input, mouse or other input device, the selected orientation of interest can be displayed in a fuller view 68 to the user. The image of the baby's face can be simply saved and printed or provided electronically to a mother.

The stored settings on the system may be provided by default on an ultrasound system. Alternatively, a sonographer or other clinician can manually define the selected orientations and store those settings on the system for later use, e.g., as shown in FIG. 4. It is noted that the present invention can also be applied for viewing other tissue structures in a fetus, such as a hand or foot. In another example, a heart could be imaged similar to the fetus as described herein. A heart model could be used to identify the orientation of the heart, and a selected orientation could be used to show the heart at a different orientation than the actual orientation shown in the acquired 3D ultrasound data. The selected orientations could be designed such that a specific chamber of the heart is always displayed in a certain orientation, and in addition with lighting and shadowing to better view specific tissue areas of the heart for better diagnostic capabilities.

[0018] It will be understood that the examples and embodiments described herein are for illustrative purposes and that various modifications or changes in light thereof may be suggested to persons skilled in the art. In addition, all features discussed in connection with any one embodiment herein can be readily adapted for use in other embodiments herein. The use of different terms or reference numerals for similar features in different embodiments does not necessarily imply differences other than those which may be expressly set forth. Accordingly, the present invention is intended to be described solely by reference to the appended claims, and not limited to the preferred embodiments disclosed herein.

Claims

1. A method for displaying a 3D ultrasound image in a desired view orientation, the method comprising:

acquiring (42), with a transducer probe (12,54) comprised in an ultrasound system, 3D ultrasound image data comprising an anatomical feature in a patient;
determining (44) by the ultrasound system (10) an actual orientation of the anatomical feature in relation to the transducer probe;
wherein the ultrasound system comprises a plurality of stored settings, each stored setting defining an orientation of the anatomical feature and a lighting model for generating lighting and shadowing on the anatomical feature;
displaying (46) the 3D ultrasound image data as a rendering comprising the anatomical feature such that the anatomical feature is positioned in a selected orientation that is different than the actual orientation and in spatial relation to a lighting model such that lighting and shadowing regions on the anatomical feature are displayed, the orientation and lighting model corresponding to a selected stored setting from the plurality of stored settings;
wherein the method comprises selecting by a user the selected stored setting upon displaying a plurality of real-time renderings (64) of the 3D ultrasound image data comprising the anatomical feature, each real-time rendering showing a different orientation of the anatomical feature and a different lighting model according to each one of the settings stored on the ultrasound system.

2. The method of claim 1, wherein the method further comprises displaying a rendering of the 3D ultrasound image data comprising the anatomical feature in an orientation corresponding to the actual orientation.

3. The method of claim 1, further comprising using the selected stored setting for subsequent ultrasound scans for different patients.

4. The method of claim 1, wherein determining (44) the actual orientation comprises applying structural models to define a surface orientation of the anatomical feature, identifying anatomical landmarks in the anatomical feature, or a combination thereof.

5. The method of claim 1, further comprising tuning relative intensities of lighting and shadowing by a user after displaying the 3D ultrasound image data as a rendering.

6. The method of claim 1, wherein the anatomical feature comprises at least a portion of a face of a fetus.

7. An ultrasound system (10) for displaying a 3D ultrasound image volume in a desired view orientation, the system comprising:

a transducer probe (12,54) configured to acquire 3D ultrasound image data comprising an anatomical feature in a patient;
a plurality of stored settings, each stored setting defining an orientation of the anatomical feature and a lighting model for generating lighting and shadowing on the anatomical feature;
a volume rendering and light model processor (32);
a display (36, 62);
an input device;
wherein the volume rendering and light model processor (32) is configured to determine an actual orientation of the anatomical feature in relation to the transducer probe (12,54), and to generate a rendering of the 3D ultrasound image data comprising the anatomical feature such that the anatomical feature is positioned in a selected orientation that is different than the actual orientation and in spatial relation to a lighting model such that lighting and shadowing regions on the anatomical feature are displayed, the orientation and lighting model corresponding to a selected stored setting from the plurality of stored settings;
wherein the volume rendering and light model processor (32) is further configured to generate a plurality of real-time renderings (64) of the 3D ultrasound image data comprising the anatomical feature, each real-time rendering showing a different orientation of the anatomical feature and a different lighting model according to each one of the settings stored on the ultrasound system;
wherein the display is configured to display the plurality of real-time renderings (64) of the 3D ultrasound image data;
wherein the input device is configured to allow a user to select the selected stored setting from the plurality of stored settings upon displaying on the display the plurality of real-time renderings (64).

8. The ultrasound system of claim 7, wherein the ultrasound system is further configured to display on the display a rendering of the 3D ultrasound image data comprising the anatomical feature in an orientation corresponding to the actual orientation.

9. The ultrasound system of claim 7, wherein determining the actual orientation comprises applying structural models to define a surface orientation of the anatomical feature, identifying anatomical landmarks in the anatomical feature, or a combination thereof.

10. The ultrasound system of claim 7, wherein the anatomical feature comprises at least a portion of a face of fetus.

11. The ultrasound system of claim 10, wherein the volume rendering and light model processor (32) is further configured to remove at least some of the 3D ultrasound image data representing tissue that is not facial tissue of the face of the fetus.

Patentansprüche

1. Verfahren zum Anzeigen eines 3D-Ultraschallbilds in einer gewünschten Ansichtausrichtung, wobei das Verfahren Folgendes umfasst:

Erfassen (42), mit einer in einem Ultraschallsystem enthaltenen Wandlersonde (12, 54), von 3D-Ultraschallbilddaten umfassend ein anatomisches Merkmal in einem Patienten;
Ermitteln (44), durch das Ultraschallsystem (10), einer tatsächlichen Ausrichtung des anatomischen Merkmals in Bezug auf die Wandlersonde;
wobei das Ultraschallsystem eine Vielzahl von gespeicherten Einstellung umfasst, wobei jede gespeicherte Einstellung eine Ausrichtung des anatomischen Merkmals und ein Beleuchtungsmodell zum Erzeugen von Beleuchtung und Verschattung auf dem anatomischen Merkmal definiert;
Anzeigen (46) der 3D-Ultraschallbilddaten als ein Rendering umfassend das anatomische Merkmal derart, dass das anatomische Merkmal in einer ausgewählten Ausrichtung, die sich von der tatsächlichen Ausrichtung unterscheidet, und in räumlichem Bezug zu einem Beleuchtungsmodell positioniert wird, so dass Licht- und Schattenregionen auf dem anatomischen Merkmal angezeigt werden, wobei die Ausrichtung und das Beleuchtungsmodell einer ausgewählten gespeicherten Einstellung aus der Vielzahl von gespeicherten Einstellungen entsprechen;
wobei das Verfahren das Auswählen, durch einen Benutzer, der ausgewählten gespeicherten Einstellung auf das Anzeigen einer Vielzahl von Echtzeit-Renderings (64) der 3D-Ultraschallbilddaten umfassend das anatomische Merkmal hin umfasst, wobei jedes Echtzeit-Rendering eine unterschiedliche Ausrichtung des anatomischen Merkmals und ein unterschiedliches Beleuchtungsmodell gemäß jeder der in dem Ultraschallsystem gespeicherten Einstellungen zeigt.

2. Verfahren nach Anspruch 1, wobei das Verfahren ferner das Anzeigen eines Renderings der 3D-Ultraschallbilddaten umfassend das anatomische Merkmal in einer Ausrichtung umfasst, die der tatsächlichen Ausrichtung entspricht.

3. Verfahren nach Anspruch 1, ferner umfassend das Verwenden der ausgewählten gespeicherten Einstellung für nachfolgende Ultraschall-Scans für unterschiedliche Patienten.

4. Verfahren nach Anspruch 1, wobei das Ermitteln (44) der tatsächlichen Ausrichtung das Anwenden von strukturellen Modellen, um eine Oberflächenausrichtung des anatomischen Merkmals zu definieren, das Identifizieren von anatomischen Orientierungspunkten in dem anatomischen Merkmal oder eine Kombination hiervon umfasst.

5. Verfahren nach Anspruch 1, ferner umfassend das Abstimmen von relativen Intensitäten von Beleuchtung und Verschattung durch einen Benutzer nach dem Anzeigen der 3D-Ultraschallbilddaten als ein Rendering.

6. Verfahren nach Anspruch 1, wobei das anatomische Merkmal mindestens einen Teil des Gesichts eines Fötus umfasst.

7. Ultraschallsystem (10) zum Anzeigen eines 3D-Ultraschallbildvolumens in einer gewünschten Ansichtausrichtung, wobei das System Folgendes umfasst:

eine Wandlersonde (12, 54), die konfiguriert ist, um 3D-Ultraschallbilddaten umfassend ein anatomisches Merkmal in einem Patienten zu erfassen;
eine Vielzahl von gespeicherten Einstellungen, wobei jede gespeicherte Einstellung eine Ausrichtung des anatomischen Merkmals und ein Beleuchtungsmodell zum Erzeugen von Beleuchtung und Verschattung auf dem anatomischen Merkmal definiert;
einen Volumenrendering- und Lichtmodellprozessor (32);
eine Anzeige (36, 62);
eine Eingabevorrichtung;
wobei der Volumenrendering- und Lichtmodellprozessor (32) konfiguriert ist, um eine tatsächliche Ausrichtung des anatomischen Merkmals in Bezug auf die Wandlersonde (12, 54) zu ermitteln und um ein Rendering der 3D-Ultraschallbilddaten umfassend das anatomische Merkmal derart zu erzeugen, dass das anatomische Merkmal in einer ausgewählten Ausrichtung, die sich von der tatsächlichen Ausrichtung unterscheidet, und in räumlichem Bezug zu ei-

nem Beleuchtungsmodell positioniert wird, so dass Licht- und Schattenregionen auf dem anatomischen Merkmal angezeigt werden, wobei die Ausrichtung und das Beleuchtungsmodell einer ausgewählten gespeicherten Einstellung aus der Vielzahl von gespeicherten Einstellungen entsprechen;
wobei der Volumenrendering- und Lichtmodellprozessor (32) ferner konfiguriert ist, um eine Vielzahl von Echtzeit-Renderings (64) der 3D-Ultraschallbilddaten umfassend das anatomische Merkmal zu erzeugen, wobei jedes Echtzeit-Rendering eine unterschiedliche Ausrichtung des anatomischen Merkmals und ein unterschiedliches Beleuchtungsmodell gemäß jeder der in dem Ultraschallsystem gespeicherten Einstellungen zeigt;
wobei die Anzeige konfiguriert ist, um die Vielzahl von Echtzeit-Renderings (64) der 3D-Ultraschallbilddasten anzuzeigen;
wobei die Eingabevorrichtung konfiguriert ist, um einem Benutzer zu erlauben, auf das Anzeigen der Vielzahl von Echtzeit-Renderings (64) auf der Anzeige hin die ausgewählte gespeicherte Einstellung aus der Vielzahl von gespeicherten Einstellungen auszuwählen.

8. Ultraschallsystem nach Anspruch 7, wobei das Ultraschallsystem ferner konfiguriert ist, um auf der Anzeige ein Rendering der 3D-Ultraschallbilddaten umfassend das anatomische Merkmal in einer Ausrichtung anzuzeigen, die der tatsächlichen Ausrichtung entspricht.

9. Ultraschallsystem nach Anspruch 7, wobei das Ermitteln der tatsächlichen Ausrichtung das Anwenden von strukturellen Modellen, um eine Oberflächenausrichtung des anatomischen Merkmals zu definieren, das Identifizieren von anatomischen Orientierungspunkten in dem anatomischen Merkmal oder eine Kombination hiervon umfasst.

10. Ultraschallsystem nach Anspruch 7, wobei das anatomische Merkmal mindestens einen Teil des Gesichts eines Fötus umfasst.

11. Ultraschallsystem nach Anspruch 10, wobei der Volumenrendering- und Lichtmodellprozessor (32) ferner konfiguriert ist, um mindestens einige der 3D-Ultraschallbilddaten zu entfernen, die Gewebe darstellen, das kein Gesichtsgewebe des Gesichts des Fötus ist.

Revendications

1. Procédé d'affichage d'une image échographique 3D dans une orientation visuelle souhaitée, le procédé comprenant :

l'acquisition (42), avec une sonde de transducteur (12, 54) comprise dans un système échographique, de données d'image échographique 3D comprenant une caractéristique anatomique chez un patient ;
la détermination (44) par le système échographique (10) d'une orientation réelle de la caractéristique anatomique en relation avec la sonde de transducteur ;
dans lequel le système échographique comprend une pluralité de réglages mémorisés, chaque réglage mémorisé définissant une orientation de la caractéristique anatomique et un modèle d'éclairage pour générer un éclairage et un ombrage sur la caractéristique anatomique ;
l'affichage (46) des données d'image échographique 3D sous la forme d'un rendu comprenant la caractéristique anatomique de sorte que la caractéristique anatomique soit positionnée dans une orientation sélectionnée qui est différente de l'orientation réelle et en relation spatiale avec un modèle d'éclairage de sorte que des régions d'éclairage et d'ombrage sur la caractéristique anatomique soient affichées, le modèle d'orientation et d'éclairage correspondant à un réglage mémorisé sélectionné à partir de la pluralité de réglages mémorisés ;
dans lequel le procédé comprend la sélection par un utilisateur du réglage mémorisé sélectionné lors de l'affichage d'une pluralité de rendus en temps réel (64) des données d'image échographique 3D comprenant la caractéristique anatomique, chaque rendu en temps réel montrant une orientation différente de la caractéristique anatomique et un modèle d'éclairage différent selon l'un quelconque des réglages mémorisés sur le système échographique.

2. Procédé selon la revendication 1, dans lequel le procédé comprend en outre l'affichage d'un rendu des données d'image échographique 3D comprenant la caractéristique anatomique dans une orientation correspondant à l'orientation réelle.

3. Procédé selon la revendication 1, comprenant en outre l'utilisation du réglage mémorisé sélectionné pour des balayages échographiques suivants pour différents patients.

4. Procédé selon la revendication 1, dans lequel la détermination (44) de l'orientation réelle comprend l'application de modèles structuraux pour définir une orientation de surface de la caractéristique anatomique, l'identification de repères anatomiques dans la caractéristique anatomique, ou une combinaison de celles-ci.

5. Procédé selon la revendication 1, comprenant en outre l'ajustement d'intensités relatives d'éclairage et d'ombrage par un utilisateur après l'affichage des données d'image échographique 3D sous la forme d'un rendu.

6. Procédé selon la revendication 1, dans lequel la caractéristique anatomique comprend au moins une partie d'une face d'un foetus.

7. Système échographique (10) pour afficher un volume d'image échographique 3D dans une orientation visuelle souhaitée, le système comprenant :

une sonde de transducteur (12, 54) configurée pour acquérir des données d'image échographique 3D comprenant une caractéristique anatomique chez un patient ;
une pluralité de réglages mémorisés, chaque réglage mémorisé définissant une orientation de la caractéristique anatomique et un modèle d'éclairage pour générer un éclairage et un ombrage sur la caractéristique anatomique ;
un processeur de rendu de volume et de modèle d'éclairage (32) ;
un dispositif d'entrée (36, 62) ;
dans lequel le processeur de rendu de volume et de modèle d'éclairage (32) est configuré pour déterminer une orientation réelle de la caractéristique anatomique en relation avec la sonde de transducteur (12, 54), et pour générer un rendu des données d'image échographique 3D comprenant la caractéristique anatomique de sorte que la caractéristique anatomique soit positionnée dans une orientation sélectionnée qui est différente de l'orientation réelle et en relation spatiale avec un modèle d'éclairage de sorte que des régions d'éclairage et d'ombrage sur la caractéristique anatomique soient affichées, le modèle d'orientation et d'éclairage correspondant à un réglage mémorisé sélectionné à partir de la pluralité de réglages mémorisés ;
dans lequel le processeur de rendu de volume et de modèle d'éclairage (32) est en outre configuré pour générer une pluralité de rendus en temps réel (64) des données d'image échographique 3D comprenant la caractéristique anatomique, chaque rendu en temps réel montrant une orientation différente de la caractéristique anatomique et un modèle d'éclairage différent selon l'un quelconque des réglages mémorisés sur le système échographique ;
dans lequel l'écran est configuré pour afficher la pluralité de rendus en temps réel (64) des données d'image échographique 3D ;
dans lequel le dispositif d'entrée est configuré pour permettre à un utilisateur de sélectionner le réglage mémorisé sélectionné à partir de la pluralité de réglages mémorisés lors de l'affichage sur l'écran de la pluralité de rendus en temps réel (64).

8. Système échographique selon la revendication 7, dans lequel le système échographique est en outre configuré pour afficher sur l'écran un rendu des données d'image échographique 3D comprenant la caractéristique anatomique dans une orientation correspondant à l'orientation réelle.

9. Système échographique selon la revendication 7, dans lequel la détermination de l'orientation réelle comprend l'application de modèles structuraux pour définir une orientation de surface de la caractéristique anatomique, l'identification de repères anatomiques dans la caractéristique anatomique, ou une combinaison de celles-ci.

10. Système échographique selon la revendication 7, dans lequel la caractéristique anatomique comprend au moins une partie d'une face d'un foetus.

11. Système échographique selon la revendication 10, dans lequel le processeur de rendu de volume et de modèle d'éclairage (32) est en outre configuré pour éliminer au moins certaines des données d'image échographique 3D représentant un tissu qui n'est pas un tissu facial de la face du foetus.

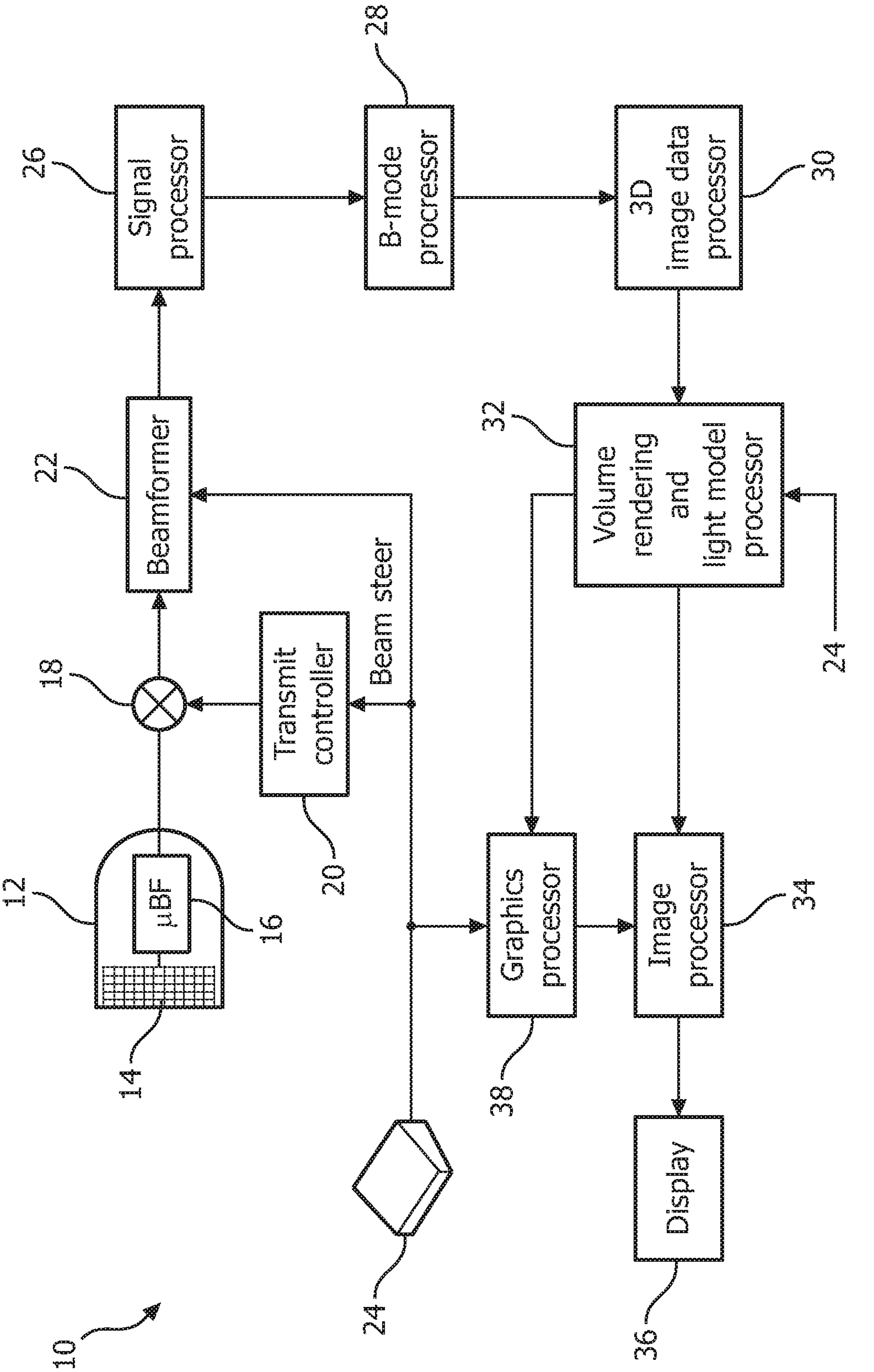
10
12
14
μBF
16
18
Transmit controller
20
Beam steer
Beamformer
22
Signal processor
26
B-mode procressor
28
3D image data processor
30
Volume rendering and light model processor
32
24
Graphics processor
38
Image processor
34
Display
36
24

FIG. 1

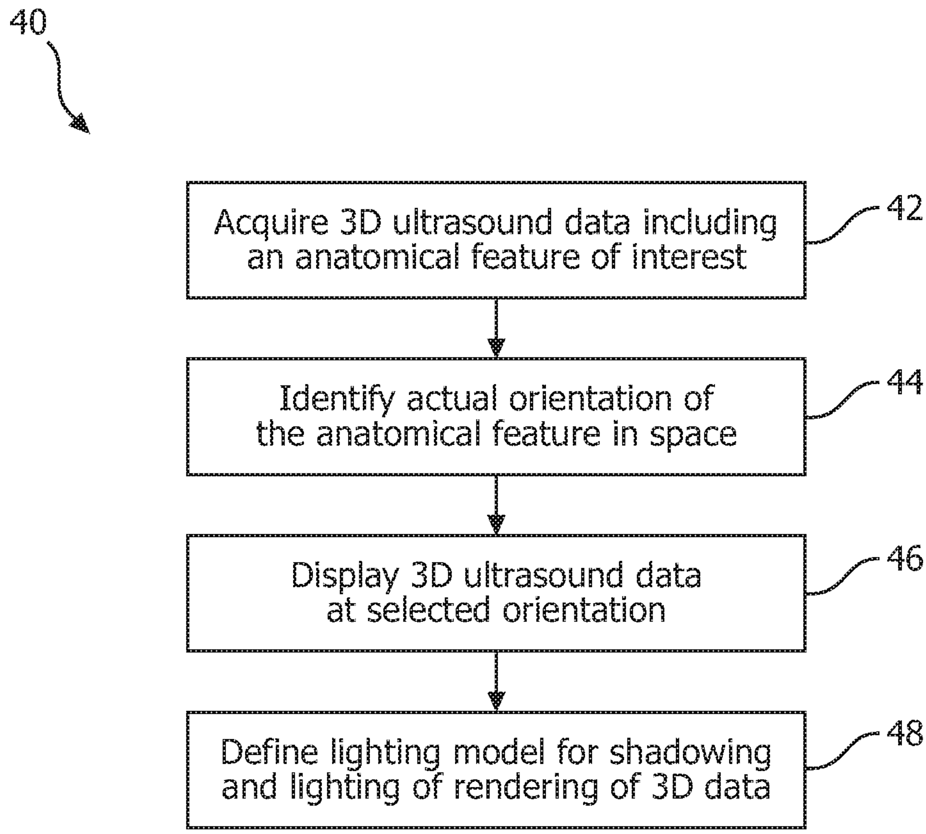
40
Acquire 3D ultrasound data including an anatomical feature of interest
42
Identify actual orientation of the anatomical feature in space
44
Display 3D ultrasound data at selected orientation
46
Define lighting model for shadowing and lighting of rendering of 3D data
48

FIG. 2

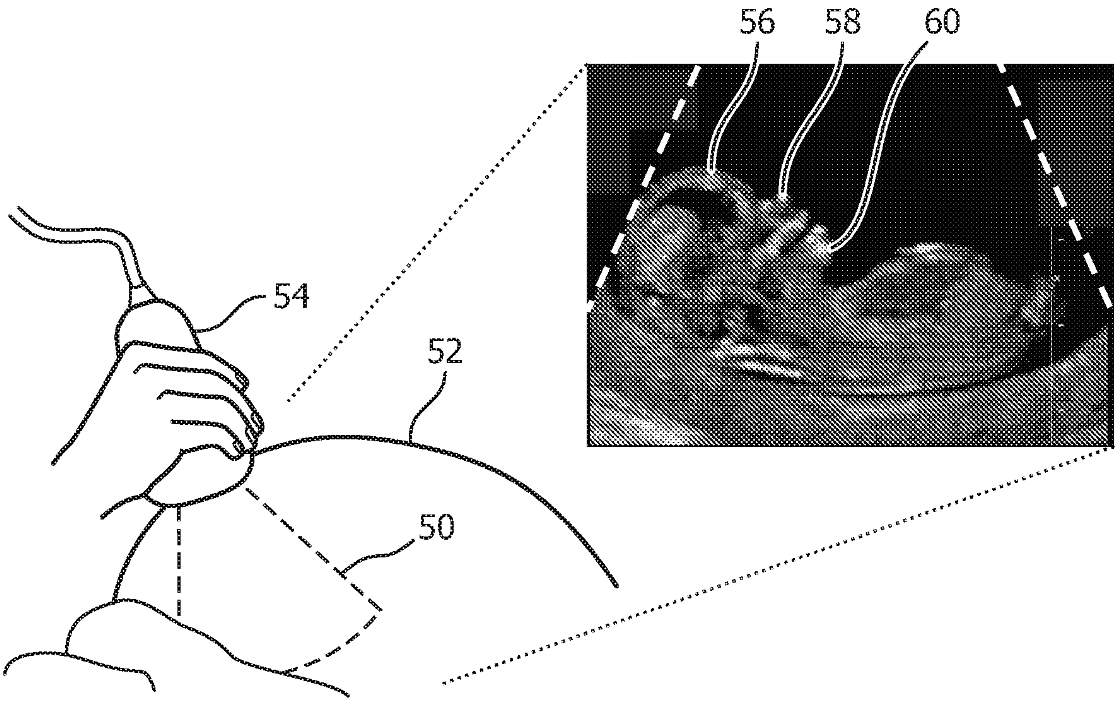

FIG. 3

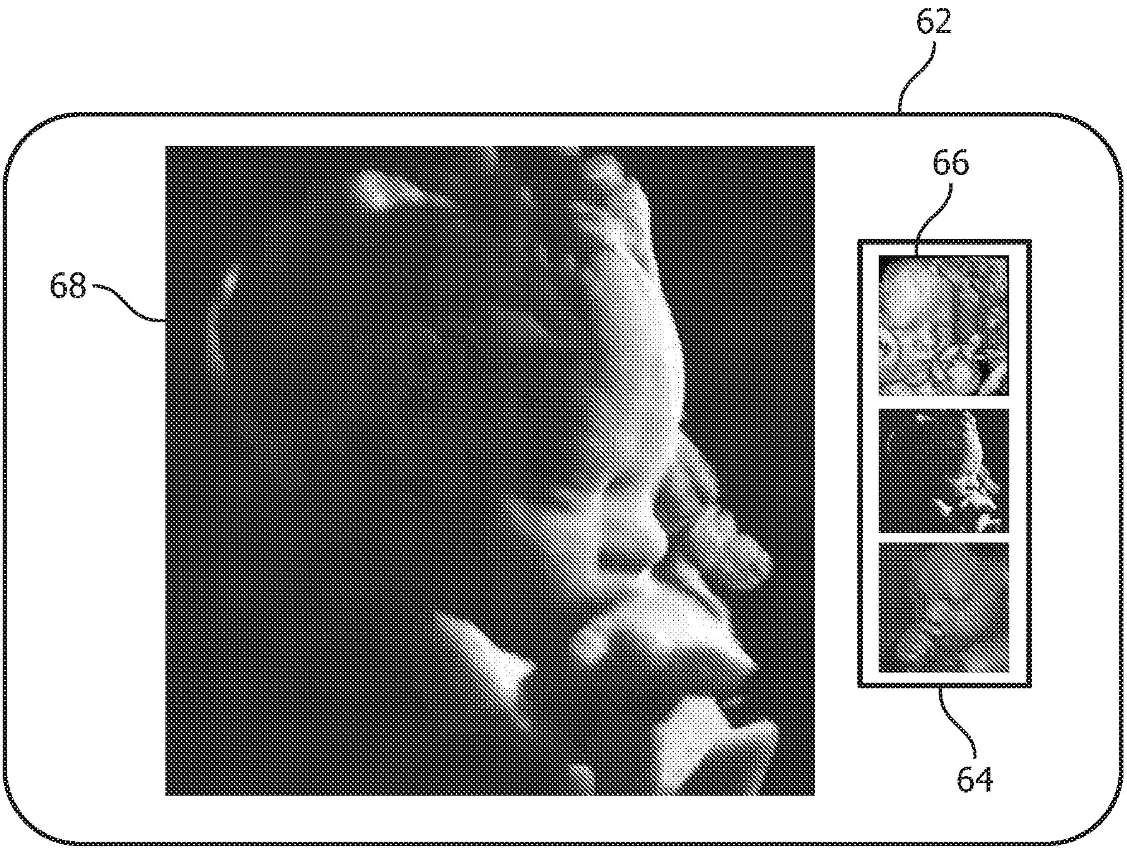

FIG.4

REFERENCES CITED IN THE DESCRIPTION

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Non-patent literature cited in the description

- **CUIGNET et al.** *IEEE Symposium on Biomedical Imaging,* 2013, 768-771 **[0013]**

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专利名称(译)	用于将3D超声体积定位在期望取向的成像系统和方法		
公开(公告)号	EP3139838B1	公开(公告)日	2018-12-19
申请号	EP2015726728	申请日	2015-05-09
[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N.V.		
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[标]发明人	ROUNDHILL DAVID NIGEL		
发明人	ROUNDHILL, DAVID NIGEL		
IPC分类号	A61B8/00 A61B8/08 G06T15/50		
CPC分类号	A61B8/0866 A61B8/4245 A61B8/466 A61B8/483 A61B8/5215 G06T19/20 G06T2219/2004 G16H50/20		
代理机构(译)	STEFFEN , THOMAS		
优先权	61/990740 2014-05-09 US		
其他公开文献	EP3139838A1		
外部链接	Espacenet		

摘要(译)

提供了用于以期望的视图方向显示3D超声图像体积的方法和系统。可以获取患者的解剖学特征的3D超声图像。可以在空间中确定解剖特征的实际取向。可以显示包括解剖特征的3D超声图像，使得解剖特征定位在与实际取向不同的选定取向上，并且与用于在解剖特征上产生照明和遮蔽的照明模型相关。

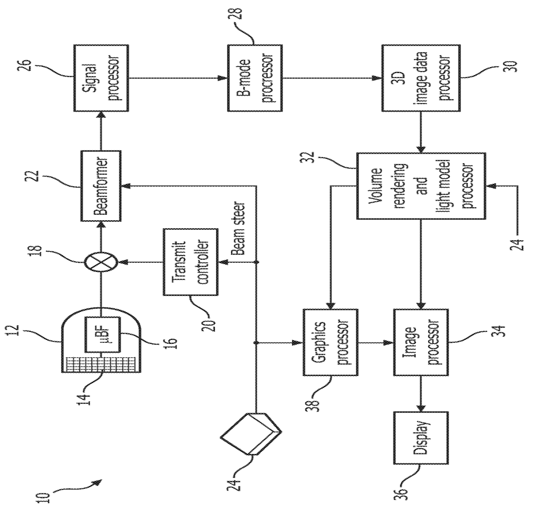

FIG. 1