



(11) **EP 1 965 704 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention
of the grant of the patent:
21.11.2012 Bulletin 2012/47

(21) Application number: **06835459.6**

(22) Date of filing: **27.12.2006**

(51) Int Cl.:
A61B 8/00 (2006.01) G01S 15/89 (2006.01)

(86) International application number:
PCT/KR2006/005757

(87) International publication number:
WO 2007/075040 (05.07.2007 Gazette 2007/27)

(54) **METHOD OF ACQUIRING AN ULTRASOUND IMAGE**

VERFAHREN ZUR ERFASSUNG EINES ULTRASCHALLBILDS

PROCEDE D'ACQUISITION D'UNE IMAGE ULTRASONORE

(84) Designated Contracting States:
DE FR IT

(30) Priority: **28.12.2005 KR 20050131562**

(43) Date of publication of application:
10.09.2008 Bulletin 2008/37

(73) Proprietor: **Samsung Medison Co., Ltd.**
Kangwon-do 250-870 (KR)

(72) Inventors:
• **JEONG, Mok Keun**
Seoul 139-768 (KR)
• **KWON, Sung Jae**
Seoul 130-781 (KR)
• **YOON, Ra Young**
Seoul 135-280 (KR)

(74) Representative: **Schmid, Wolfgang**
Lorenz & Kollegen
Patentanwälte Partnerschaftsgesellschaft
Alte Ulmer Strasse 2
89522 Heidenheim (DE)

(56) References cited:
US-A- 4 972 838 US-A- 5 129 399
US-B2- 6 971 992

- **ANDERSON M E ET AL:** "The impact of sound speed errors on medical ultrasound imaging", **THE JOURNAL OF THE ACOUSTICAL SOCIETY OF AMERICA, AMERICAN INSTITUTE OF PHYSICS FOR THE ACOUSTICAL SOCIETY OF AMERICA, NEW YORK, NY, US, vol. 107, no. 6, 1 June 2000 (2000-06-01), pages 3540-3548, XP012001761, ISSN: 0001-4966, DOI: DOI: 10.1121/1.429422**
- **KRUCKER J F ET AL:** "Sound speed estimation using automatic ultrasound image registration", **IEEE TRANSACTIONS ON ULTRASONICS, FERROELECTRICS AND FREQUENCY CONTROL, IEEE, US, vol. 51, no. 9, 20 September 2004 (2004-09-20), pages 1095-1105, XP002560798, ISSN: 0885-3010, DOI: DOI: 10.1109/TUFFC.2004.1334842**
- **CHEN Q ET AL:** "Simulation study of effects of speed of sound and attenuation on ultrasound lateral resolution", **ULTRASOUND IN MEDICINE AND BIOLOGY, NEW YORK, NY, US, vol. 30, no. 10, 1 October 2004 (2004-10-01), pages 1297-1306, XP004872063, ISSN: 0301-5629, DOI: DOI: 10.1016/J.ULTRASMEDBIO.2004.07.012**
- **NAPOLITANO D ET AL:** "Sound speed correction in ultrasound imaging", **ULTRASONICS, IPC SCIENCE AND TECHNOLOGY PRESS LTD. GUILDFORD, GB, vol. 44, 22 December 2006 (2006-12-22), pages E43-E46, XP025009137, ISSN: 0041-624X, DOI: DOI:10.1016/J.ULTRAS. 2006.06.061 [retrieved on 2006-12-22]**

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 1 965 704 B1

Description**Technical Field**

5 **[0001]** The present invention generally relates to image forming methods, and more particularly to a method of forming an ultrasound compound image while correcting a focusing error.

Background Art

10 **[0002]** An ultrasound imaging system transmits ultrasound signals into a target object and receives ultrasound echo signals. The echo signals are converted into electrical signals in a probe. The ultrasound imaging system performs signal processing for the electrical signals, thereby forming an ultrasound image. The ultrasound imaging system has been extensively used in the medical procession due to its non-invasive and non-destructive nature. In order to acquire a high-resolution ultrasound image, various techniques have been studied and researched in the ultrasound imaging system. Recently, an array transducer comprising a plurality of transducer elements is used to acquire the high-resolution ultrasound image. Also, the transmit focusing and receive focusing methods have been adopted for acquiring high-resolution ultrasound images.

15 **[0003]** Fig. 1 is a schematic diagram illustrating the delays of ultrasound echo signals arriving at each transducer element in an array transducer. A predetermined delay profile of transmit pulse signals is established so that ultrasound signals produced at the array transducer 10 are focused on a focal point, wherein each transducer element then produces ultrasound signals according to such predetermined delay profile. Ultrasound echo signals reflected from the focal point arrive at each transducer element in different times.

20 **[0004]** As shown in Fig. 1, an ultrasound echo signal reflected from the focal point travels a distance of "d" to arrive at a transducer element Tc, while an ultrasound echo signal reflected from the focal point travels a distance of r ($r=d+\Delta r(x)$) to reach a transducer element Tx. That is, the ultrasound echo signal received at the transducer element Tx is delayed by $\Delta r(x)$ compared to the ultrasound echo signal received at the transducer element Tc. The ultrasound echo signals received at each transducer element are converted into electrical signals (hereinafter referred to as receive signals). The receive signals should be focused in order to obtain image signals. In focusing the receive signals, the delays of the ultrasound echo signals arriving at each transducer element should be compensated. A receive focusing delay technique is usually adopted to compensate for the delays of the ultrasound echo signals.

25 **[0005]** The delay of the ultrasound echo signal arriving at each transducer element can be calculated using the following equation:

30 **[0006]**

$$\Delta \tau(x) = \frac{\Delta r(x)}{v} = \frac{\sqrt{x^2 + d^2} - d}{v}$$

35 (1)

40 **[0007]** wherein, $\Delta \tau(x)$ represents a time delay of an ultrasound echo signal arriving at the transducer element Tx, v represents a propagation speed of the ultrasound signal (speed of sound) in a target object, x represents a distance between the elements Tc and Tx and d represents a distance between the focal point and the transducer element Tc. d may be calculated using the following equation:

45 **[0008]**

$$d=vt$$

50 (2)

55 **[0009]** Wherein, t represents a time for the ultrasound signal to arrive at the transducer element Tc from the focal point.

[0010] As shown in the above equations, the speed of sound in the target object is important for determining the delays of ultrasound echo signals. When the target object is a human body, the speed of sound is generally set to 1540 m/s, which is an average speed in the soft tissues of the human body. However, the speed of sound is 1460 m/s in fat, 1555 m/s in liver, 1560 m/s in blood and 1600 m/s in muscle. That is, the speed of sound is changed according to the type of

media. Therefore, if the fixed speed of sound is used, then a calculation error in the delays of ultrasound echo signals arriving at each transducer element may occur.

[0011] Recently, a compound ultrasound image is used to enhance the quality of an ultrasound image. In order to obtain the compound ultrasound image, the scan lines are steered in different angles and then ultrasound images are obtained at each angle of the scan lines. Thereafter, the obtained ultrasound images are spatially compounded, thereby forming the compound ultrasound image. In this case, if the speed of sound is not accurately set, then the delays of ultrasound echo signals arriving at each transducer element for each steered scan line cannot be accurately calculated. Thus, the pixels corresponding to an identical image of the target object may not be exactly overlapped. Therefore, the overall compound image becomes dark and a signal to noise ratio (SNR) and a contrast may be decreased.

[0012] XP 012001761 "The impact of sound speed errors on medical ultrasound imaging" by M. E. Anderson et al. describes results of a quantitative study of the impact of sound speed errors on the spatial resolution and amplitude sensitivity of a commercial medical ultrasound scanner. In general, sound speed errors have a more significant impact on point target detectability over a lesion detectability by these analyses, producing up to a 22 % reduction in correct decisions for a typical error.

[0013] XP 002560798 "Sound Speed Estimation Using Automatic Ultrasound Image Registration" by Jochen F. Krücker et al. refers to mismatches between the sound speed assumed for beamforming and scan conversion and the true sound speed in the tissue to be imaged, which can lead to significant defocusing and some geometric distortions in ultrasound images. In this document, which forms the closest prior art document for the invention, a method for estimating the average sound speed based on detection of these distortions using automatic registration of overlapping is presented.

[0014] XP 004872063 "Simulation Study of Effects of Speed of Sound and Attenuation on Ultrasound Lateral Resolution" by Quan Chen et al. describes experiments which have shown that the lateral profile of a point target measured with a clinical ultrasound scanner is wider when the target is embedded in a urethane phantom than when it is in a traditional gel phantom.

Disclosure of Invention

Technical Problem

[0015] As described above, if the speed of sound is incorrectly set for the target object, then image pixels corresponding to an identical position of the target object in the ultrasound images obtained by steering a scan angle cannot be overlapped in compounding the ultrasound images. Therefore, the compound image becomes dark and SNR and contrast are decreased.

Technical Solution

[0016] The present invention provides a method of acquiring a compound ultrasound image having a high resolution by determining the real speed of sound in a target object.

[0017] In accordance with an aspect of the present invention, there is provided a method of acquiring an ultrasound image in an ultrasound imaging system according to claim 1.

[0018] In accordance with another embodiment of the present invention, there is provided a method of acquiring an ultrasound image in an ultrasound imaging system according to claim 4.

Brief Description of the Drawings

[0019] Fig. 1 is a schematic diagram illustrating delays of ultrasound echo signals arriving at each transducer element in an array transducer.

[0020] Fig. 2 is a schematic diagram showing an example of acquiring a compound image from a plurality of ultrasound image obtained by steered scan lines.

[0021] Fig. 3 is a schematic diagram showing an example of illustrating acquisition of ultrasound image data from a focal point at which steered scan lines are overlapped.

[0022] Fig. 4 is a diagram showing an example of a delay of an ultrasound echo signal according to a steered scan line.

[0023] Fig. 5 is a flowchart illustrating a method of determining a real speed of sound in a target object in accordance with an embodiment of the present invention.

[0024] Fig. 6 is a graph illustrating a change in amplitude of image signals with respect to depth at differently set speeds of sound.

[0025] Fig. 7 is a graph illustrating a change of amplitude of image signals corresponding to the image point according to a change of the speed of sound.

Best Mode for Carrying Out the Invention

[0026] Fig. 2 is a schematic diagram illustrating an example of acquiring a compound image from a plurality of ultrasound images obtained by steered scan lines.

[0027] As shown in Fig. 2, a first ultrasound image 20, a second ultrasound image 22, a third ultrasound image 24, which are acquired by scan lines steered in first, second and third angles, respectively, are overlapped, thereby forming a compound ultrasound image 26. In Fig. 2, a dashed region 26 represents the compound ultrasound image formed by combining the first, second and third ultrasound images 20, 22 and 24.

[0028] Fig. 3 is a schematic diagram showing an example of illustrating the acquisition of ultrasound image data from a focal point at which steered scan lines are overlapped. As shown therein, the compound image is formed by using image data obtained from a focal point, at which scan lines steered in predetermined angles of θ and $-\theta$ and a scan line perpendicular to a scan head, are overlapped.

[0029] Fig. 4 is a diagram illustrating an example of a delay of an ultrasound echo signal according to a steered scan line. Since the scan line set from a transducer element Tc is steered in an angle of θ as shown in Fig. 4, the steering delay of an ultrasound echo signal reflected from a focal point placed on the scan line may occur. The steering delay $\Delta\tau_\theta(x)$ at a transducer element Tx away from the transducer element Tc by x may be approximately calculated by the following equation.

[0030]

$$\Delta\tau_\theta(x) \approx \frac{x \cdot \sin \theta}{v}$$

(3)

[0031] wherein, θ represents the steering angle and v represent the speed of sound. As can be seen through the equation (3), in order to calculate the steering delay at each transducer, the speed of sound should be accurately set in the target object. If the steering delay $\Delta\tau_\theta(x)$ is not accurately calculated, then the image signals acquired from identical focal points on the steered scan lines may not be overlapped.

[0032] Fig. 5 is a flowchart illustrating a method of determining a real speed of sound in a target object in accordance with an embodiment of the present invention. For the sake of convenience, the method of calculating the real speed of sound in the target object will be described by using an ultrasound image acquired through scan lines 31 perpendicular to the scan head of the array transducer 10. Also, an array transducer of a linear structure is used and the ultrasound signals are transmitted by using a plurality of channels.

[0033] As shown in Fig. 5, a predetermined speed of sound (hereinafter referred to as a reference speed) is set at step S510. The reference speed may be arbitrarily set according to the type of target objects. It is preferable to set a mean speed at media constructing the target object as a reference speed. Also, various reference speeds may be previously set to the target objects, which are frequently examined by using the ultrasound imaging system, such as a human body. The previously set reference speeds may be stored and then an appropriate reference speed may be used according to the type of the target object. For example, if the target object is a human body, then the reference speed may be a mean speed in fat, blood, muscle and the like. Typically, the mean speed of the human body may be set to a speed in a soft tissue of 1540 m/s.

[0034] Subsequently, it is checked whether a new speed of sound is set at step S520. If it is determined not to set the new speed of sound, then an ultrasound image is acquired by using the reference speed of sound set at step S510. On the other hand, if it is determined to set the new speed of sound, then an image point is selected in a predetermined depth on an ultrasound image acquired by using the reference speed of sound at step S530. The image point may be arbitrarily selected on the ultrasound image by using one of various markers provided in the ultrasound imaging system. The setup of the new speed of sound may be carried out by using a setup button mounted on a predetermined position of the ultrasound imaging system. Also, a detecting sensor may be mounted on the probe of the ultrasound imaging system such that the new speed of sound is set when the probe is contacted to a surface of the target object.

[0035] In order to set the new speed of sound, a predetermined range of speed of sound is set with reference to the reference speed of sound at step S540. The range of speed of sound may be set to include the overall speeds of sound in media constructing the target object. Also, various ranges of speed of sound may be previously set to the target objects, which are frequently examined by using the ultrasound imaging system, such as a human body. The previously set ranges of the speed of sound may be stored. Then, an appropriate range of the speed of sound may be used

according to the type of the target object such as the reference speed of sound.

[0036] After setting the range of the speed of sound, a plurality of speeds of sound are set in a predetermined interval from a slowest speed of sound within the range of variable speeds of sound at step S550. A plurality of ultrasound images are acquired at each of the set speeds of sound at step S560. Then, the brightness of the image point set in the predetermined depth of the target object is calculated at each acquired ultrasound image at step S570. The speed of sound applied to an ultrasound image having a maximum brightness is set as a real speed of sound of the target object at step S580.

[0037] Fig. 6 is a graph illustrating a change in amplitude of image signals with respect to depth at differently set speeds of sound. When a real speed of the sound in the target object is of 1550 m/s, curves 61, 62 and 63 are obtained by simulating that speeds of sound are set at 1500 m/s, 1550 m/s and 1600 m/s, respectively. The simulation is carried out by assuming that 92 transducers of 40 mm and a frequency of 7.5 MHz are used and the ultrasound signals are focused on the image point positioned at a depth of 20 mm.

[0038] As shown in Fig. 6, if the speed of sound is set faster than the real speed of sound, then maximum amplitude appears at a depth deeper than the depth of 20 mm by 0.8 mm. On the other hand, if the speed of sound is set slower than the real speed of sound, then maximum amplitude appears at a depth shallower than the depth of 20 mm by 0.7 mm. That is, in case of setting the image point at a depth of 20 mm, the amplitudes are about 0.6, 1 and 0.6 at the image point when the speed of sound is set to 1500 m/s, 1550 m/s and 1600 m/s, respectively. Therefore, the speed of sound of 1550 m/s is selected as a real speed of sound in the target object.

[0039] Fig. 7 is a graph showing a change in amplitude of image signals corresponding to the image point according to a change in the speed of sound. As shown in Fig. 7, the amplitude is calculated by changing the speed of sound from 1500 m/s to 1600 m/s in a predetermined interval, thereby obtaining a curve of the speed of sound to amplitude. The curve shown in Fig. 7 may be formed by curve-fitting the maximum points of each 2-order function obtained at each speed of sound. As shown therein, when the speed of sound is 1550 m/s, the amplitude becomes maximum. Therefore, the speed of sound of 1550 m/s may be adopted as a real speed of sound of the target object.

[0040] If the real speed of sound is set according to the above method, then the real speed of sound is applied to the equations (1) and (2), thereby accurately calculating the receive focusing delay and the steering delay. Since the delays are accurately calculated in accordance with one embodiment of the present invention, the steered scan lines can be accurately overlapped at the desirable image points. Therefore, a compound image having a high resolution can be acquired.

[0041] When the speed of sound is determined by using the amplitude of brightness at an image point, it may be difficult to determine the speed of sound due to noises. Therefore, a window of a predetermined size may be set on an image of the target object. Further, the sum of amplitudes of pixels included in the window may be used to determine the speed of sound of the target object in accordance with another embodiment of the present invention. This is so that a calculation error owing to the noises may be reduced.

[0042] While the present invention has been described and illustrated with respect to a preferred embodiment of the invention, it will be apparent to those skilled in the art that variations and modifications are possible without deviating from the broad principles and teachings of the present invention, which should be limited solely by the scope of the claims appended hereto.

Industrial Applicability

[0043] As mentioned above, since the speed of sound in the target object is accurately determined, an enhanced compound image can be acquired.

Claims

1. A method of acquiring an ultrasound image in an ultrasound imaging system having an array transducer, comprising:

- a) setting an image point at a predetermined depth on an ultrasound image acquired based on a reference speed of sound for a target object;
- b) setting a range of speed of sound with reference to the reference speed;
- c) setting a plurality of speeds of sound in a constant interval within the range of speed of sound;
- d) acquiring ultrasound images at the respective speeds of sound;
- e) setting image points at the predetermined depth on the respective ultrasound images and calculating amplitudes of the image points set on the respective ultrasound images;
- f) determining the speed of sound applied to the ultrasound image having highest amplitude at the image point among the calculated amplitudes as a real speed of sound in the target object; and

g) acquiring an ultrasound image based on the determined real speed of sound in the target object.

2. The method of Claim 1, wherein the step a) includes:

- a1) selecting the reference speed of sound previously set according to a type of the target object;
- a2) checking whether to set a new speed of sound for the target object;
- a3) if it is determined to set the new speed of sound at step a2), acquiring the ultrasound image based on the reference speed of sound; and
- a4) setting the image point on the acquired ultrasound image at the predetermined depth.

3. The method of Claim 2, wherein the reference speed of sound is a mean speed of sound of media consisting of the target object.

4. A method of acquiring an ultrasound image in an ultrasound imaging system having an array transducer, comprising:

- a) setting an image point at a predetermined depth on an ultrasound image acquired based on a reference speed of sound for a target object;
- b) setting a range of speed of sound with reference to the reference speed;
- c) setting a plurality of speeds of sound in a constant interval within the range of speed of sound;
- d) acquiring ultrasound images at the respective speeds of sound;
- e) setting image points at the predetermined depth on the respective ultrasound images and calculating amplitudes of the image points set on the respective ultrasound images;
- f) determining the speed of sound applied to the ultrasound image having highest amplitude at the image point among the calculated amplitudes as a real speed of sound in the target object;
- g) acquiring a plurality of ultrasound images by steering scan lines in predetermined angles based on the determined real speed of sound; and
- h) forming a compound ultrasound image by compounding the acquired ultrasound images.

5. The method of Claim 4, wherein the step a) includes:

- a1) selecting the reference speed of sound previously set according to a type of the target object;
- a2) checking whether to set a new speed of sound for the target object;
- a3) if it is determined to set the new speed of sound at step a2), acquiring the ultrasound image based on the reference speed of sound; and
- a4) setting the image point on the acquired ultrasound image at the predetermined depth.

6. The method of Claim 5, wherein the reference speed of sound is a mean speed of sound of media consisting of the target object.

Patentansprüche

1. Verfahren zur Erfassung eines Ultraschallbilds in einem Ultraschallbildsystem mit einer Array-Sonde, welches Folgendes aufweist:

- a) Festlegen eines Bildpunkts in einer bestimmten Tiefe auf einem Ultraschallbild, welches basierend auf einer Referenzschallgeschwindigkeit für ein Zielobjekt erfasst wurde;
- b) Festlegen eines Bereichs einer Schallgeschwindigkeit unter Bezugnahme auf die Referenzgeschwindigkeit;
- c) Festlegen einer Vielzahl von Schallgeschwindigkeiten in einem konstanten Intervall innerhalb des Bereichs der Schallgeschwindigkeit;
- d) Erfassen von Ultraschallsignalen mit den jeweiligen Schallgeschwindigkeiten;
- e) Festlegen von Bilddaten in der vorbestimmten Tiefe auf den jeweiligen Ultraschallbildern und Berechnen von Amplituden der Bildpunkte, die auf den jeweiligen Ultraschallbildern festgelegt wurden;
- f) Ermitteln der auf das Ultraschallbild angewendeten Schallgeschwindigkeit, welche die höchste Amplitude an dem Bildpunkt unter den berechneten Amplituden aufweist, als eine reale Schallgeschwindigkeit in dem Zielobjekt; und
- g) Erfassen eines Ultraschallbilds basierend auf der ermittelten realen Schallgeschwindigkeit in dem Zielobjekt.

2. Verfahren nach Anspruch 1, wobei der Schritt a) Folgendes aufweist:

- a1) Auswählen der vorher festgelegten Referenzschallgeschwindigkeit gemäß einer Art des Zielobjekt;
- a2) Prüfen, ob eine neue Schallgeschwindigkeit für das Zielobjekt eingestellt wird;
- a3) Wenn in dem Schritt a2) festgelegt wird, dass die neue Schallgeschwindigkeit eingestellt wird, Erfassen des Ultraschallbilds basierend auf der Referenzschallgeschwindigkeit; und
- a4) Festlegen des Bildpunkts auf dem erfassten Ultraschallbild in der vorbestimmten Tiefe.

3. Verfahren nach Anspruch 2, wobei die Referenzschallgeschwindigkeit eine mittlere Schallgeschwindigkeit des Mediums ist, aus dem das Zielobjekt besteht.

4. Verfahren zur Erfassung eines Ultraschallbilds in einem Ultraschallbildsystem mit einer Array-Sonde, welches Folgendes aufweist:

- a) Festlegen eines Bildpunkts in einer bestimmten Tiefe auf einem Ultraschallbild, welches basierend auf einer Referenzschallgeschwindigkeit für ein Zielobjekt erfasst wurde;
- b) Festlegen eines Bereichs einer Schallgeschwindigkeit unter Bezugnahme auf die Referenzgeschwindigkeit;
- c) Festlegen einer Vielzahl von Schallgeschwindigkeiten in einem konstanten Intervall innerhalb des Bereichs der Schallgeschwindigkeit;
- d) Erfassen von Ultraschallsignalen mit den jeweiligen Schallgeschwindigkeiten;
- e) Festlegen von Bilddaten in der vorbestimmten Tiefe auf den jeweiligen Ultraschallbildern und Berechnen von Amplituden der Bildpunkte, die auf den jeweiligen Ultraschallbildern festgelegt wurden;
- f) Ermitteln der auf das Ultraschallbild angewendeten Schallgeschwindigkeit, welche die höchste Amplitude an dem Bildpunkt unter den berechneten Amplituden aufweist, als eine reale Schallgeschwindigkeit in dem Zielobjekt;
- g) Erfassen einer Vielzahl von Ultraschallbildern durch Steuern von Scanlinien in vorbestimmten Winkeln basierend auf der ermittelten realen Schallgeschwindigkeit; und
- h) Bilden eines Verbund-Ultraschallbilds durch Verbinden der erfassten Ultraschallbilder.

5. Verfahren nach Anspruch 4, wobei der Schritt a) Folgendes aufweist:

- a1) Auswählen der vorher festgelegten Referenzschallgeschwindigkeit gemäß einer Art des Zielobjekts;
- a2) Prüfen, ob eine neue Schallgeschwindigkeit für das Zielobjekt eingestellt wird;
- a3) Wenn in dem Schritt a2) festgelegt wird, dass die neue Schallgeschwindigkeit eingestellt wird, Erfassen des Ultraschallbilds basierend auf der Referenzschallgeschwindigkeit; und
- a4) Festlegen des Bildpunkts auf dem erfassten Ultraschallbild in der vorbestimmten Tiefe.

6. Verfahren nach Anspruch 5, wobei die Referenzschallgeschwindigkeit eine mittlere Schallgeschwindigkeit des Mediums ist, aus dem das Zielobjekt besteht.

Revendications

1. Procédé d'acquisition d'une image ultrasonique dans un système d'imagerie ultrasonique ayant un transducteur en réseau comprenant :

- a) la détermination d'un point image à une profondeur prédéterminée sur une image ultrasonique acquise basée sur une vitesse de référence du son pour un objet cible ;
- b) la détermination d'une gamme de vitesses du son en référence à la vitesse de référence ;
- c) la détermination d'une pluralité de vitesses du son dans un intervalle constant compris dans la gamme de vitesses du son ;
- d) l'acquisition d'images ultrasoniques aux vitesses du son respectives ;
- e) la détermination de points images à la profondeur prédéterminée sur les différentes images ultrasoniques et le calcul des amplitudes des points images fixés sur les images ultrasoniques respectives ;
- f) la détermination de la vitesse du son appliquée à l'image ultrasonique ayant la plus grande amplitude au point image parmi les amplitudes calculées comme étant une vitesse réelle du son de l'objet cible et
- g) l'acquisition d'une image ultrasonique basée sur la vitesse réelle du son dans l'objet cible.

2. Procédé selon la revendication 1, dans lequel l'étape a) comporte :

- a1) la sélection de la vitesse du son de référence précédemment déterminée pour un type d'objet cible ;
- a2) le choix de l'utilisation éventuelle d'une nouvelle vitesse du son pour l'objet cible ;
- a3) s'il a été décidé de choisir une nouvelle vitesse du son lors de l'étape a2), l'acquisition de l'image ultrasonique basée sur la vitesse du son de référence ; et
- a4) la détermination du point image sur l'image ultrasonique acquise à la profondeur prédéterminée.

3. Procédé selon la revendication 2, dans lequel la vitesse du son de référence est une vitesse moyenne du son du milieu constitué par l'objet cible.

4. Procédé d'acquisition d'une image ultrasonique dans un système d'imagerie ultrasonique ayant un transducteur en réseau comportant :

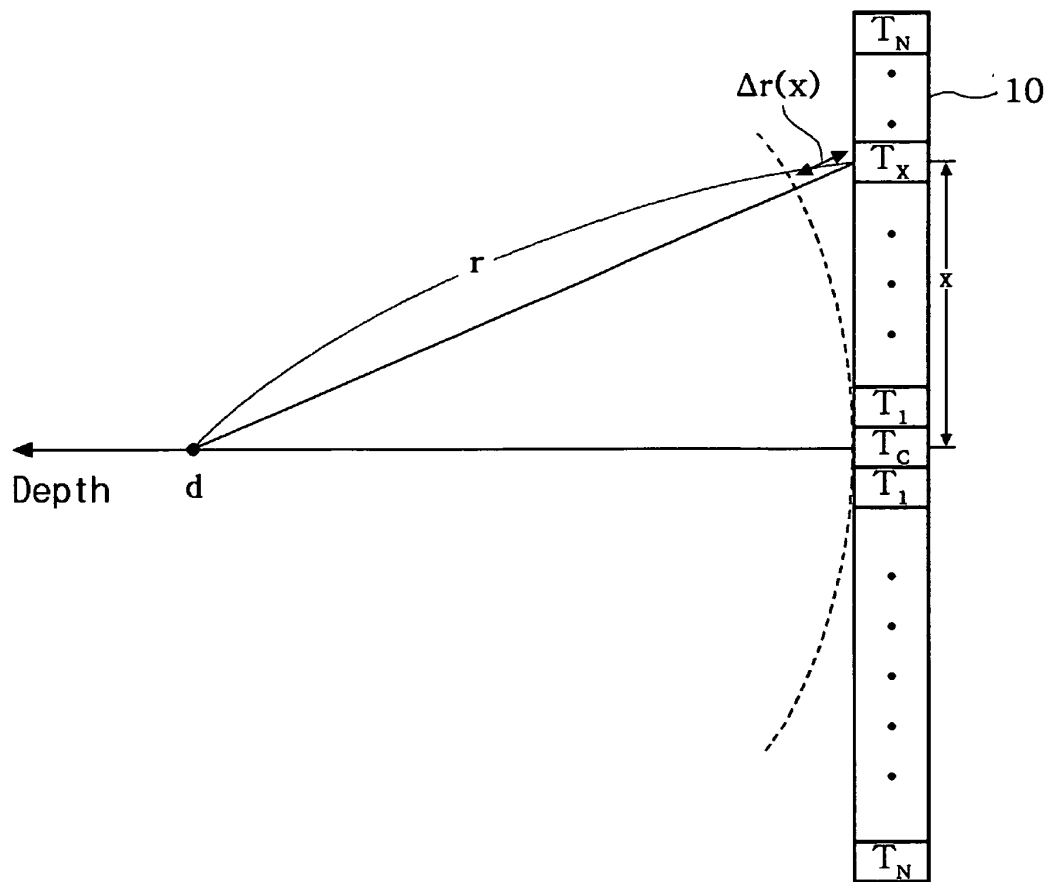
- a) la détermination d'un point image à une profondeur prédéterminée sur une image ultrasonique acquise basée sur une vitesse de préférence du son pour un objet cible ;
- b) la détermination d'une gamme de vitesses du son en référence à la vitesse de référence ;
- c) la détermination d'une pluralité de vitesses du son dans un intervalle constant compris dans la gamme de vitesses du son ;
- d) l'acquisition d'images ultrasoniques aux vitesses du son respectives ;
- e) la détermination de points images à la profondeur prédéterminée sur les différentes images ultrasoniques et le calcul des amplitudes des points images fixés sur les images ultrasoniques respectives ;
- f) la détermination de la vitesse du son appliquée à l'image ultrasonique ayant la plus grande amplitude au point image parmi les amplitudes calculées comme étant une vitesse réelle du son de l'objet cible ; à
- g) l'acquisition d'une image ultrasonique basée sur la vitesse réelle du son dans l'objet cible ; et
- h) la formation d'une image ultrasonique obtenue en mélangeant toutes les images ultrasoniques acquises.

5. Procédé selon la revendication 4, dans lequel l'étape a) comporte :

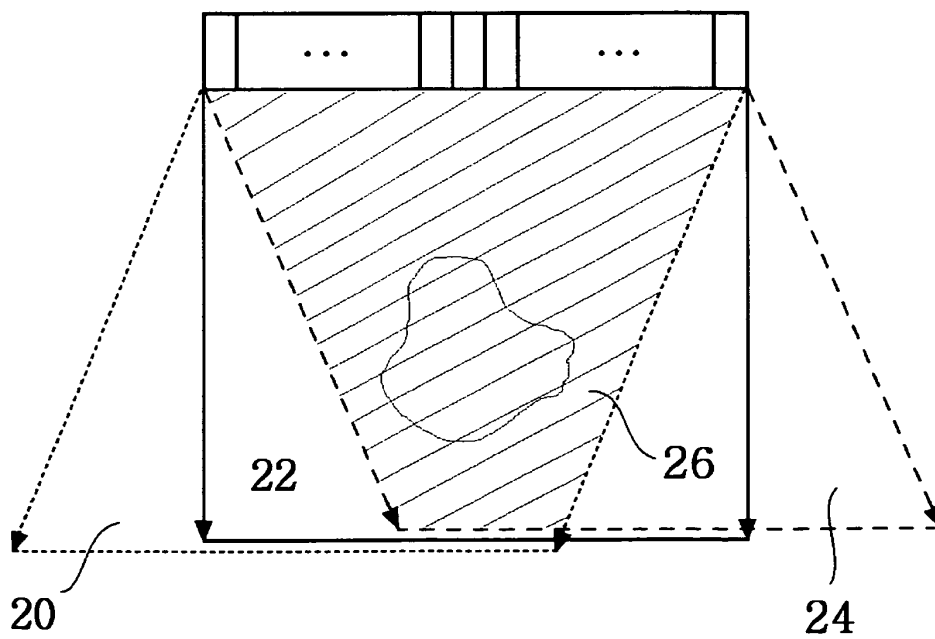
- a1) la sélection de la vitesse du son de référence précédemment déterminée pour un type d'objet cible ;
- a2) le choix de l'utilisation éventuelle d'une nouvelle vitesse du son pour l'objet cible ;
- a3) s'il a été décidé de choisir une nouvelle vitesse du son lors de l'étape a2), l'acquisition de l'image ultrasonique basée sur la vitesse du son de référence ; et
- a4) la détermination du point image sur l'image ultrasonique acquise à la profondeur précédente.

6. Procédé selon la revendication 5, dans lequel la vitesse du son de référence est une vitesse moyenne du son du milieu constitué par l'objet cible.

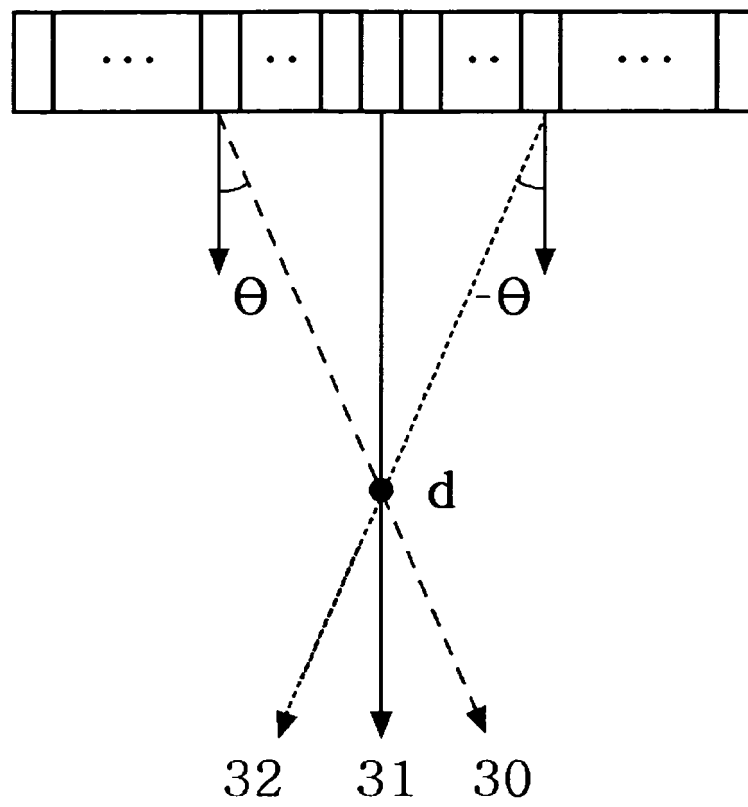
[Fig. 1]



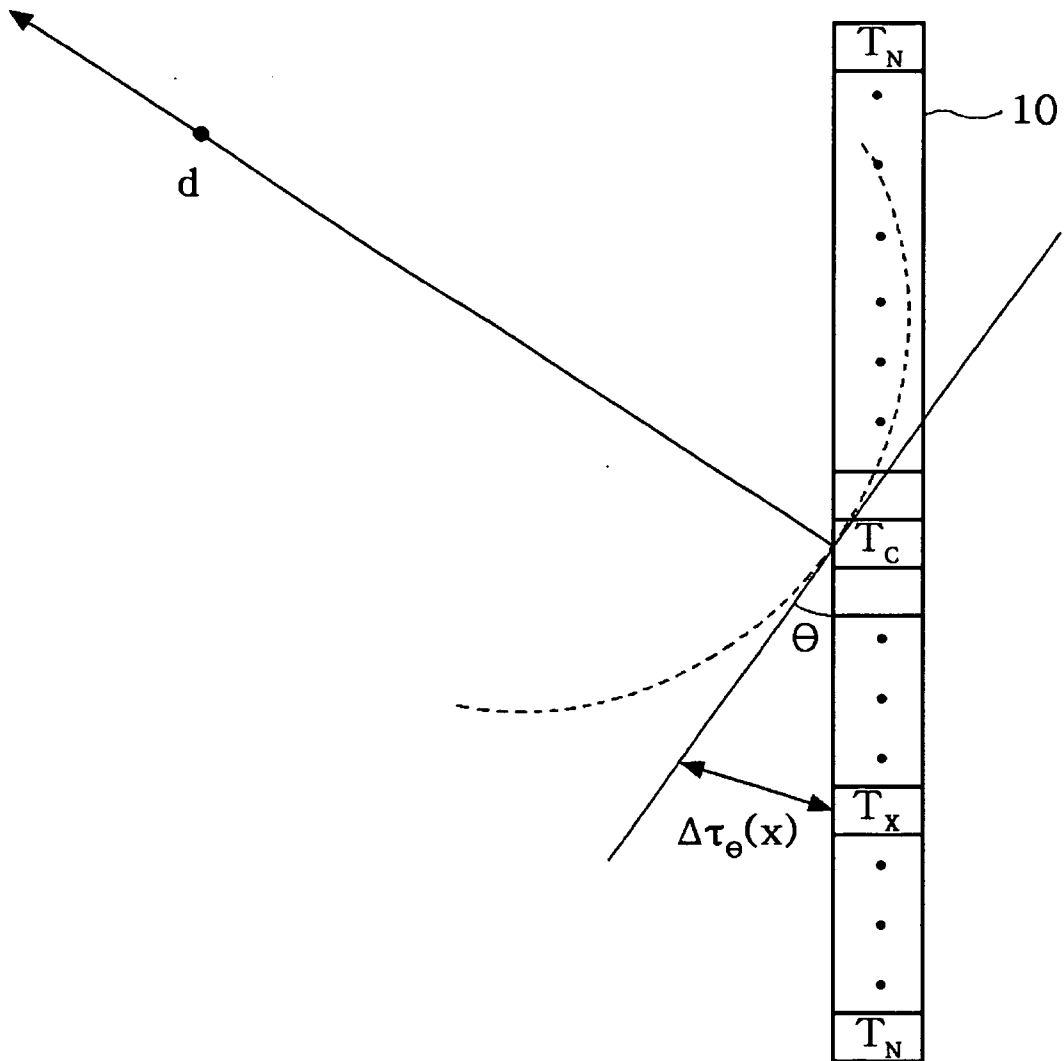
[Fig. 2]



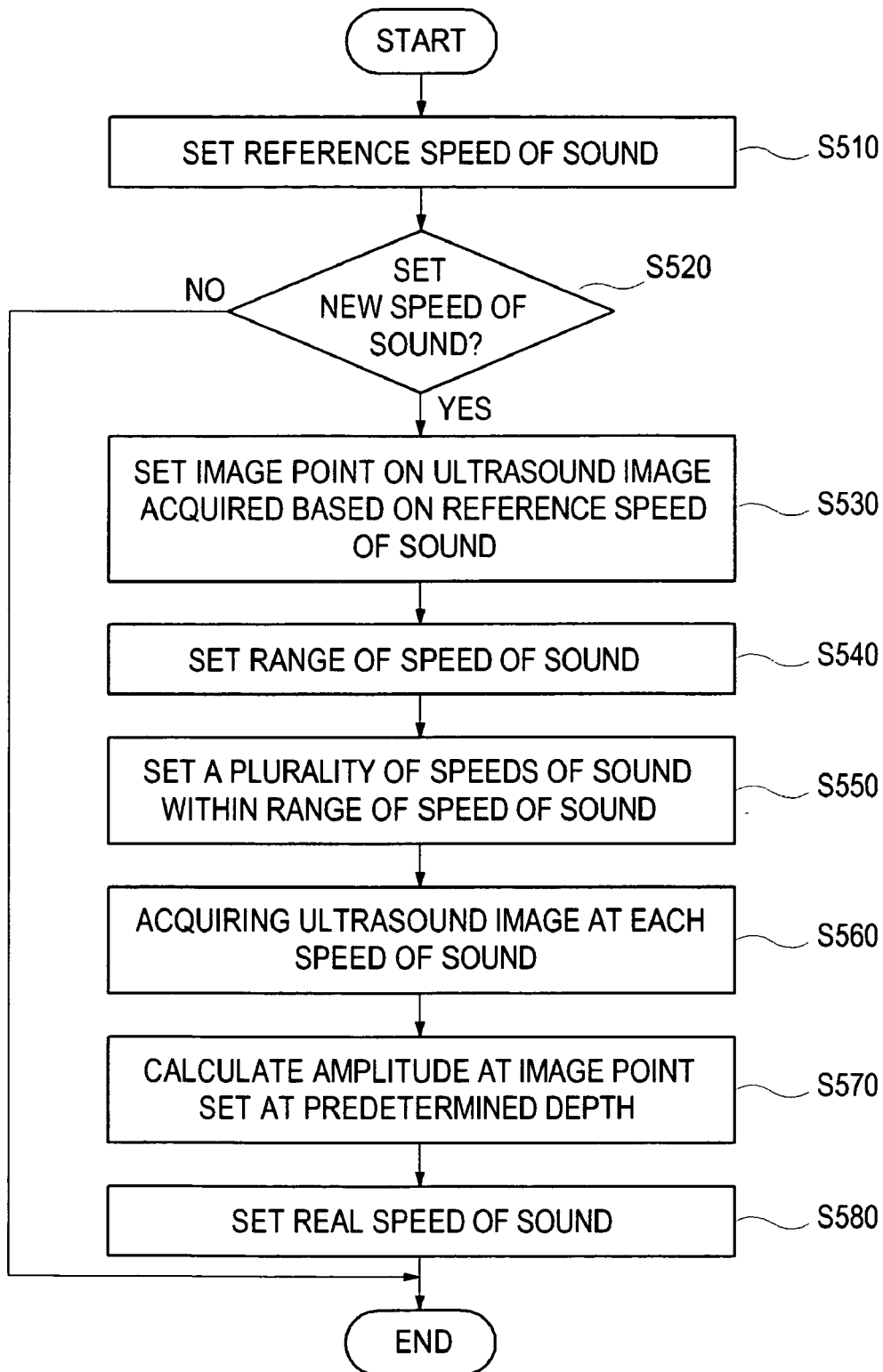
[Fig. 3]



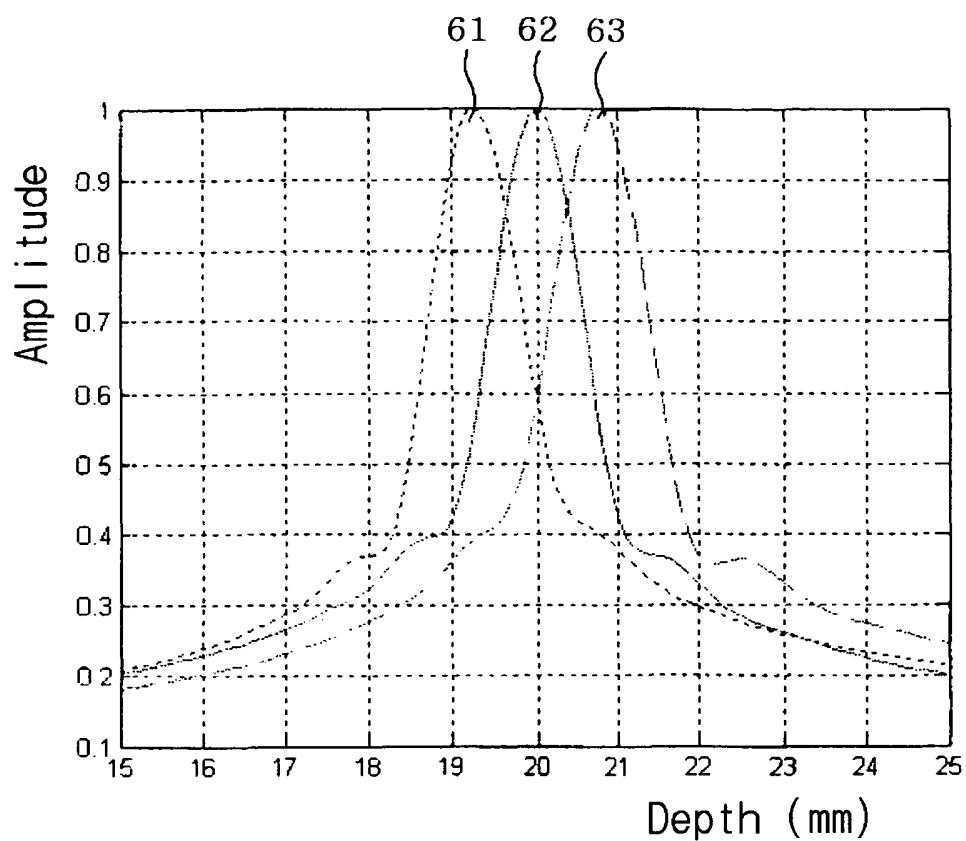
[Fig. 4]



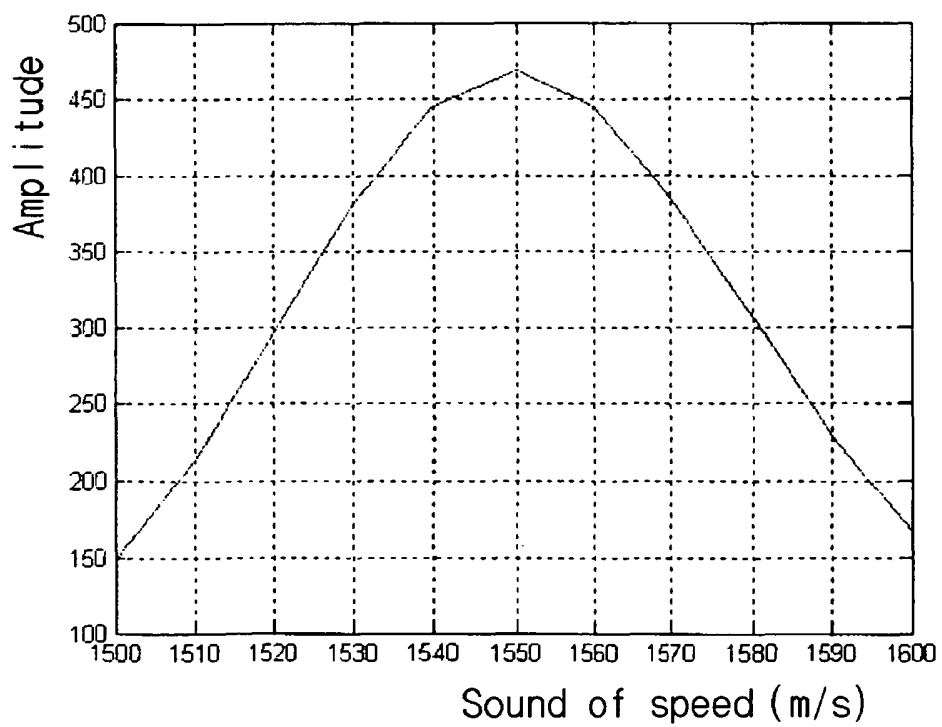
[Fig. 5]



[Fig. 6]



[Fig. 7]



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Non-patent literature cited in the description

- **M. E. ANDERSON.** *The impact of sound speed errors on medical ultrasound imaging* [0012]
- **JOCHEN F. KRÜCKER.** *Sound Speed Estimation Using Automatic Ultrasound Image Registration* [0013]
- **QUAN CHEN.** *Simulation Study of Effects of Speed of Sound and Attenuation on Ultrasound Lateral Resolution* [0014]

专利名称(译)	获取超声图像的方法		
公开(公告)号	EP1965704B1	公开(公告)日	2012-11-21
申请号	EP2006835459	申请日	2006-12-27
申请(专利权)人(译)	MEDISON CO. , LTD.		
当前申请(专利权)人(译)	三星MEDISON CO. , LTD.		
[标]发明人	JEONG MOK KEUN KWON SUNG JAE YOON RA YOUNG		
发明人	JEONG, MOK KEUN KWON, SUNG JAE YOON, RA YOUNG		
IPC分类号	A61B8/00 G01S15/89		
CPC分类号	G01S15/8995 A61B8/00 A61B8/5269 A61B8/585 G01H5/00 G01S7/52049 G01S7/5205		
代理机构(译)	SCHMID , WOLFGANG		
优先权	1020050131562 2005-12-28 KR		
其他公开文献	EP1965704A1 EP1965704A4		
外部链接	Espacenet		

摘要(译)

本发明涉及一种在具有阵列换能器的超声成像系统中获取超声图像的方法，包括：a) 在基于目标对象的声音的参考速度获取的超声图像上设置预定深度的图像点；b) 参考参考速度设定声速范围；c) 在声速范围内以预定间隔设定多个声速；d) 以每个声速获取超声图像；e) 计算在每个超声图像的预定深度处设置的图像点的幅度；f) 基于计算的幅度确定目标对象中的实际声速；g) 基于所确定的目标对象中的实际声速获取超声图像。

$$\Delta \tau(x) = \frac{\Delta \tau(x)}{1'} = \frac{\sqrt{x^2 + d^2} - d}{1'}$$

(1)