(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 599 442 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
23.03.2016 Bulletin 2016/12

(51) Int Cl.:
A61B 8/00 *(2006.01)* ***G01S 7/52*** *(2006.01)*

(21) Application number: **12161586.8**

(22) Date of filing: **27.03.2012**

(54) **Method and apparatus for correcting ultrasound images by using interest index map**

Verfahren und Vorrichtung für die Korrektur von Ultraschallbildern durch die Verwendung einer Interessenverzeichniskarte

Procédé et appareil pour la correction d'images ultrasonores au moyen d'une carte à index d'intérêt

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **30.11.2011 KR 20110127229**

(43) Date of publication of application:
05.06.2013 Bulletin 2013/23

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Printed by Jouve, 75001 PARIS (FR)

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a method and apparatus for correcting ultrasound images by using an interest index map.

2. Description of the Related Art

[0002] An ultrasound diagnosis apparatus delivers an ultrasound signal from a body surface of a target object to a predetermined part in the body, and then obtains an image of tomography or hematocele of a soft tissue by using information of the ultrasound signal reflected from a tissue in the body.

[0003] The ultrasound diagnosis apparatus is advantageous in that it is small, is inexpensive, and displays in real-time. Also, the ultrasound diagnosis apparatus is not harmful such as radioactivity and thus is safe, so that it is widely used together with an X-ray diagnosis apparatus, a computerized tomography (CT) scanner, a magnetic resonance image (MRI) apparatus, a nuclear medicine diagnosis apparatus, and the like.

[0004] In general, an output (a transmission voltage, a pressure, and energy) of the ultrasound diagnosis apparatus is limited by and is decided according to an international reference (e.g., a mechanical index (MI)). Here, the MI is an index of quantification of mechanical affects by ultrasound with respect to a human body.

[0005] Another example of the quantification of mechanical affects by ultrasound with respect to a human body is a thermal index (TI). According to a common level, international permission levels of the MI and the TI are less than 1.9 and 6.0, respectively.

[0006] The ultrasound diagnosis apparatus further precisely diagnoses a target object by increasing a transmission voltage of an ultrasound signal which is output from a pulser. In this regard, as the transmission voltage is increased, a sensitivity of an image is improved but the MI or an acoustic pressure (a pressure generated by ultrasound that passes through a medium) is increased.

[0007] Also, when an ultrasound signal output from the ultrasound diagnosis apparatus passes through a medium such as a human body, interest indexes such as the MI, the acoustic pressure, the TI, and the like may not have regular dispersion in one frame, according to a focus forming method or an interest depth of an ultrasound beam.

[0008] That is, ultrasound images based on a received ultrasound echo signal do not have a uniform brightness or quality of some of the ultrasound images may deteriorate.

[0009] The US 5,482,046 A describes an acoustic power control technique computes relevant system transmit parameters in real-time by optimally combining a current system imaging configuration with an empirically derived measurement database. The database contains measurement information that is used by the acoustic power control technique to determine optimal transmit parameters for a given imaging situation. The optimal parameters are determined by adjusting the measured database parameters through the use of the current scanning parameters to maximize system performance. Utilizing system constraints, the acoustic power control technique computes the optimal transmit parameters to maximize system performance.

[0010] In the US 2010/016719 A1 an acoustic output power is adaptively regulated in medical diagnostic ultrasound imaging. Given transmit settings, the acoustic power and/or another setting may be altered to avoid violating a limit set by regulation. The limit is based, at least in part, on an assumed attenuation. By measuring the attenuation, such as by identifying a type of tissue, the power and/or limit may be altered or adapt. By accounting for the attenuation in the region to be scanned, a greater output power may be possible while still providing the same level of safety.

[0011] In the US 2006/030779 A1 a target mechanical index, acoustic pressure, intensity or other value associated with contrast agent imaging is established. For contrast agent imaging associated with limited destruction of contrast agents, the transmit power is matched to the target intensity value as a function of position, time or combinations thereof. Given multiple foci, the transmit power is adjusted to provide a substantially uniform acoustic pressure or intensity at two or more of the foci. Where an imaging parameter is adjusted during an imaging session, the transmit power is altered to provide a similar or same target intensity value at a given location that is consistent with the value before the adjustment. By setting the transmit power as a function of a target value, more consistent contrast agent imaging may be provided despite the use of multiple foci, changes in the location of one or more foci, or changes in other imaging parameters. By automating setting the transmit power as a function of the target value, user adjustment may be avoided. A target acoustic pressure, intensity or mechanical index value may be used for high power more destructive imaging as well.

SUMMARY OF THE INVENTION

[0012] The invention is defined in the independent claims 1, 3, 4 and 10, 12, 13. The present invention provides a method of correcting ultrasound images by using an interest index map, and more particularly, to a method and apparatus for correcting ultrasound images by using one of a mechanical index (MI) map, an acoustic pressure map, and a thermal index (TI) map.

[0013] According to an aspect of the present invention, there is provided a method of correcting ultrasound images, the method including operations of, by an ultrasound output unit, outputting an ultrasound signal to a target object; obtaining a MI map indicating a correlation between depth values according to a travel direction of the ultrasound signal, and MI values by the ultrasound signal; and adjusting a gain value of an ultrasound echo signal corresponding to the ultrasound signal by using a reverse MI map that is obtained by reversing the MI map, so as to allow the MI values, which are displayed on the MI map, to be a virtually constant MI value with respect to the depth values.

[0014] The method may further include operations of generating ultrasound image of the target object based on the ultrasound echo signal having the adjusted gain value; and displaying the ultrasound image.

[0015] The method may include operations of obtaining an acoustic pressure map indicating a correlation between depth values according to a travel direction of the ultrasound signal, and acoustic pressure values by the ultrasound signal; and adjusting a gain value of an ultrasound echo signal corresponding to the ultrasound signal by using a reverse acoustic pressure map that is obtained by reversing the acoustic pressure map.

[0016] The method may include operations of obtaining a TI map indicating a correlation between depth values according to a travel direction of the ultrasound signal, and TI values by the ultrasound signal; and adjusting a gain value of an ultrasound echo signal corresponding to the ultrasound signal by using a reverse TI map that is obtained by reversing the TI map.

[0017] The method may include operations of, by the ultrasound output unit, outputting ultrasound signals having a first focus and a second focus; obtaining a first MI map and a second MI map that correspond to the first focus and the second focus, respectively; adjusting a gain value of an ultrasound echo signal corresponding to the first focus by using a first reverse MI map that is obtained by reversing the first MI map, so as to allow the MI values, which are displayed on the first MI map, to be a virtual first MI value with respect to the depth values; and adjusting a gain value of an ultrasound echo signal corresponding to the second focus by using a second reverse MI map that is obtained by reversing the second MI map, so as to allow the MI values, which are displayed on the second MI map, to be a virtual second MI value with respect to the depth values.

[0018] The virtual first MI value may be decided based on a maximum MI value of the first MI map, and the virtual second MI value may be decided based on a maximum MI value of the second MI map.

[0019] The method may further include operations of determining whether the virtual first MI value and the virtual second MI value are equal to each other; and, if not equal, re-adjusting the adjusted gain value of the ultrasound echo signal corresponding to the first focus or the adjusted gain value of the ultrasound echo signal corresponding to the second focus, so as to allow the virtual first MI value and the virtual second MI value to be equal to each other.

[0020] The method may include operations of generating the ultrasound image of the target object by blending the ultrasound echo signal having the adjusted gain value corresponding to the first focus with the ultrasound echo signal having the adjusted gain value corresponding to the second focus; and displaying the ultrasound image.

[0021] The method may further include operations of adjusting a first ultrasound transmission voltage corresponding to the first focus or a second ultrasound transmission voltage corresponding to the second focus, so as to allow a first maximum MI corresponding to the first focus and a second maximum MI corresponding to the second focus to be equal to each other.

[0022] According to another aspect of the present invention, there is provided an ultrasound images correcting apparatus including an ultrasound output unit for outputting an ultrasound signal to a target object; a map obtaining unit for obtaining a MI map indicating a correlation between depth values according to a travel direction of the ultrasound signal, and MI values by the ultrasound signal; and a control unit for adjusting a gain value of an ultrasound echo signal corresponding to the ultrasound signal by using a reverse MI map that is obtained by reversing the MI map, so as to allow the MI values, which are displayed on the MI map, to be a virtually constant MI value with respect to the depth values.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The above and other features and advantages of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

FIG. 1 is a conceptual drawing describing a reference axis with respect to obtaining or displaying an interest index map according to an embodiment of the present invention;

FIG. 2 is a block diagram illustrating a structure of an ultrasound images correcting apparatus according to an embodiment of the present invention;

FIG. 3 is a flowchart describing a method of correcting ultrasound images, according to an embodiment of the present invention;

FIG. 4 is a diagram illustrating a displayed mechanical index (MI) map, according to an embodiment of the present invention;

FIG. 5 is a diagram illustrating a reverse interest index map, according to an embodiment of the present invention;

FIG. 6 is a flowchart describing a method of correcting ultrasound images having multiplex focuses, according to another embodiment of the present invention; and

FIG. 7 is a diagram illustrating an interest index map and a reverse interest index map with respect to the multiplex focuses, according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0024] Terms or words used in the following description should not be construed as being limited to common or general meanings but should be construed as fully satisfying the concept of the invention. In the following description, the applicant arbitrarily selects some terms or words, and in those cases, the detailed meaning are provided here.

[0025] Also, when a part "includes" or "comprises" an element, unless there is a particular description contrary thereto, the part can further include other elements, not excluding the other elements. In the following description, terms such as "unit" and "module" indicate a unit for processing at least one function or operation, wherein the unit and the block may be embodied as hardware or software or embodied by combining hardware and software.

[0026] In the following description, "user" may indicate a medical expert including a doctor, a nurse, a clinical pathologist, a medical image expert, or the like but is not limited thereto.

[0027] In the following description, "interest index" may include a mechanical index (MI), a thermal index (TI), or an acoustic pressure.

[0028] Hereinafter, the present invention will be described in detail by explaining exemplary embodiments of the invention with reference to the attached drawings. In the following description, functions or constructions that are not related to the present invention are omitted, and like reference numerals in the drawings denote like elements.

[0029] Expressions such as "at least one of," when preceding a list of elements, modify the entire list of elements and do not modify the individual elements of the list.

[0030] FIG. 1 is a conceptual drawing describing a reference axis with respect to obtaining or displaying an interest index map according to an embodiment of the present invention.

[0031] A direction in which ultrasound that is output from an ultrasound output unit 110 of an ultrasound images correcting apparatus travels may be an axis of depth values 120 according to the present embodiment. The ultrasound output unit 110 may be included in a probe.

[0032] The axis of the depth values 120 may correspond to a direction in which the depth values 120 that start in an interface of a target object to be diagnosed by using the ultrasound images correcting apparatus increase toward the inside of a soft tissue.

[0033] The probe may transmit an ultrasound beam to the target object along scan lines 130, wherein the ultrasound beam is generated in a manner that transmission pulse signals are input after an appropriate delay. In this case, the ultrasound images correcting apparatus may generate a two-dimensional (2D) map or a three-dimensional (3D) map based on interest index values corresponding to the depth values 120 and the scan lines 130.

[0034] According to the present embodiment, the probe may be at least one of a 1-dimensional (1 D) probe, a 1.5D probe, and a 2D (matrix) probe.

[0035] FIG. 2 is a block diagram illustrating a structure of an ultrasound images correcting apparatus 200 according to an embodiment of the present invention.

[0036] As illustrated in FIG. 2, the ultrasound images correcting apparatus 200 may include an ultrasound output unit 210, a map obtaining unit 220, an ultrasound image correcting unit 230, a display unit 240, and a control unit 250. However, not every element of the ultrasound images correcting apparatus 200 is necessary. More elements or less elements than the aforementioned elements may embody the ultrasound images correcting apparatus 200.

[0037] The ultrasound output unit 210 may output an ultrasound signal to a target object. The ultrasound output unit 210 may output the ultrasound signal having multiplex focuses. Also, the ultrasound output unit 210 may output the ultrasound signal by using pulses having various wavelengths, or may output the ultrasound signal based on a transmission voltage having various levels.

[0038] In a case of the multiplex focuses, the ultrasound output unit 210 may adjust a voltage of a transmission ultrasound signal so as to allow maximum MIs at the multiplex focuses to be same. That is, in order to maintain the same MIs or acoustic pressures, the voltage of the transmission ultrasound signal may vary according to positions of the multiplex focuses.

[0039] The map obtaining unit 220 may obtain an interest index map. The interest index map according to the present embodiment may include an MI map, a TI map, and an acoustic pressure map. The MI map is visual data indicating a correlation between the depth values 120 and an MI according to a travel direction of an ultrasound signal output from the ultrasound output unit 210. The acoustic pressure map is visual data indicating a correlation between the depth values 120 and an acoustic pressure according to the travel direction of the ultrasound signal output from the ultrasound output unit 210.

[0040] The map obtaining unit 220 may calculate an interest index according to the ultrasound signal output from the ultrasound output unit 210, and may generate the interest index map by using the calculated interest index.

[0041] For example, the map obtaining unit 220 may calculate at least one of an MI, a TI, and an acoustic pressure with respect to depth values of an axial direction in which ultrasound is transmitted. In this case, the map obtaining unit 220 may continuously calculate the interest index for all depth values, or may select some of depth values, may calculate the interest index for only the selected depth values, and may interpolate the rest of the interest indexes, which are not calculated, by using the calculated interest index.

[0042] In another embodiment, the map obtaining unit 220 may receive an interest index map from an external source.

[0043] The TI may include a TI-soft tissue (TIs), Ti-bone (Tlb), and TI-cranial bone (TIc). Thus, according to the present embodiment, the map obtaining unit 220 may obtain each of a TIs map, a Tlb map, and a TIc map, or may only obtain one of the TIs map, the Tlb map, and the Tic map according to a user' s selection.

[0044] Also, the map obtaining unit 220 may extract a representative TI from among the TIs, the Tlb, and the Tic, and may obtain a representative TI map with respect to the extracted representative TI. In the present embodiment, the map obtaining unit 220 may extract a greatest value from among the TIs, the Tlb, and the Tic, as the representative TI.

[0045] The interest index map may include a 2D map or a 3D map with respect to each of the MI map, the acoustic pressure map, and the TI map.

[0046] In a case where ultrasound signals having multiplex focuses are output, the map obtaining unit 220 may obtain a plurality of interest index maps corresponding to the multiplex focuses, respectively.

[0047] For example, in a case where the ultrasound output unit 210 outputs ultrasound signals having a first focus and a second focus with respect to one scan line, the map obtaining unit 220 may obtain a first interest index map and a second interest index map that correspond to the first focus and the second focus, respectively.

[0048] The ultrasound image correcting unit 230 may generate ultrasound image with respect to the target object by using an ultrasound echo signal of which a gain value is adjusted. The ultrasound images correcting apparatus 200 adjusts the gain value of the ultrasound echo signal so as to allow an interest index, which is displayed on an interest index map, to be a virtually constant value with respect to all depth values. Thus, by using the ultrasound echo signal of which a gain value is adjusted, it is possible to obtain uniform ultrasound images with respect to depth values or scan lines.

[0049] That is, according to the present embodiment, the adjustment of the gain value of the ultrasound echo signal may create the same effect as a case in which a power of the ultrasound signal that is output from the ultrasound output unit 210 is regularly adjusted with respect to the depth values or the scan lines.

[0050] In a case where multiplex focuses are used, the ultrasound image correcting unit 230 blends ultrasound echo signals that have adjusted gain values and that correspond to the multiplex focuses, respectively, so that the ultrasound image correcting unit 230 may correct ultrasound image with respect to a target object.

[0051] For example, the ultrasound image correcting unit 230 may correct the ultrasound image with respect to the target object by blending an ultrasound echo signal of which a gain value corresponding to a first focus is adjusted with an ultrasound echo signal of which a gain value corresponding to a second focus is adjusted.

[0052] That is, according to the present embodiment, in a case where the multiplex focuses are used, the ultrasound image correcting unit 230 does not simply perform zone-blending on the ultrasound echo signals corresponding to the multiplex focuses, respectively, but adjusts a gain value of each of the ultrasound echo signals and then performs weighted zone-blending. By doing so, the ultrasound image correcting unit 230 may correct the ultrasound image with respect to the target object.

[0053] The display unit 240 may display the ultrasound image with respect to the target object. According to the present embodiment, the display unit 240 may display the ultrasound images that have been corrected by adjusting the gain value of the ultrasound echo signal.

[0054] Also, the display unit 240 may display the interest index map. Here, the display unit 240 may selectively display at least one from among the interest index map including the MI map, the TI map, and the acoustic pressure map or may display all of the three interest index maps.

[0055] The display unit 240 may be implemented by a monitor of a general ultrasound diagnosis apparatus or, if required, the display unit 240 may be implemented by a user interface.

[0056] In the present embodiment, if a display mode indicates a single mode, the display unit 240 may display the ultrasound images together with the interest index (i.e., the MI, the acoustic pressure, and the TI) on a specific region. In another embodiment, if a display mode indicates a dual mode, the ultrasound images and the interest index may be separately displayed on different screens.

[0057] Also, the display unit 240 may provide a magnified image of a specific part of the ultrasound images or a specific part of the interest index.

[0058] According to the present embodiment, the display unit 240 may selectively display at least one of the TIs map and the Tlb map, and the TIc map. Also, the display unit 240 may selectively display the TI map and the thermal dose map.

[0059] The display unit 240 may display at least one of a 1 D map, a 2D map, and a 3D map with respect to each of the MI, the acoustic pressure, and the TI, or may display at least one of a contour line map, a gray map, a mesh map, and a color map.

[0060] The control unit 250 may adjust the gain value of the ultrasound echo signal corresponding to the output ultrasound signal. According to the present embodiment, the control unit 250 may adjust the gain value of the ultrasound echo signal according to the depth values 120 or the scan lines 130 so as to obtain the ultrasound images that are uniform.

[0061] For example, in order to allow the interest index, which is displayed on the interest index map, to be a virtually constant interest index value with respect to all depth values, the control unit 250 may adjust the gain value of the ultrasound echo signal corresponding to the output ultrasound signal by using a reverse interest index map that is obtained by reversing the interest index map. That is, the control unit 250 may adjust the gain value of the ultrasound echo signal by using at least one of a reverse MI map, a reverse TI map, and a reverse acoustic pressure map.

[0062] According to the present embodiment, a virtual interest index value with respect to the ultrasound echo signal having the adjusted gain value may be constant. This is because a case in which sensitivity of the ultrasound images becomes uniform by adjusting the gain value by using software may achieve a similar effect to a case in which power level of transmission signals are equally adjusted by using hardware.

[0063] The virtual interest index value according to the present embodiment does not mean an actual interest index value by the output ultrasound signal. In a case where the ultrasound images are corrected to have the uniform sensitivity, the virtual interest index value corresponds to a virtual transmission voltage that is required to obtain the corrected ultrasound images.

[0064] For example, in a case where the ultrasound images are uniformly, corrected by adjusting the gain value of the ultrasound echo signal, a transmission voltage of 140 Vpp is required for all depth values or all scan lines so as to obtain the same sensitivity as the corrected ultrasound images, and if an MI value corresponding to 140 Vpp is 1.4, a virtual M may be 1.4.

[0065] That is, in a case where MIs shown in the MI are different, e.g., 1.2, 1.3, 1.4, 1.3, and 1.2 according to the depth values, although the control unit 250 does not adjust the transmission voltage with respect to all depth values or all scan lines as 140 Vpp, the control unit 250 may obtain the uniform ultrasound images by adjusting the gain value of the ultrasound echo signal according to the depth values.

[0066] In the present embodiment, the virtual interest index value may be decided in consideration of a maximum interest index value displayed on the interest index map or an international permission reference for the interest index. That is, the virtual interest index value may be the maximum interest index value or a predetermined multiplied value of the maximum interest index value which does not exceed an international permission reference.

[0067] For example, when the maximum interest index value on the MI map is 1.2, the gain value of the ultrasound echo signal may be adjusted to allow the virtual interest index value with respect to all depth values to be 1.2 or 1.44 (=1.22 x 120%).

[0068] In a case where the multiplex focuses are used, the control unit 250 may adjust the gain values of the ultrasound echo signals that correspond to the multiplex focuses, respectively.

[0069] For example, it is assumed that the ultrasound output unit 210 outputs ultrasound signals having a first focus and a second focus. In this regard, in order to allow an interest index value, which is displayed on an interest index map corresponding to the first focus, to be a virtual first interest index value for all depth values, the control unit 250 may adjust a gain value of an ultrasound echo signal corresponding to the first focus by using a first reverse interest index map. Also, in order to allow an interest index value, which is displayed on an interest index map corresponding to the second focus, to be a virtual second interest index value for all depth values, the control unit 250 may adjust a gain value of an ultrasound echo signal corresponding to the second focus by using a second reverse interest index map.

[0070] In this case, the control unit 250 may determine whether the virtual first interest index value corresponding to the first focus is the same as the virtual second interest index value corresponding to the second focus.

[0071] According to the present embodiment, the virtual first interest index value and the virtual second interest index value may be equal or different. In a case where they are different from each other, although the ultrasound echo signal having the adjusted gain value corresponding to the first focus is blended with the ultrasound echo signal having the adjusted gain value corresponding to the second focus, sensitivity of corrected ultrasound images may not be uniform.

[0072] Thus, in order to allow the virtual first interest index value and the virtual second interest index value to be equal to each other, the control unit 250 may readjust the gain value of the ultrasound echo signal corresponding to the first focus or the second focus.

[0073] Also, in order to allow a first maximum interest index value corresponding to the first focus and a second maximum interest index value corresponding to the second focus to be equal to each other, the control unit 250 may adjust a first ultrasound transmission voltage corresponding to the first focus or a second ultrasound transmission voltage corresponding to the second focus.

[0074] That is, the control unit 250 adjusts an ultrasound transmission voltage at each focus, thereby actually changing the MI, the acoustic pressure, and the TI. In this case, since a virtual first MI value and a virtual second MI value that are decided based on a maximum MI may be the same, the control unit 250 may not readjust the gain value of the ultrasound echo signal corresponding to the first focus or the second focus.

[0075] FIG. 3 is a flowchart describing a method of correcting ultrasound images, according to an embodiment of the present invention.

[0076] Referring to FIG. 3, the method includes operations that are chronologically performed in the ultrasound images correcting apparatus 200 of FIG. 2. Thus, although some features are omitted in the description below, if the features are described above with reference to the ultrasound images correcting apparatus 200 of FIG. 2, the features are also applied to the method of FIG. 3.

[0077] As illustrated in FIG. 3, according to the present embodiment, the ultrasound images correcting apparatus 200 may output an ultrasound signal from the ultrasound output unit 210 to a target object (operation S310).

[0078] Here, the ultrasound images correcting apparatus 200 may obtain an interest index map indicating a correlation between depth values according to a travel direction of the output ultrasound signal, and an interest index by the output ultrasound signal (operation S320). The interest index map may include an MI map, a TI map, and an acoustic pressure map.

[0079] The interest index displayed on the interest index map may vary according to the depth values. For example, as illustrated in FIG. 4, an MI may vary according to the depth values.

[0080] The ultrasound images correcting apparatus 200 uses a focus beam, and thus, the MI at the depth value corresponding to a focus may be a maximum value. The acoustic pressure map may have a similar graph as that of the MI map in FIG. 4. Also, in a case of the TI map, a graph of the TI map may be similar to that of the MI map or the acoustic pressure map, however, a TI may be greater at a depth value that is lower than the depth value corresponding to the focus.

[0081] The ultrasound images correcting apparatus 200 may generate the interest index map as a 1 D map, a 2D map, or a 3D map. For example, in a case where the ultrasound images correcting apparatus 200 uses a 1 D probe, the ultrasound images correcting apparatus 200 may calculate interest indexes corresponding to the depth values 120 and the scan lines 130 and then may generate a 2D map. In this case, the ultrasound images correcting apparatus 200 may generate a 3D map by stereographically expressing the interest indexes corresponding to the depth values 120 and the scan lines 130 in the form of a net. In another embodiment, the ultrasound images correcting apparatus 200 may express the interest indexes as an interest index map that is not fixed but varies according to time (frame) while ultrasound scanning is performed. That is, the ultrasound images correcting apparatus 200 may calculate interest indexes according to the depth values 120, the scan lines 130, and time, and then may generate a 3D map.

[0082] In a case where the ultrasound images correcting apparatus 200 uses a 1.5D probe or a 2D (matrix) probe, the ultrasound images correcting apparatus 200 may express interest indexes with respect to an axial direction (depth values), a lateral direction (scan line values), and an elevation direction, as the 3D map.

[0083] The ultrasound images correcting apparatus 200 may express the interest index map as one of various types including a contour line map, a gray map, a mesh map, and a color map.

[0084] Referring back to FIG. 3, in order to allow an interest index value, which is displayed on the interest index map, to be a virtually constant interest index value with respect to all depth values, the ultrasound images correcting apparatus 200 may adjust a gain value of an ultrasound echo signal by using a reverse interest index map (operation S330).

[0085] For example, as illustrated in FIG. 5, the ultrasound images correcting apparatus 200 may obtain an MI map 510 having a maximum MI value of 1.3 at a depth value a. In this case, the ultrasound images correcting apparatus 200 may adjust the gain value of the ultrasound echo signal by using a reverse MI map 520, so as to allow MIs, which correspond to all depth values, to be a constant value (e.g., a maximum MI value). Referring to FIG. 5, virtual MIs 530 with respect to all depth values become 1.3, which is the maximum MI value of the MI map 510.

[0086] Referring back to FIG. 3, the ultrasound images correcting apparatus 200 may correct ultrasound image of the target object by using the adjusted gain value (operation S340). That is, the ultrasound images correcting apparatus 200 corrects the ultrasound image by re-generating the ultrasound image of the target object by using the ultrasound echo signal having the adjusted gain value.

[0087] According to the present embodiment, the ultrasound images correcting apparatus 200 may display the corrected ultrasound images (operation S350). That is, the ultrasound images correcting apparatus 200 may display the ultrasound images that are re-generated by adjusting the gain value of the ultrasound echo signal.

[0088] FIG. 6 is a flowchart describing a method of correcting ultrasound images having multiplex focuses, according to another embodiment of the present invention.

[0089] Referring to FIG. 6, the method includes operations that are chronologically performed in the ultrasound images correcting apparatus 200 of FIG. 2. Thus, although some features are omitted in the description below, if the features are described above with reference to the ultrasound images correcting apparatus 200 of FIG. 2, the features are also applied to the method of FIG. 6.

[0090] As illustrated in FIG. 6, according to the present embodiment, the ultrasound images correcting apparatus 200 may output ultrasound signals having a first focus and a second focus from the ultrasound output unit 210 (operation S610).

[0091] In this case, the ultrasound images correcting apparatus 200 may obtain a first interest index map and a second interest index map that correspond to the first focus and the second focus, respectively (operation S620). The first interest index map and the second interest index map may include at least one of an MI map, a TI map, and an acoustic pressure map. Hereinafter, an MI is described as an example of an interest index.

[0092] According to the present embodiment, the ultrasound images correcting apparatus 200 may adjust a gain value of an ultrasound echo signal corresponding to the first focus by using a first reverse MI map, so as to allow MI values, which are displayed on a first MI map, to be a virtual first MI value with respect to all depth values (operation S630).

[0093] Also, the ultrasound images correcting apparatus 200 may adjust the gain value of the ultrasound echo signal corresponding to the second focus by using a second reverse MI map, so as to allow MI values, which are displayed on a second MI map, to be a virtual second MI value with respect to all depth values (operation S640).

[0094] Here, the virtual first MI value may be decided based on a maximum MI value of the first MI map, and the virtual second MI value may be decided based on a maximum MI value of the second MI map.

[0095] According to the present embodiment, the ultrasound images correcting apparatus 200 may determine whether the virtual first MI value and the virtual second MI value are the same (operation S650).

[0096] If they are not the same, in order to allow the virtual first MI value and the virtual second MI value to be equal to each other, the ultrasound images correcting apparatus 200 re-adjusts the adjusted gain value of the ultrasound echo signal corresponding to the first focus or the adjusted gain value of the ultrasound echo signal corresponding to the second focus (operation S660).

[0097] For example, referring to FIG. 7, in a case where the ultrasound output unit 210 outputs ultrasound signals having an x-focus, a y-focus, and a z-focus, the ultrasound images correcting apparatus 200 may obtain MI maps 710 corresponding to the x-focus, the y-focus, and the z-focus, respectively.

[0098] In this case, the ultrasound images correcting apparatus 200 may adjust a gain value of an ultrasound echo signal corresponding to each focus by using reverse MI maps 720, so as to allow MIs, which correspond to all depth values, to be a constant value (e.g., a maximum MI).

[0099] In a case of the x-focus, in order to allow MIs at all depth values to be 1.2, which is a maximum MI value corresponding to the x-focus, the ultrasound images correcting apparatus 200 first adjusts a gain value of an ultrasound echo signal received at the x-focus.

[0100] In a case of the y-focus, in order to allow Mis at all depth values to be 1.3, which is a maximum MI value corresponding to the y-focus, the ultrasound images correcting apparatus 200 first adjusts a gain value of an ultrasound echo signal received at the y-focus.

[0101] In a case of the z-focus, in order to allow MIs at all depth values to be 1.2, which is a maximum MI value corresponding to the z-focus, the ultrasound images correcting apparatus 200 first adjusts a gain value of an ultrasound echo signal received at the z-focus.

[0102] After the first adjustment, a virtual MI corresponding to the x-focus becomes 1.2, a virtual MI corresponding to the y-focus becomes 1.3, and a virtual MI corresponding to the z-focus becomes 1.2.

[0103] Here, the virtual MIs that correspond to the x, y, and z focuses, respectively, have different values of 1.2 and 1.3 (refer to reference numeral 730 of FIG. 7). Thus, in order to allow all of the virtual MIs, which correspond to the x, y, and z focuses, to be 1.3, the ultrasound images correcting apparatus 200 secondly re-adjusts the ultrasound echo signal received at the x-focus and the ultrasound echo signal received at the z-focus.

[0104] The ultrasound images correcting apparatus 200 may adjust a first ultrasound transmission voltage corresponding to the first focus or a second ultrasound transmission voltage corresponding to the second focus, so as to allow a first maximum MI corresponding to the first focus and a second maximum MI corresponding to the second focus to be equal to each other.

[0105] For example, in a case where a maximum MI corresponding to the x-focus is 1.2, and a maximum MI corresponding to the y-focus is 1.3, the ultrasound images correcting apparatus 200 may increase the ultrasound transmission voltage corresponding to the x-focus so as to allow the maximum MI, which corresponds to the x-focus, to become 1.3 from 1.2.

[0106] In this case, the maximum MIs that correspond to the x, y, and z focuses, respectively, may be equalized by adjusting the ultrasound transmission voltages, so that the virtual MIs that correspond to the x, y, and z focuses, respectively, may be equalized. Thus, the ultrasound images correcting apparatus 200 may not re-adjust the gain value of the ultrasound echo signal.

[0107] Referring back to FIG. 6, the ultrasound images correcting apparatus 200 may re-generate the ultrasound image of the target object by blending the ultrasound echo signal having the adjusted gain value corresponding to the first focus with the ultrasound echo signal having the adjusted gain value corresponding to the second focus, and thus, may correct the ultrasound images (operation S670). In this case, the ultrasound images correcting apparatus 200 may display the corrected ultrasound images (operation S680).

[0108] Thus, according to the one or more embodiments of the present invention, it is possible to provide the uniform ultrasound images to the user by using the interest index map.

[0109] The invention can also be embodied as programmed commands to be executed in various computer means, and then can be recorded to a computer-readable recording medium. The computer-readable recording medium may include one or more of the programmed commands, data files, data structures, or the like. The programmed commands recorded to the computer-readable recording medium may be particularly designed or configured for the invention or may be well known to one of ordinary skill in the art. Examples of the computer-readable recording medium include magnetic media including hard disks, magnetic tapes, and floppy disks, optical media including CD-ROMs, and DVDs, magneto-optical media including floptical disks, and a hardware apparatus designed to store and execute the programmed commands in read-only memory (ROM), random-access memory (RAM), flash memories, and the like. Examples of the programmed commands include not only machine codes generated by a compiler but also include great codes to be executed in a computer by using an interpreter.

Claims

1. A method of correcting ultrasound images, the method comprising:

outputting an ultrasound signal to a target object and receiving an ultrasound echo signal corresponding to the output ultrasound signal;
obtaining an mechanical index (MI) map indicating a correlation between depth values according to a travel direction of the ultrasound signal, and mechanical index (MI) values by the ultrasound signal;
characterised in that it further comprises:

obtaining a reverse mechanical index (MI) map by reversing the mechanical index (MI) map and
adjusting a gain value of the ultrasound echo signal for each of the depth values by using the reverse mechanical index (MI) map, so that the mechanical index (MI) values, which are displayed on the mechanical index (MI) map to be a virtually constant mechanical index (MI) value with respect to the depth values.

2. The method of claim 1, further comprising:

generating ultrasound image of the target object based on the ultrasound echo signal having the adjusted gain value; and
displaying the ultrasound image.

3. A method of correcting ultrasound images, the method comprising:

outputting an ultrasound signal to a target object and receiving an ultrasound echo signal corresponding to the output ultrasound signal;
obtaining an acoustic pressure map indicating a correlation between depth values according to a travel direction of the ultrasound signal, and acoustic pressure values by the ultrasound signal;
characterised in that it further comprises:

obtaining a reverse acoustic pressure map by reversing the acoustic pressure map and adjusting a gain value of the ultrasound echo signal for each of the depth values by using the reverse acoustic pressure map, so that the acoustic pressure values, which are displayed on the acoustic pressure map to be a virtually constant acoustic pressure value with respect to the depth values.

4. A method of correcting ultrasound images, the method comprising:

outputting an ultrasound signal to a target object and receiving an ultrasound echo signal corresponding to the output ultrasound signal;
obtaining an thermal index (TI) map indicating a correlation between depth values according to a travel direction of the ultrasound signal, and thermal index (TI) values by the ultrasound signal;
characterised in that it further comprises:

obtaining a reverse thermal index (TI) map by reversing the thermal index (TI) map and adjusting a gain value of the ultrasound echo signal for each of the depth values by using the reverse thermal index (TI) map, so that the thermal index (TI) values, which are displayed on the thermal index (TI) map to be a virtually constant thermal index (TI) value with respect to the depth values.

5. The method of claim 1, wherein the method comprises:

outputting ultrasound signals having a first focus and a second focus;
obtaining a first mechanical index (MI) map and a second mechanical index (MI) map that correspond to the first focus and the second focus, respectively;
adjusting a gain value of an ultrasound echo signal corresponding to the first focus by using a first reverse mechanical index (MI) map that is obtained by reversing the first mechanical index (MI) map, so as to allow the mechanical index (MI) values, which are displayed on the first mechanical index (MI) map, to be a virtual first mechanical index (MI) value with respect to the depth values (120); and
adjusting a gain value of an ultrasound echo signal corresponding to the second focus by using a second reverse mechanical index (MI) map that is obtained by reversing the second mechanical index (MI) map, so as to allow the mechanical index (MI) values, which are displayed on the second mechanical index (MI) map, to be a virtual second mechanical index (MI) value with respect to the depth values (120).

6. The method of claim 5, wherein the virtual first mechanical index (MI) value is decided based on a maximum mechanical index (MI) value the first mechanical index (MI) map, and the virtual second mechanical index (MI) value is decided based on a maximum mechanical index (MI) value of the second mechanical index (MI) map.

7. The method of claim 6, further comprising:

determining whether the virtual first mechanical index (MI) value and the virtual second mechanical index (MI) value are equal to each other; and if not equal, re-adjusting the adjusted gain value of the ultrasound echo signal corresponding to the first focus or the adjusted gain value of the ultrasound echo signal corresponding to the second focus, so as to allow the virtual first mechanical index (MI) value and the virtual second mechanical index (MI) value to be equal to each other.

8. The method of claim 5, wherein the method comprises:

generating the ultrasound image of the target object by blending the ultrasound echo signal having the adjusted gain value corresponding to the first focus with the ultrasound echo signal having the adjusted gain value corresponding to the second focus; and
displaying the ultrasound image.

9. The method of claim 5, further comprising adjusting a first ultrasound transmission voltage corresponding to the first focus or a second ultrasound transmission voltage corresponding to the second focus, so as to allow a first maximum mechanical index (MI) corresponding to the first focus and a second maximum mechanical index (MI) corresponding to the second focus to be equal to each other.

10. An ultrasound images correcting apparatus comprising:

an ultrasound output unit for outputting an ultrasound signal to a target object and receiving an ultrasound echo signal corresponding to the output ultrasound signal;
a map obtaining unit for obtaining an mechanical index (MI) map indicating a correlation between depth values according to a travel direction of the ultrasound signal, and mechanical index (MI)values by the ultrasound signal; **characterised in that** it further comprises
a control unit for obtaining a reverse mechanical index (MI) map by reversing the mechanical index (MI) map and adjusting a gain value of the ultrasound echo signal for each of the depth values by using the reverse mechanical index (MI) map, so that the mechanical index (MI) values, which are displayed on the mechanical index (MI) map to be a virtually constant mechanical index (MI) value with respect to the depth values.

11. The ultrasound images correcting apparatus of claim 10, further comprising:

an ultrasound image correcting unit for generating ultrasound image of the target object based on the ultrasound echo signal having the adjusted gain value; and
a display unit for displaying the ultrasound image.

12. An ultrasound images correcting apparatus comprising:

an ultrasound output unit for outputting an ultrasound signal to a target object and receiving an ultrasound echo signal corresponding to the output ultrasound signal;
a map obtaining unit for obtaining an acoustic pressure map indicating a correlation between depth values according to a travel direction of the ultrasound signal, and acoustic pressure values by the ultrasound signal; **characterised in that** it further comprises
a control unit for obtaining a reverse acoustic pressure map by reversing the acoustic pressure map and adjusting a gain value of the ultrasound echo signal for each of the depth values by using the reverse acoustic pressure map, so that the acoustic pressure values, which are displayed on the acoustic pressure map to be a virtually constant acoustic pressure value with respect to the depth values.

13. An ultrasound images correcting apparatus comprising:

an ultrasound output unit for outputting an ultrasound signal to a target object and receiving an ultrasound echo signal corresponding to the output ultrasound signal;
a map obtaining unit for obtaining an thermal index (TI) map indicating a correlation between depth values according to a travel direction of the ultrasound signal, and thermal index (TI)values by the ultrasound signal; **characterised in that** it further comprises
a control unit for obtaining a reverse thermal index (TI) map by reversing the thermal index (TI) map and adjusting a gain value of the ultrasound echo signal for each of the depth values by using the reverse thermal index (TI) map, so that the thermal index (TI) values, which are displayed on the thermal index (TI) map to be a virtually constant thermal index (TI) value with respect to the depth values.

14. The ultrasound images correcting apparatus (200) of claim 10, wherein the ultrasound output unit (210) outputs ultrasound signals having a first focus and a second focus;
the map obtaining unit (220) is adapted to obtain a first mechanical index (MI) map and a second mechanical index (MI) map that correspond to the first focus and the second focus, respectively; and

the control unit (250) is adapted to adjust a gain value of an ultrasound echo signal corresponding to the first focus by using a first reverse mechanical index (MI) map that is obtained by reversing the first mechanical index (MI) map, so as to allow the mechanical index (MI) values, which are displaced on the first mechanical index (MI) map, to be a virtual first mechanical index (MI) value with respect to the depth values (120), and adjusts a gain value of an utirasound echo signal corresponding to the second focus by using a second reverse mechanical index (MI) map that is obtained by reversing the second mechanical index (MI) map, so as to allow the mechanical index (MI) values, which are displayed on the second mechanical index (MI) map, to be a virtual second mechanical index (MI) value with respect to the depth values (120.)

15. A computer-readable recording medium having recoded thereon a program for executing the method of claim 1.

Patentansprüche

1. Verfahren für die Korrektur von Ultraschallbildern, wobei das Verfahren Folgendes aufweist:

Ausgeben eines Ultraschallsignals an ein Zielobjekt und Empfangen eines dem ausgegebenen Ultraschallsignal entsprechenden Ultraschallechosignals;
Erlangen eines mechanischen Index (MI)-Kennfelds, das eine Korrelation zwischen Tiefenwerten gemäß einer Bewegungsrichtung des Ultraschallsignals und mechanischen Index (MI)-Werten durch das Ultraschallsignal anzeigt;
dadurch gekennzeichnet, dass
es des Weiteren Folgendes aufweist:

Erlangen eines umgekehrten mechanischen Index (MI)-Kennfelds durch Umkehren des mechanischen Index (MI)-Kennfelds; und
Einstellen eines Steigerungswerts des Ultraschallechosignals für jeden der Tiefenwerte durch Verwenden des umgekehrten mechanischen Index (MI)-Kennfelds, so dass die mechanischen Index (MI)-Werte, die auf dem mechanischen Index (MI)-Kennfeld angezeigt werden, ein im Wesentlichen konstanter mechanischer Index (MI)-Wert in Bezug auf die Tiefenwerte sind.

2. Verfahren nach Anspruch 1, welches des Weiteren Folgendes aufweist:

Erzeugen eines Ultraschallbilds des Zielobjekts basierend auf dem Ultraschallechosignal, welches den eingestellten Steigerungswert aufweist; und
Anzeigen des Ultraschallbilds.

3. Verfahren für die Korrektur von Ultraschallbildern, wobei das Verfahren Folgendes aufweist:

Ausgeben eines Ultraschallsignals an ein Zielobjekt und Empfangen eines dem ausgegebenen Ultraschallsignal entsprechenden Ultraschallechosignals;
Erlangen eines akustischen Druckkennfelds, das einen Zusammenhang zwischen Tiefenwerten gemäß einer Bewegungsrichtung des Ultraschallsignals und akustischen Druckwerten durch das Ultraschallsignal anzeigt;
dadurch gekennzeichnet, dass
es des Weiteren Folgendes aufweist:

Erlangen eines umgekehrten akustischen Druckkennfelds durch Umkehren des akustischen Druckkennfelds; und
Einstellen eines Steigerungswerts des Ultraschallechosignals für jeden der Tiefenwerte durch Verwenden des umgekehrten akustischen Druckkennfelds, so dass die akustischen Druckwerte, die auf dem akustischen Druckkennfeld angezeigt werden, ein im Wesentlichen konstanter akustischer Druckwert in Bezug auf die Tiefenwerte sind.

4. Verfahren für die Korrektur von Ultraschallbildern, wobei das Verfahren Folgendes aufweist:

Ausgeben eines Ultraschallsignals an ein Zielobjekt und Empfangen eines dem ausgegebenen Ultraschallsignal entsprechenden Ultraschallechosignals;
Erlangen eines thermischen Index (TI)-Kennfelds, das eine Korrelation zwischen Tiefenwerten gemäß einer Bewegungsrichtung des Ultraschallsignals und thermischen Index (TI)-Werten durch das Ultraschallsignal anzeigt;
dadurch gekennzeichnet, dass
es des Weiteren Folgendes aufweist:

Erlangen eines umgekehrten thermischen Index (TI)-Kennfelds durch Umkehren des thermischen Index (TI)-Kennfelds; und
Einstellen eines Steigerungswerts des Ultraschallechosignals für jeden der Tiefenwerte durch Verwenden des umgekehrten thermischen Index (TI)-Kennfelds, so dass die thermischen Index (TI)-Werte, die auf dem thermischen Index (TI)-Kennfeld an-

gezeigt werden, ein im Wesentlichen konstanter thermischen Index (TI)-Wert in Bezug auf die Tiefenwerte sind.

5. Verfahren nach Anspruch 1, wobei das Verfahren Folgendes aufweist:

Ausgeben von Ultraschallsignalen, die einen ersten Fokus und einen zweiten Fokus aufweisen;
Erlangen eines ersten mechanischen Index (MI)-Kennfelds und eines zweiten mechanischen Index (MI)-Kennfelds, die jeweils dem ersten Fokus und dem zweiten Fokus entsprechen;
Einstellen eines Steigerungswerts eines Ultraschallechosignals entsprechend dem ersten Fokus durch Verwenden eines ersten umgekehrten mechanischen Index (MI)-Kennfelds, das durch Umkehren des ersten mechanischen Index (MI)-Kennfelds erhalten wird, um es den mechanischen Index (MI)-Werten, die auf dem ersten mechanischen Index (MI)-Kennfeld angezeigt werden, zu erlauben, ein virtueller erster mechanischer Index (MI)-Wert in Bezug auf die Tiefenwerte (120) zu sein; und
Einstellen eines Steigerungswerts eines Ultraschallechosignals entsprechend dem zweiten Fokus durch Verwenden eines zweiten umgekehrten mechanischen Index (MI)-Kennfelds, das durch Umkehren des zweiten mechanischen Index (MI)-Kennfelds erhalten wird, um es den mechanischen Index (MI)-Werten, die auf dem zweiten mechanischen Index (MI)-Kennfeld angezeigt werden, zu erlauben, ein virtueller zweiter mechanischer Index (MI)-Wert in Bezug auf die Tiefenwerte (120) zu sein.

6. Verfahren nach Anspruch 5, wobei der virtuelle erste mechanische Index (MI)-Wert basierend auf einem maximalen mechanischen Index (MI)-Wert des ersten mechanischen Index (MI)-Kennfelds bestimmt wird, und wobei der virtuelle zweite mechanische Index (MI)-Wert basierend auf einem maximalen mechanischen Index (MI)-Wert des zweiten mechanischen Index (MI)-Kennfelds bestimmt wird.

7. Verfahren nach Anspruch 6, welches des Weiteren Folgendes aufweist:

Festlegen, ob der virtuelle erste mechanische Index (MI)-Wert und der virtuelle zweite mechanische Index (MI)-Wert gleich zueinander sind; und
wenn sie nicht gleich sind, nochmaliges Einstellen des eingestellten Steigerungswerts des Ultraschallechosignals entsprechend dem ersten Fokus oder dem eingestellten Wert des Ultraschallechosignals entsprechend dem zweiten Fokus, um es dem virtuellen ersten mechanischen Index (MI)-Wert und dem virtuellen zweiten mechanischen Index (MI)-Wert zu erlauben, gleich zueinander zu sein.

8. Verfahren nach Anspruch 5, wobei das Verfahren Folgendes aufweist:

Erzeugen des Ultraschallbilds des Zielobjekts durch Vermischen des Ultraschallechosignals, welches den eingestellten Steigerungswert entsprechend dem ersten Fokus aufweist, mit dem Ultraschallechosignal, welches den eingestellten Steigerungswert entsprechend dem zweiten Fokus aufweist; und
Anzeigen des Ultraschallbilds.

9. Verfahren nach Anspruch 5, welches des Weiteren das Einstellen einer ersten Ultraschallübertragungsspannung entsprechend dem ersten Fokus oder einer zweiten Ultraschallübertragungsspannung entsprechend dem zweiten Fokus aufweist, um es einem ersten maximalen mechanischen Index (MI)-Wert entsprechend dem ersten Fokus und einem zweiten maximalen mechanischen Index (MI)-Wert entsprechend dem zweiten Fokus zu erlauben, gleich zueinander zu sein.

10. Vorrichtung für die Korrektur von Ultraschallbildern, welche Folgendes aufweist:

eine Ultraschallausgabeeinheit zum Ausgeben eines Ultraschallsignals an ein Zielobjekt und zum Empfangen eines dem ausgegebenen Ultraschallsignal entsprechenden Ultraschallechosignals;
eine Kennfelderlangungseinheit zum Erlangen eines mechanischen Index (MI)-Kennfelds, das eine Korrelation zwischen Tiefenwerten gemäß einer Bewegungsrichtung des Ultraschallsignals und mechanischen Index (MI)-Werten durch das Ultraschallsignal anzeigt;
dadurch gekennzeichnet, dass
es des Weiteren Folgendes aufweist:

eine Steuereinheit zum Erlangen eines umgekehrten mechanischen Index (MI)-Kennfelds durch Umkehren des mechanischen Index (MI)-Kennfelds und zum Einstellen eines Steigerungswerts für das Ultraschallechosignal für jeden der Tiefenwerte durch Verwenden des umgekehrten mechanischen Index (MI)-Kennfelds, so dass die mechanischen Index (MI)-Kennfelder, die auf dem mechanischen Index (MI)-Kennfeld angezeigt werden, ein im Wesentlichen konstanter mechanischer Index (MI)-Wert in Bezug auf die Tiefenwerte sind.

11. Vorrichtung für die Korrektur von Ultraschallbildern nach Anspruch 10, welches des Weiteren Folgendes aufweist:

eine Ultraschallbildkorrektureinheit zum Erzeugen eines Ultraschallbilds des Zielobjekts basierend auf dem Ultraschallechosignal, welches den eingestellten Steigerungswert aufweist; und
eine Anzeigeeinheit zum Anzeigen des Ultraschallbilds.

12. Vorrichtung für die Korrektur von Ultraschallbildern, welche Folgendes aufweist:

eine Ultraschallausgabeeinheit zum Ausgeben eines Ultraschallsignals an ein Zielobjekt und zum Empfangen eines dem ausgegebenen Ultraschallsignal entsprechenden Ultraschallechosignals;
eine Kennfelderlangungseinheit zum Erlangen eines akustisches Druckkennfelds, das eine Korrelation zwischen Tiefenwerten gemäß einer Bewegungsrichtung des Ultraschallsignals und akustische Druckwerten durch das Ultraschallsignal anzeigt;
dadurch gekennzeichnet, dass
es des Weiteren Folgendes aufweist:

eine Steuereinheit zum Erlangen eines umgekehrten akustischen Druckkennfelds durch Umkehren des akustischen Druckkennfelds und zum Einstellen eines Steigerungswerts für das Ultraschallechosignal für jeden der Tiefenwerte durch Verwenden des umgekehrten akustischen Druckkennfelds, so dass die akustischen Druckkennfelder, die auf dem akustischen Druckkennfeld angezeigt werden, ein im Wesentlichen konstanter akustischer Druckwert in Bezug auf die Tiefenwerte sind.

13. Vorrichtung für die Korrektur von Ultraschallbildern, welche Folgendes aufweist:

eine Ultraschallausgabeeinheit zum Ausgeben eines Ultraschallsignals an ein Zielobjekt und zum Empfangen eines dem ausgegebenen Ultraschallsignal entsprechenden Ultraschallechosignals;
eine Kennfelderlangungseinheit zum Erlangen eines thermischen Index (TI)-Kennfelds, das eine Korrelation zwischen Tiefenwerten gemäß einer Bewegungsrichtung des Ultraschallsignals und thermischen Index (TI)-Werten durch das Ultraschallsignal anzeigt;
dadurch gekennzeichnet, dass
es des Weiteren Folgendes aufweist:

eine Steuereinheit zum Erlangen eines umgekehrten thermischen Index (TI)-Kennfelds durch Umkehren des thermischen Index (TI)-Kennfelds und zum Einstellen eines Steigerungswerts für das Ultraschallechosignal für jeden der Tiefenwerte durch Verwenden des umgekehrten thermischen Index (TI)-Kennfelds, so dass die thermischen Index (TI)-Kennfelder, die auf dem thermischen Index (TI)-Kennfeld angezeigt werden, ein im Wesentlichen konstanter thermischer Index (TI)-Wert in Bezug auf die Tiefenwerte sind.

14. Vorrichtung (200) für die Korrektur von Ultraschallbildern nach Anspruch 10, wobei die Ultraschallausgabeeinheit (210) Ultraschallsignale ausgibt, welche einen ersten Fokus und einen zweiten Fokus aufweisen;
die Kennfelderlangungseinheit (220) dafür vorgesehen ist, ein erstes mechanisches Index (MI)-Kennfeld und ein zweites mechanisches Index (MI)-Kennfeld zu erlangen, die jeweils dem ersten Fokus und dem zweiten Fokus entsprechen; und
die Steuereinheit (250) dafür vorgesehen ist, einen Steigerungswert eines Ultraschallechosignals entsprechend dem ersten Fokus durch Verwenden eines ersten umgekehrten mechanischen Index (MI)-Kennfelds einzustellen, welche durch Umkehren des ersten mechanischen Index (MI)-Kennfelds erlangt wird, um es den mechanischen Index (MI)-Werten, die auf dem ersten mechanischen Index (MI)-Kennfeld angezeigt werden, zu erlauben, ein virtueller erster mechanischer Index (MI)-Wert in Bezug auf die Tiefenwerte (120) zu sein, und einen Steigerungswert eines Ultraschallechosignals entsprechend dem zweiten Fokus durch Verwenden eines zweiten umgekehrten mechanischen Index (MI)-Kennfelds einzustellen, welche durch Umkehren des zweiten mechanischen Index (MI)-Kennfelds erlangt wird, um es den mechanischen Index (MI)-Werten, die auf dem zweiten mechanischen Index (MI)-Kennfeld angezeigt werden, zu erlauben, ein virtueller zweiter mechanischer Index (MI)-Wert in Bezug auf die Tiefenwerte (120) zu sein.

15. Computerlesbares Aufzeichnungsmedium, auf dem ein Programm zur Durchführung des Verfahrens nach Anspruch 1 aufgezeichnet ist.

Revendications

1. Procédé de correction d’images ultrasoniques, ce procédé comportant :

l'émission d'un signal ultrasonique vers un objet cible et la réception d'un signal d'écho correspondant au signal de sortie ultrasonique ;
l'obtention d'une carte d'indice mécanique (MI) indiquant une corrélation entre les valeurs de profondeur relatives à une direction de trajet du signal ultrasonique et les valeurs des indices mécaniques (MI) par le signal ultrasonique ;
caractérisé en ce qu'il comporte en outre :

l'obtention d'une carte d'indices mécaniques inverses (MI) en inversant la carte des indices mécaniques (MI) et
l'ajustage d'un gain de valeur du signal d'écho ultrasonique pour chacune des valeurs de profondeurs par utilisation de la carte d'indices mécaniques inverses (MI), de sorte que les valeurs des indices mécaniques (MI) qui sont affichées sur la carte d'indices mécaniques inverses (MI) constituent une valeur d'indice mécanique (MI) virtuellement constante par rapport aux valeurs de profondeur.

2. Procédé selon la revendication 1, comportant en outre :

la génération d'une image ultrasonique de l'objet cible sur la base du signal d'écho ayant une valeur de gain ajustée ; et
l'affichage de l'image ultrasonique.

3. Procédé de correction d'images ultrasoniques, ce procédé comportant :

l'émission d'un signal ultrasonique sur un objet cible et la réception d'un signal d'écho correspondant au signal de sortie ultrasonique ;
l'obtention d'une carte de pression acoustique indiquant la corrélation entre les valeurs de profondeur relatives à une direction de trajet du signal ultrasonique et les valeurs de pression acoustique du signal acoustique ;
caractérisé en ce qu'il comporte en outre :

l'obtention d'une carte de pression acoustique inverse en inversant la carte de la pression acoustique et
l'ajustage d'une valeur de gain du signal d'écho ultrasonique pour chacune des valeurs de profondeurs par utilisation de la carte des pressions inverses de sorte que les valeurs de pression acoustique qui sont affichées sur la carte de pressions acoustiques constituent une valeur de pression acoustique virtuellement constante par rapport aux valeurs de profondeur.

4. Procédé de correction d'images ultrasoniques, ce procédé comportant :

l'émission d'un signal ultrasonique sur un objet cible et la réception d'un signal d'écho correspondant au signal de sortie ultrasonique ;
l'obtention d'une carte d'indice thermique (TI) indiquant la corrélation entre les valeurs de profondeur relatives à une direction de trajet du signal ultrasonique et les valeurs d'indice thermique (TI) du signal acoustique ;
caractérisé en ce qu'il comporte en outre :

l'obtention d'une carte d'indices thermiques (TI) inverses en inversant la carte des indices thermiques (TI) et
l'ajustage d'une valeur de gain du signal d'écho ultrasonique pour chacune des valeurs d'indice thermique inverses (TI) par utilisation de la carte des indices thermiques inverses (TI) de sorte que les indices thermiques (TI) qui sont affichés sur la carte d'indices thermiques (TI) inverses constituent une valeur d'indice thermique (TI) inverse virtuellement constante par rapport aux valeurs de profondeur.

5. Procédé selon la revendication 1, dans lequel le procédé comporte :

l'émission de signaux ultrasoniques ayant un premier foyer et un second foyer ;
l'obtention d'une première carte d'indice mécanique (MI) et d'une seconde carte d'indice mécanique (MI) qui correspondent respectivement au premier et au second foyer;
l'ajustage d'une valeur de gain d'un signal d'écho ultrasonique correspondant au premier foyer en utilisant une première carte d'indice mécanique (MI) inverse qui est obtenue en inversant la première carte d'indice mécanique (MI) de manière à permettre aux valeurs d'indice mécanique (MI) qui sont affichées sur la première carte d'indice mécanique (MI) d'être une première valeur d'indice mécanique (MI) virtuel par rapport aux valeurs de profondeur (120) ; et
l'ajustage d'une valeur de gain d'un signal d'écho ultrasonique correspondant au second foyer en utilisant une seconde carte inverse d'indice mécanique (MI) qui est obtenue en inversant la seconde carte d'indice mécanique (MI) de manière à permettre aux valeurs d'indice mécanique (MI) qui sont affichées sur la seconde carte d'indice mécanique (MI) d'être une seconde valeur d'indice mécanique (MI) virtuel par rapport aux valeurs de profondeur (120).

6. Procédé selon la revendication 5, dans lequel la première valeur d'indice mécanique (MI) virtuelle est choisie sur la base d'une valeur maximale d'indice mécanique (MI) sur la première carte d'indice mécanique (MI), et la seconde valeur d'indice mécanique (MI) virtuelle est choisie sur la base d'une valeur maximale d'indice mécanique (MI) sur la seconde carte d'indice mécanique (MI).

7. Procédé selon la revendication 6, comportant en outre :

la détermination si la première valeur d'indice mécanique (MI) virtuelle et la seconde valeur d'indice mécanique (MI) virtuelle sont égales l'une à l'autre ; et
si elles ne sont pas égales, le réajustement de la valeur de gain du signal d'écho ultrasonique correspondant au premier foyer ou la valeur de gain réajustée du signal d'écho ultrasonique correspondant au second foyer, de manière à autoriser le première valeur d'indice mécanique (MI) virtuelle et la seconde valeur d'indice mécanique (MI) virtuelle d'être égales l'une à l'autre.

8. Procédé selon la revendication 5, dans lequel le procédé comporte :

la génération de l'image ultrasonique de l'objet cible en mélangeant le signal d'écho ultrasonique ayant la valeur de gain ajustée correspondant au premier foyer avec le signal d'écho ultrasonique ayant la valeur de gain ajustée correspondant au second foyer ; et
l'affichage de l'image ultrasonique.

9. Procédé selon la revendication 5, comportant en outre :

l'ajustage d'une première tension de transmission ultrasonique correspondant au premier foyer ou de la seconde tension de transmission ultrasonique correspondant au second foyer, de manière à permettre un premier maximum d'indice mécanique (MI) correspondant au premier foyer et un second maximum d'indice mécanique (MI) correspondant au second foyer d'être égaux entre eux.

10. Appareil de correction d'images ultrasoniques, comportant :

une unité émettrice pour émettre un signal ultrasonique d'un objet cible et
pour recevoir un signal d'écho correspondant au signal de sortie ultrasonique ;
une unité réceptrice pour obtenir une carte d'indice mécanique (MI) indiquant une corrélation entre les valeurs de profondeur relatives à une direction de trajet du signal ultrasonique et les valeurs des indices mécaniques (MI) par le signal ultrasonique ; **caractérisé en ce qu'**il comporte en outre une unité de commande pour obtenir une carte d'indices mécaniques inverses (MI) en inversant la carte des indices mécaniques (MI) et pour ajuster une valeur de gain du signal d'écho ultrasonique pour chacune des valeurs de profondeurs en utilisant de la carte des indices mécaniques inverses (MI), de telle manière que les valeurs d'indice mécanique (MI), qui sont affichées sur la carte des indices mécaniques inverses (MI) constituent un standard virtuel de valeur d'indice mécanique (MI) par rapport aux valeurs de profondeur.

11. Appareil de correction d'images ultrasoniques, selon la revendication 10, comportant en outre :

une unité de correction d'image ultrasonique pour générer une image ultrasonique de l'objet cible sur la base du signal d'écho ultrasonique ayant la valeur de gain ajustée ; et
une unité d'affichage pour afficher l'image ultrasonique.

12. Appareil de correction d'images ultrasoniques, comportant :

une unité émettrice pour émettre un signal ultrasonique sur un objet cible et pour recevoir un signal d'écho correspondant au signal de sortie ultrasonique ;
une unité d'obtention d'une carte pour obtenir une carte de pression acoustique indiquant une corrélation entre les valeurs de profondeur relatives à une direction de trajet du signal ultrasonique et les valeurs de pression acoustique par le signal ultrasonique ; **caractérisé en ce qu'**il comporte en outre
une unité de commande pour obtenir une carte de pression acoustique en inversant la carte des pressions acoustiques et en ajustant une valeur de gain du signal d'écho ultrasonique pour chacune des valeurs de profondeurs en utilisant la carte de pression acoustique, de telle manière que les valeurs de pression acoustique, qui sont affichées sur la carte de pression acoustique constituent une valeur de pression acoustique constante virtuelle par rapport aux valeurs de profondeur.

13. Appareil de correction d'images ultrasoniques, comportant :

une unité émettrice pour émettre un signal ul-

trasonique sur un objet cible et pour recevoir un signal d'écho correspondant au signal de sortie ultrasonique ;
une unité d'obtention d'une carte pour obtenir une carte d'indice thermique (TI) indiquant une corrélation entre les valeurs de profondeur relatives à une direction de trajet du signal ultrasonique et les valeurs d'indice thermique(TI) par le signal ultrasonique ; **caractérisé en ce qu'**il comporte en outre une unité de commande pour obtenir une carte d'indice thermique (TI) en inversant la carte d'indice thermique (TI) et en ajustant une valeur de gain du signal d'écho ultrasonique pour chacune des valeurs de profondeurs en utilisant la carte des indices thermiques (TI) inverses, de telle manière que les valeurs d'indice thermique (TI), qui sont affichées sur la carte d'indices thermiques (TI) constituent une valeur d'indice thermique (TI) virtuellement constante par rapport aux valeurs de profondeur.

14. Appareil de correction d'images ultrasoniques (200) selon la revendication 10, dans lequel l'unité émettrice (210) ultrasonique émet des signaux ultrasoniques ayant un premier foyer et un second foyer ;
l'unité d'obtention (220) d'une carte est agencée pour obtenir une première carte d'indice mécanique (MI) et une seconde carte d'indice mécanique (MI) qui correspondent respectivement au premier et au second foyers ; et
l'unité de commande (250) est agencée pour ajuster une valeur de gain d'un signal d'écho correspondant au premier foyer en utilisant un première carte d'indice mécanique (MI) inverses qui est obtenue en inversant la première carte d'indice mécanique (MI), de manière à autoriser les valeurs d'indice mécanique (MI), qui sont affichées sur la première carte des indices mécaniques inverses (MI) d'être une première valeur d'indice mécanique (MI) virtuelle par rapport par rapport aux valeurs de profondeur (120), et pour ajuster une valeur de gain du signal d'écho ultrasonique correspondant au second foyer en utilisant un seconde carte d'indice mécanique (MI) inverses qui est obtenue en inversant la seconde carte d'indice mécanique (MI), de manière à autoriser les valeurs d'indice mécanique (MI), qui sont affichées sur la seconde carte des indices mécaniques inverses (MI) d'être une seconde valeur d'indice mécanique (MI) virtuelle par rapport par rapport aux valeurs de profondeur (120).

15. Support lisible par un ordinateur programmé sur lequel est enregistré un programme pour exécuter le procédé selon la revendication 1.

FIG. 1

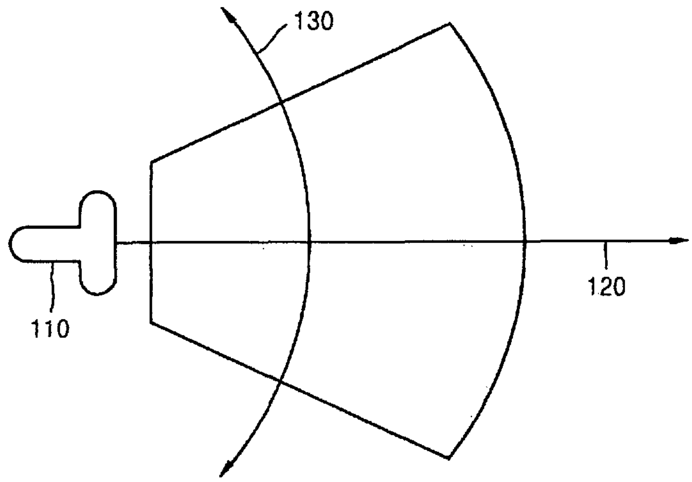

130
120
110

FIG. 2

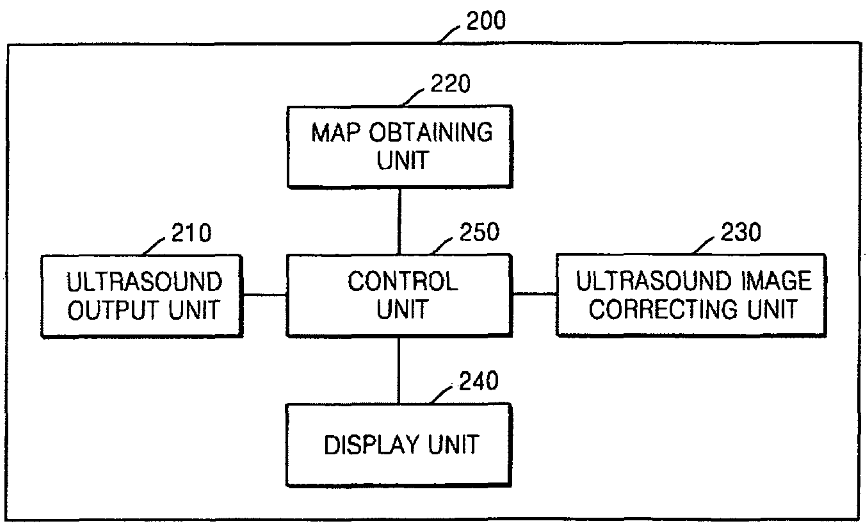

200
220
MAP OBTAINING UNIT
210
ULTRASOUND OUTPUT UNIT
250
CONTROL UNIT
230
ULTRASOUND IMAGE CORRECTING UNIT
240
DISPLAY UNIT

FIG. 3

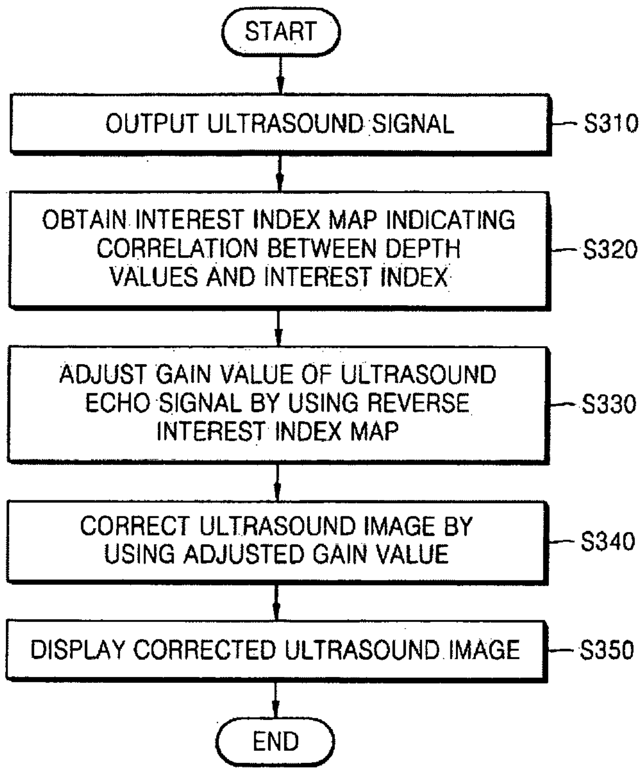

START
OUTPUT ULTRASOUND SIGNAL
S310
OBTAIN INTEREST INDEX MAP INDICATING CORRELATION BETWEEN DEPTH VALUES AND INTEREST INDEX
S320
ADJUST GAIN VALUE OF ULTRASOUND ECHO SIGNAL BY USING REVERSE INTEREST INDEX MAP
S330
CORRECT ULTRASOUND IMAGE BY USING ADJUSTED GAIN VALUE
S340
DISPLAY CORRECTED ULTRASOUND IMAGE
S350
END

FIG. 4

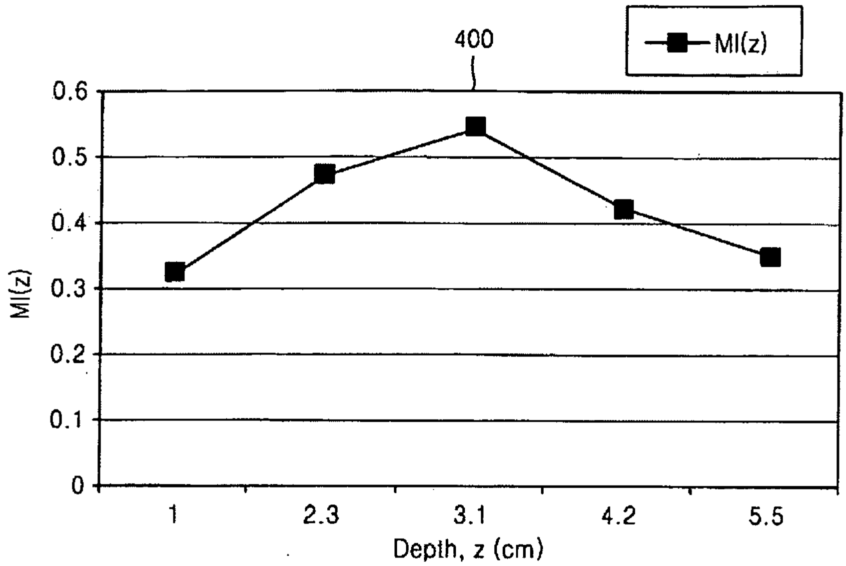

400
MI(z)
0.6
0.5
0.4
0.3
0.2
0.1
0
MI(z)
1
2.3
3.1
4.2
5.5
Depth, z (cm)

FIG. 5

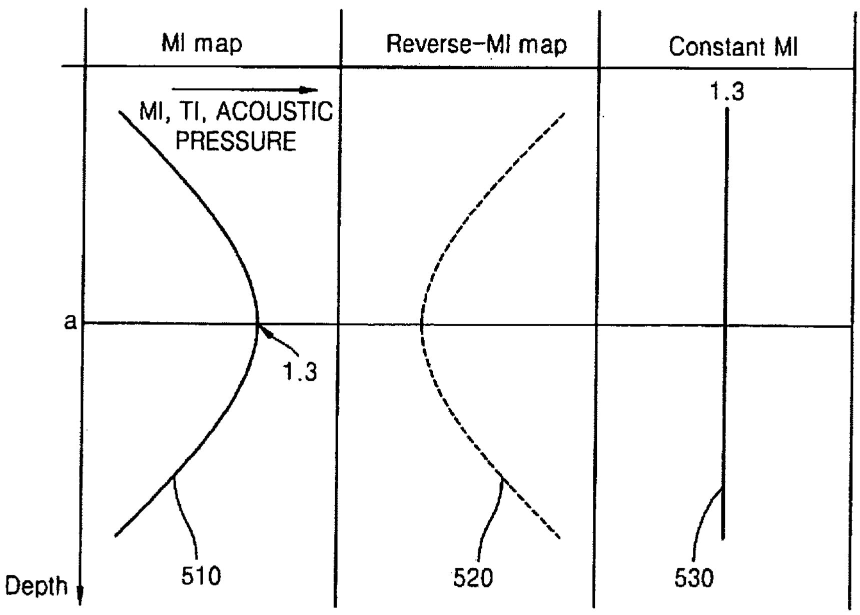

MI map
Reverse-MI map
Constant MI
MI, TI, ACOUSTIC PRESSURE
1.3
a
1.3
Depth
510
520
530

FIG. 6

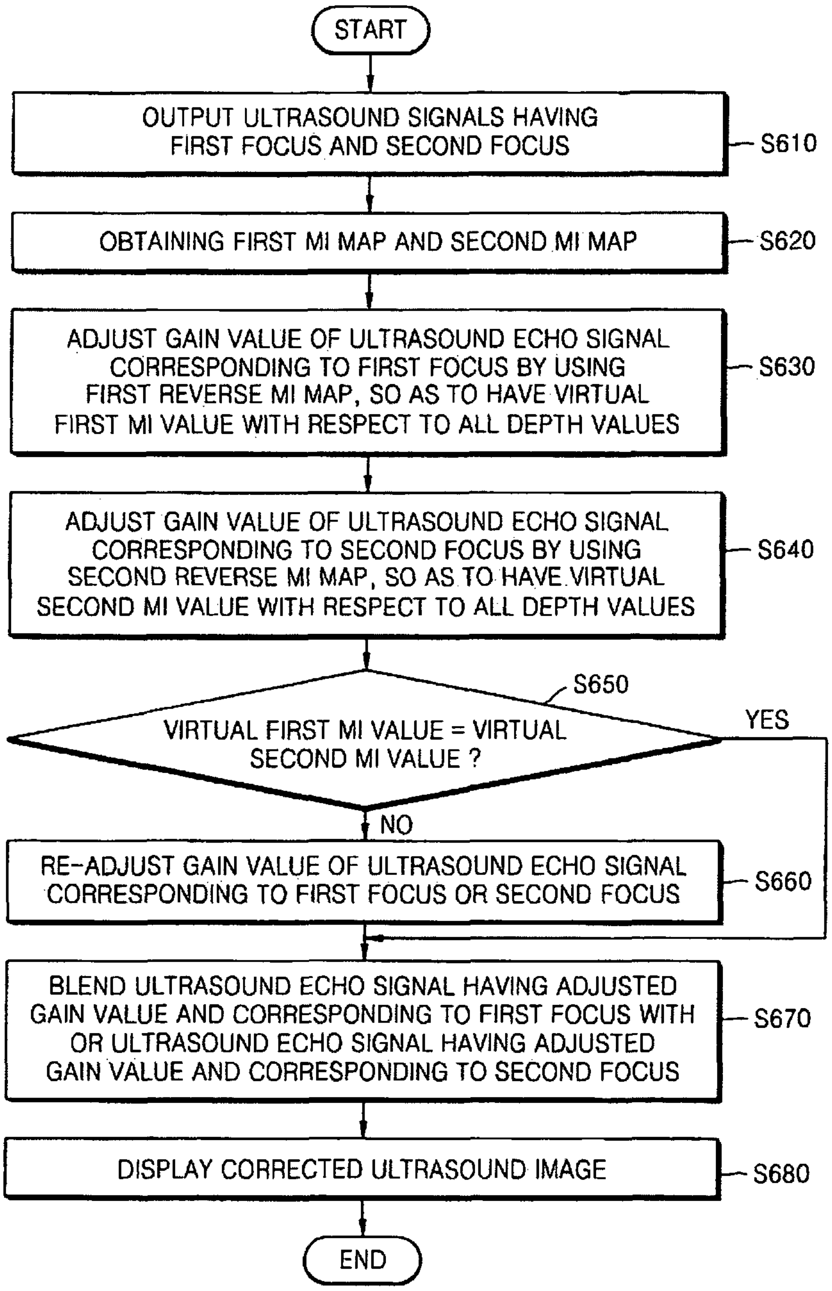
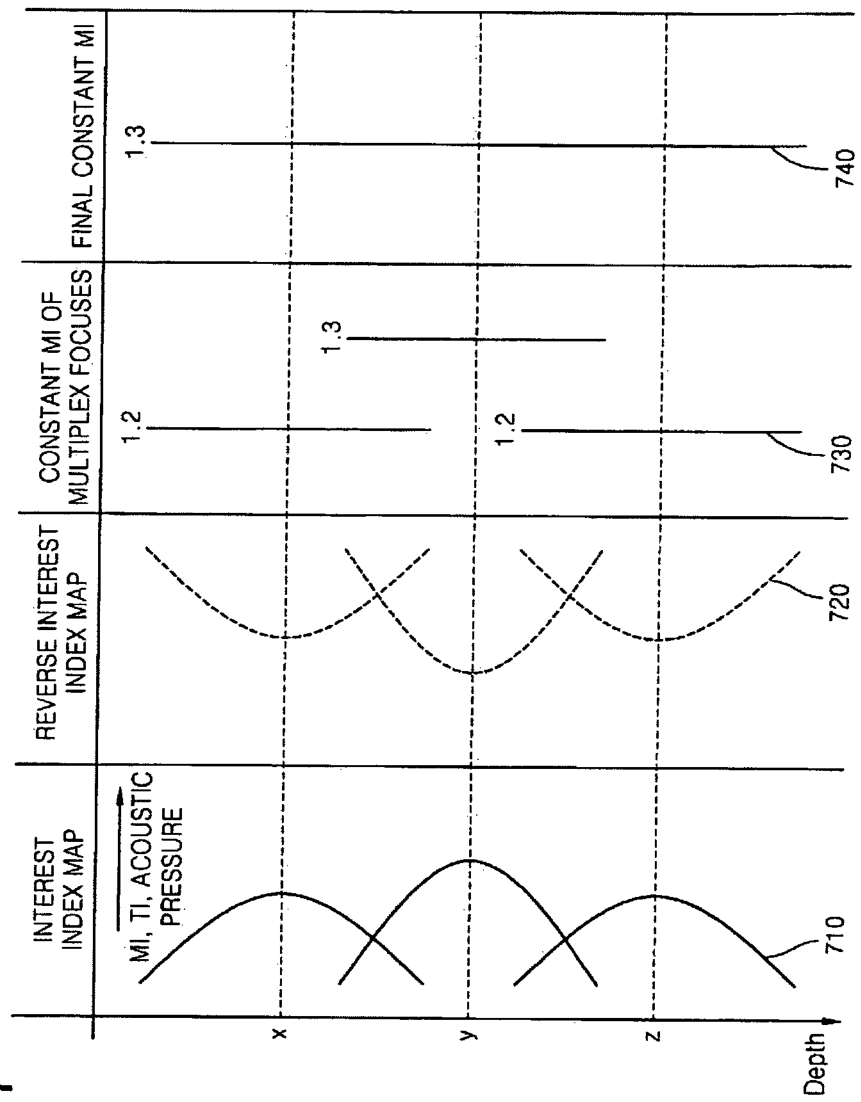

START
OUTPUT ULTRASOUND SIGNALS HAVING FIRST FOCUS AND SECOND FOCUS
S610
OBTAINING FIRST MI MAP AND SECOND MI MAP
S620
ADJUST GAIN VALUE OF ULTRASOUND ECHO SIGNAL CORRESPONDING TO FIRST FOCUS BY USING FIRST REVERSE MI MAP, SO AS TO HAVE VIRTUAL FIRST MI VALUE WITH RESPECT TO ALL DEPTH VALUES
S630
ADJUST GAIN VALUE OF ULTRASOUND ECHO SIGNAL CORRESPONDING TO SECOND FOCUS BY USING SECOND REVERSE MI MAP, SO AS TO HAVE VIRTUAL SECOND MI VALUE WITH RESPECT TO ALL DEPTH VALUES
S640
S650
VIRTUAL FIRST MI VALUE = VIRTUAL SECOND MI VALUE ?
YES
NO
RE-ADJUST GAIN VALUE OF ULTRASOUND ECHO SIGNAL CORRESPONDING TO FIRST FOCUS OR SECOND FOCUS
S660
BLEND ULTRASOUND ECHO SIGNAL HAVING ADJUSTED GAIN VALUE AND CORRESPONDING TO FIRST FOCUS WITH OR ULTRASOUND ECHO SIGNAL HAVING ADJUSTED GAIN VALUE AND CORRESPONDING TO SECOND FOCUS
S670
DISPLAY CORRECTED ULTRASOUND IMAGE
S680
END

FIG. 7


INTEREST INDEX MAP
MI, TI, ACOUSTIC PRESSURE
REVERSE INTEREST INDEX MAP
CONSTANT MI OF MULTIPLEX FOCUSES
FINAL CONSTANT MI
1.2
1.3
1.2
1.3
x
y
z
Depth
710
720
730
740

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 5482046 A **[0009]**
- US 2010016719 A1 **[0010]**
- US 2006030779 A1 **[0011]**

专利名称(译)	通过使用兴趣指数图来校正超声图像的方法和装置		
公开(公告)号	EP2599442B1	公开(公告)日	2016-03-23
申请号	EP2012161586	申请日	2012-03-27
[标]申请(专利权)人(译)	三星麦迪森株式会社		
申请(专利权)人(译)	三星MEDISON CO.，LTD.		
当前申请(专利权)人(译)	三星MEDISON CO.，LTD.		
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发明人	LEE, YOON-CHANG SANDSTRAM, KURT		
IPC分类号	A61B8/00 G01S7/52		
CPC分类号	A61B8/54 A61B8/463 A61B8/5207 A61B8/5246 G01S7/52033		
代理机构(译)	SCHMID，WOLFGANG		
优先权	1020110127229 2011-11-30 KR		
其他公开文献	EP2599442A1 EP2599442B8		
外部链接	Espacenet		

摘要(译)

一种校正超声图像的方法，该方法包括由超声输出单元输出超声信号到目标对象的操作;获得指示根据超声信号的行进方向的深度值与超声信号的MI值之间的相关性的机械指标（MI）图;通过使用通过反转MI图获得的反向MI图来调整与超声信号对应的超声回波信号的增益值，以允许在MI图上显示的MI值是虚拟的。相对于深度值的恒定MI值。

FIG. 1

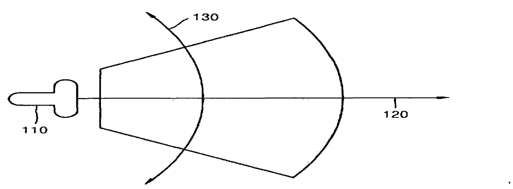

FIG. 2