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(54) Ultrasound system

Ultraschallsystem

Système à ultrasons

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(73) Proprietor: **MEDISON CO., LTD.**
Kangwon-do 250-870 (KR)

(72) Inventors:
- **Lee, Doo Sik**
  Seoul 135-280 (KR)
- **Ahn, Mi Jeoung**
  Seoul 135-280 (KR)

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

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Description

BACKGROUND

1. Field

[0001] The present invention generally relates to an ultrasound system, and more particularly to an ultrasound system adapted to precisely and easily perform TGC (Time Gain Compensation) and LGC (Lateral Gain Compensation).

2. Background

[0002] An ultrasound system has become an important and popular diagnostic tool since it has a wide range of applications. Specifically, due to its non-invasive and nondestructive nature, the ultrasound system has been extensively used in the medical profession. Modern high-performance ultrasound systems and techniques are commonly used to produce two or three-dimensional diagnostic images of internal features of an object.

[0003] In order to transmit and receive ultrasound signals, the ultrasound system is generally provided with a probe including a wideband transducer. When the transducer is electrically stimulated, it produces ultrasound signals and transmits them into a human body. The ultrasound signals transmitted into the human body are reflected from borders between human tissues and then returned to the transducer. The returned ultrasound echo signals are converted into electric signals. Thereafter, ultrasound image data for imaging the tissues is produced by amplifying and signal-processing the echo signals.

[0004] Typically, the ultrasound system is provided with a control panel including a plurality of input units in order to perform a control function of acquiring the ultrasound image, a menu control function, a measurement and annotation function, etc. The control panel is comprised of a touch panel, an image control unit, a measurement control unit, etc. The touch panel displays menus for optimizing an ultrasound image displayed on a display unit. The menus on the touch panel can be touched and selected by a user. The image control unit controls the ultrasound image, whereas the measurement control unit measures a distance to the object, a circumference of the object, etc. As illustrated in Fig. 1, the image control unit includes a plurality of TGC control keys 11 and a plurality of LGC control keys 12. The TGC control keys 11 are used to control a gain of each echo signal based on depth of the position from which the echo signal is reflected. Further, since the echo signal is attenuated at the outer right and left sides, the LGC control keys 12 are used to control a gain of the attenuated echo signal.

[0005] In the conventional system, the TGC control keys 11 and the LGC control keys 12 are arranged on different areas of the control panel. The problem associated with such an arrangement is that the size of the control panel must be inevitably increased. Further, a user of the system suffers a great inconvenience when operating the TGC control keys 11 and the LGC control keys 12. Another problem of the conventional system is that since the TGC control keys 11 and the LGC control keys 12 are comprised of slide-type variable resistors, it is very difficult for an unskilled user to finely control TGC and LGC with the TGC control keys 11 and the LGC control keys 12.

[0006] EP-A-0 539 697 A discloses an operator adjusted lateral gain control structure for an ultrasound imaging system, which may include an operator adjusted time gain compensation gain control structure. The lateral gain control structure enables an operator to adjust the gain of one or more scan lines independently of the gain of at least one other scan line.

[0007] JP 2006 296978 concerns the adjustment of the gain of a depth position of an ultrasonic image, so as to improve operability, by facilitating the adjustment of the sensitivity time control gain, i.e. directly designating the position of the ultrasonic image in the depth direction, which is displayed on a display screen.

[0008] In order to resolve the above problems, the present invention is directed to providing an ultrasound system adapted to display a setup screen used to input TGC and LGC curves on a touch panel and perform TGC and LGC based on the inputted TGC and LGC curves.

[0009] The present invention provides an ultrasound system according to claim 1.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Arrangements and embodiments may be described in detail with reference to the following drawings in which like reference numerals refer to like elements and wherein:

[0011] Fig. 1 is a schematic diagram illustrating conventional TGC and LGC control keys;

[0012] Fig. 2 is a block diagram showing a structure of an ultrasound system according to one embodiment of the present invention;

[0013] Figs. 3 to 7 illustrate a setup screen according to one embodiment of the present; and

[0014] Fig. 8 illustrates an exemplary distinction between TGC and LGC curves according to one embodiment of the present invention.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

[0015] Certain embodiments of the present invention will be explained below with reference to Figs. 2 to 8.

[0016] As illustrated in Fig. 2, an ultrasound system 100 comprises: a probe 110; a beam former 120; a signal processing unit 130; a processor 140; a display unit 150; and a TGC/LGC setup unit 160. The probe 110 includes a plurality of transducers 112. Each of the transducers

112 may be configured to transmit an ultrasound signal to an object and receive the ultrasound signal reflected from the object. The beam former 120 may be configured to focus the transmitted ultrasound signals from the transducers 112 on the object and collect the reflected ultrasound signals from the object to the transducers 112 together with corresponding time delay.

[0017] The signal processing unit 130 may be configured to amplify the signals collected by the beam former 120 and control gains of the amplified echo signals. Specifically, the signal processing unit 130 may be configured to perform TGC (Time Gain Compensation) and LGC (Lateral Gain Compensation) upon the echo signals based on predetermined TGC and LGC values at a coarse compensation mode (e.g., in an initial operation stage). The signal processing unit 130 may be further configured to perform TGC and LGC upon the echo signals based on TGC and LGC values calculated in a TGC/LGC setup unit 160 using a curve inputted by a user at a fine compensation mode (e.g., during operations).

[0018] The processor 140 may be configured to receive the echo signals from the signal processing unit 130 and produce an ultrasound image signal based on the echo signals. The display unit 150 may be adapted to receive the ultrasound image signal from the processor and display an ultrasound image based on the signal.

[0019] The TGC/LGC setup unit 160 may include a touch panel 161 and a TGC/LGC setup processor 162.

[0020] The touch panel 161 may be configured to display a setup screen and detect TGC/LGC curves inputted by the user on the touch panel 161 to produce a detecting signal. The touch panel 161 detects the user's input according to either the pressure sensing method or the electromagnetic induction method. The touch panel 161 may be a touch panel included in a control panel (not shown) of the ultrasound system 100. Alternatively, it may be separate and apart from the ultrasound system 100.

[0021] In one embodiment of the present invention, the touch panel 161 may be configured to display a setup screen 210 (shown in Fig. 3) including an ultrasound image 310 and first and second reference lines 410, 420. The ultrasound image 310 is based on the echo signal, the TGC and LGC of which are controlled based on the predetermined TGC and LGC values. The first and second reference lines 410, 420 may be used to detect a TGC curve 510 and a LGC curve 520 inputted by the user (i.e., to determine whether a curve inputted by the user is a TGC curve 510 or a LGC curve 520). After inputting a curve, the user can modify a portion of the curve.

[0022] In another embodiment of the present invention, the touch panel 161 may be configured to display a setup screen 220 (shown in Fig. 4) including first and second ultrasound images 311, 312 and first and second reference lines 410, 420. The first and second ultrasound images 311, 312 are based on the echo signal, the TGC and LGC of which are controlled based on the predetermined TGC and LGC values. The first and second reference lines 410, 420 may be used to detect whether a curve inputted by the user is a TGC curve 510 or a LGC curve 520. The first ultrasound image 311 may be identical to the second initial ultrasound image 312.

[0023] In yet another embodiment of the present invention, the touch panel 161 may be configured to display a first setup screen 231 (shown in Fig. 5) including an ultrasound image 310 and a first reference line 410. The ultrasound image 310 is based on the echo signal, the TGC and LGC of which are controlled based on the predetermined TGC and LGC values. The first reference line 410 may be used to detect a TGC curve 510 inputted by the user. The touch panel may then display a second setup screen 232 (shown in Fig. 6) including the ultrasound image 310 and a second reference line 420. The second reference lines 420 may be used to detect a LGC curve 520 inputted by the user. Alternatively, the touch panel 161 may be configured to display the second setup screen 232 before the first setup screen 231.

[0024] In still yet another embodiment of the present invention, the touch panel 161 may be configured to display a setup screen 240 (shown in Fig. 7) including a virtual ultrasound image 330 and first and second reference lines 410, 420.

[0025] The TGC/LGC setup processor 162 may be configured to detect TGC and LGC curves 510, 520 inputted by the user on the touch panel 161. The TGC/LGC setup processor 162 may then calculate new TGC and LGC values in consideration of the detected TGC and LGC curves and transmit the values to the signal processing unit 130.

[0026] In one embodiment of the present invention, as illustrated in Fig. 8, the TGC/LGC setup processor 162 may be configured to establish a first group of lines 610 and a second group of lines 620. The first group of lines 610 is perpendicular to a first reference line 410 and the lines in said group are equally spaced apart from each other. The second group of lines 620 is perpendicular to a second reference line 420 and the lines in this group are equally spaced apart from each other. If it is determined that a curve inputted by the user (such as the curve 510) intersects the first group of lines more often than the second group of lines, then the TGC/LGC setup processor 162 recognizes that the curve is a TGC curve. Alternatively, if it is determined that a curve inputted by the user (such as the curve 520) intersects the second group of lines more often than the first group of lines, then the TGC/LGC setup processor 162 recognizes that the curve is a LGC curve. The TGC/LGC setup processor 162 then calculates the new TGC value corresponding to the TGC curve 510 based on the first reference line 410. It also calculates the LGC value corresponding to the LGC curve 520 based on the second reference line 420. The TGC value and the LGC value are transmitted to the signal processing unit 130.

[0027] The present invention allows the user to accurately control the TGC and LGC by using the TGC and LGC curves inputted into the touch panel, thereby improving operational accuracy and time. Further, the

present invention reduces the size of the control panel to thereby improve the spatial efficiency.

Claims

1. An ultrasound system (100), comprising: a signal acquiring unit (110, 120) for transmitting an ultrasound signal to an object and acquiring an echo signal reflected from the object; a signal processing unit (130) for performing Time Gain Compensation (TGC) and Lateral Gain Compensation (LGC) upon the echo signal at a coarse compensation mode based on predetermined TGC and LGC values; and an image producing unit (140) for producing an ultrasound image of the object based on the TGC and LGC compensated echo signal,
characterized by further comprising:

an input unit (161) for allowing a user to provide TGC and LGC curves, the input unit comprising a touch panel adapted to display a setup screen including the produced ultrasound image and receive the TGC and LGC curves provided by the user on the produced ultrasound image, wherein the setup screen further includes first and second reference lines on the ultrasound image to detect the TGC and LGC curves; and
a TGC/LGC setup processor (162) for setting TGC and LGC values based on the TGC and LGC curves provided by the user,
wherein the signal processing unit (130) is further adapted to perform the TGC and LGC upon the echo signal at a fine compensation mode based on the TGC and LGC values set by the TGC/LGC setup processor.

2. The ultrasound system of Claim 1, wherein the touch panel is adapted to receive the TGC and LGC curves according to at least one of a pressure sensing method and an electromagnetic induction method.

3. The ultrasound system of Claim 1, wherein the touch panel is adapted to display the first and second reference lines on first and second ultrasound images, respectively, wherein the first reference line can be used to detect the TGC curve provided on the first ultrasound image and the second reference line can be used to detect the LGC curve shown on the second ultrasound image.

4. The ultrasound system of Claim 1, wherein the TGC/LGC setup processor (162) is adapted to establishe first and second group of lines, wherein the first group of lines are perpendicular to the first reference line and are equally spaced from each other, wherein the second group of lines are perpendicular to the second reference line and are equally spaced from each other, and wherein the processor is adapted to determine whether a curve provided by a user on the touch panel is the TGC curve or the LGC curve using the first and second group of lines.

5. The ultrasound system of Claim 3, wherein the TGC/LGC setup processor (162) establishes first and second group of lines, wherein the first group of lines are perpendicular to the first reference line and are equally spaced from each other, wherein the second group of lines are perpendicular to the second reference line and are equally spaced from each other, and wherein the processor is adapted to determine whether a curve provided by a user on the touch panel is the TGC curve or the LGC curve using the first and second group of lines.

6. The ultrasound system of Claim 4, wherein the TGC/LGC setup processor is adapted to (162) determine whether the curve provided by the user is the TGC curve or the LGC curve based on a comparison of the number of times of intersections between the curve and the first group of lines and the number of times of intersection between the curve and the second group of lines.

7. The ultrasound system of Claim 5, wherein the TGC/LGC setup processor is adapted to (162) determine whether the curve provided by the user is the TGC curve or the LGC curve based on a comparison of the number of times of intersections between the curve and the first group of lines and the number of times of intersection between the curve and the second group of lines.

Patentansprüche

1. Ultraschallsystem (100), welches Folgendes aufweist:

eine Signalerlangungseinheit (110,120) zum Übertragen eines Ultraschallsignals zu einem Objekt und zum Erlangen eines von dem Objekt reflektierten Echosignals; eine Signalverarbeitungseinheit (130) zum Durchführen einer Tiefenausgleichsregelung (TGC) und
einer Seitenausgleichsregelung (LGC) an dem Echosignal mit einem Grobausgleichsmodus basierend auf vorbestimmten TGC- und LGC-Werten; und eine Bilderzeugungseinheit (140) zum Erzeugen eines Ultraschallbilds des Objekts basierend auf dem TGC- und LGCkompensierten Echosignal,
dadurch gekennzeichnet, dass es des weiteren Folgendes aufweist:

eine Eingabeeinheit (161), um es einem Be-

nutzer zu erlauben, TGC- und LGC-Kurven zur Verfügung zu stellen, wobei die Eingabeeinheit ein Bildschirm-Tastenfeld aufweist, welches dafür vorgesehen ist,
einen Einstellungsbildschirm einschließlich des produzierten Ultraschallbilds anzuzeigen und die von dem Benutzer zur Verfügung gestellten TGC- und LGC-Kurven auf das produzierte Ultraschallbild zu empfangen, wobei der Einstellbildschirm des weiteren erste und zweite Referenzlinien auf dem Ultraschallbild aufweist, um die TGC- und LGC-Kurven zu ermitteln; und
einen TGC- bzw. LGC-Einstellungsprozessor (162) zum Einstellen von TGC- und LGC-Werten basierend auf den von dem Benutzer zur Verfügung gestellten TGC- und
LGC-Kurven,
wobei die Signalverarbeitungseinheit (130) des weiteren dafür vorgesehen ist, die TGC und die LGC an den Echosignalen mit einem Feinausgleichsmodus basierend auf den TGC- und LGC-Werten durchzuführen, welche durch den TGC- bzw. LGC-Einstellprozessor eingestellt wurden.

2. Ultraschallsystem nach Anspruch 1, wobei das Bildschirm-Tastenfeld dafür vorgesehen ist, die TGC- und LGC-Kurven gemäß eines Druckabtastverfahrens und/oder eines elektromagnetischen Induktionsverfahrens zu empfangen.

3. Ultraschallsystem nach Anspruch 1, wobei das Bildschirmtastenfeld dafür vorgesehen ist, die ersten und zweiten Referenzlinien auf jeweiligen ersten und zweiten Ultraschallbildern anzuzeigen, wobei die erste Referenzlinie verwendet werden kann, um die auf dem ersten Ultraschallbild zur Verfügung gestellte TGC-Kurve zu ermitteln, und die zweite Referenzlinie dafür verwendet werden kann, um die auf dem zweiten Ultraschallbild dargestellte LGC-Kurve zu ermitteln.

4. Ultraschallsystem nach Anspruch 1, wobei der TGC- bzw. LGC-Einstellungsprozessor (162) dafür vorgesehen ist, erste und zweite Gruppen von Linien zu erstellen, wobei die erste Gruppe von Linien senkrecht zu der ersten Referenzlinie und mit gleichem Abstand voneinander angeordnet sind, wobei die zweite Gruppe von Linien senkrecht zu der zweiten Referenzlinie und mit gleichem Abstand voneinander angeordnet sind, und wobei der Prozessor dafür vorgesehen ist, unter Verwendung der ersten und der zweiten Gruppe von Linien zu ermitteln, ob eine von einem Benutzer auf dem Bedientastenfeld zur Verfügung gestellte Kurve die TGC-Kurve oder die LGC-Kurve ist.

5. Ultraschallsystem nach Anspruch 3, wobei der TGC- bzw. LGC-Einstellungsprozessor (162) erste und zweite Gruppen von Linien erstellt, wobei die erste Gruppe von Linien senkrecht zu der ersten Referenzlinie und mit gleichem Abstand voneinander angeordnet sind, wobei die zweite Gruppe von Linien senkrecht zu der zweiten Referenzlinie und mit gleichem Abstand voneinander angeordnet sind, und wobei der Prozessor dafür vorgesehen ist unter Verwendung der ersten und der zweiten Gruppe von Linien, zu ermitteln, ob eine von einem Benutzer auf dem Bedientastenfeld zur Verfügung gestellte Kurve die TGC-Kurve oder die LGC-Kurve ist.

6. Ultraschallsystem nach Anspruch 4, wobei der TGC- bzw. LGC-Einstellungsprozessor (162) dafür vorgesehen ist, zu ermitteln, ob die von dem Benutzer zur Verfügung gestellte Kurve die TGC-Kurve oder die LGC-Kurve ist, und zwar basierend auf einem Vergleich der Anzahl von Schnittpunkten zwischen der Kurve und der ersten Gruppe von Linien und der Anzahl von Schnittpunkten zwischen der Kurve und der zweiten Gruppe von Linien.

7. Ultraschallsystem nach Anspruch 5, wobei der TGC- bzw. LGC-Einstellungsprozessor (162) dafür vorgesehen ist, zu ermitteln, ob die von dem Benutzer zur Verfügung gestellte Kurve die TGC-Kurve oder die LGC-Kurve ist, und zwar basierend auf einem Vergleich der Anzahl von Schnittpunkten zwischen der Kurve und der ersten Gruppe von Linien und der Anzahl von Schnittpunkten zwischen der Kurve und der zweiten Gruppe von Linien.

Revendications

1. Système à ultrasons (100) comprenant une unité d'acquisition de signal (110, 120) pour transmettre un signal ultrasonore vers un objet et acquérir un signal écho réfléchi à partir de l'objet ; une unité de traitement du signal (130) pour exécuter une compensation de gain en fonction de la profondeur (TGC) et une compensation du gain latéral (LGC) sur le signal écho dans un mode de compensation grossière sur la base de valeurs prédéterminées de TGC et de LGC ; et une unité de production d'image (140) pour produire une image ultrasonore de l'objet sur la base du signal écho compensé en TGC et LGC,
caractérisé en ce qu'il comprend en outre :

une unité d'entrée (161) pour permettre à un utilisateur de fournir des courbes du TGC et du LGC, l'unité d'entrée comprenant un panneau tactile agencé pour afficher un écran de paramétrage qui contient l'image ultrasonore produite et pour recevoir les courbes des TGC et LGC

fournies par l'utilisateur sur l'image ultrasonore produite, dans lequel l'écran de paramétrage comprend en outre des première et seconde lignes de référence sur l'image ultrasonore afin de détecter les courbes du TGC et du LGC ; et un processeur de paramétrage de TGC/LGC (162) pour paramétrer des valeurs du TGC et du LGC sur la base des courbes des TGC et LGC fournies par l'utilisateur,
dans lequel l'unité de traitement de signal (130) est en outre agencée pour exécuter le TGC et le LGC sur le signal écho dans un mode de compensation fine sur la base des valeurs du TGC et du LGC paramétrées par le processeur de paramétrage de TGC/LGC.

2. Système à ultrasons de la revendication 1, dans lequel le panneau tactile est agencé pour recevoir les courbes des TGC et LGC selon au moins l'un d'un procédé de détection de pression et d'un procédé d'induction électromagnétique.

3. Système à ultrasons de la revendication 1, dans lequel le panneau tactile est agencé pour afficher les première et seconde lignes de référence respectivement sur les première et seconde images ultrasonores, dans lequel la première ligne de référence peut être utilisée pour détecter la courbe du TGC fournie sur la première image ultrasonore et la seconde ligne de référence peut être utilisée pour détecter la courbe du LGC représentée sur la seconde image ultrasonore.

4. Système à ultrasons de la revendication 1, dans lequel le processeur de paramétrage de TGC/LGC (162) est agencé pour établir des premier et second groupes de lignes, dans lequel les lignes du premier groupe de lignes sont perpendiculaires à la première ligne de référence et sont également espacées l'une de l'autre, dans lequel les lignes du second groupe de lignes sont perpendiculaires à la seconde ligne de référence et sont également espacées l'une de l'autre, et dans lequel le processeur est agencé pour déterminer si une courbe fournie par l'utilisateur sur le panneau tactile est la courbe TGC ou la courbe LGC en utilisant les premier et second groupes de lignes.

5. Système à ultrasons de la revendication 3, dans lequel le processeur de paramétrage de TGC/LGC (162) établit des premier et second groupes de lignes, dans lequel les lignes du premier groupe de lignes sont perpendiculaires à la première ligne de référence et également espacées l'une de l'autre, dans lequel les lignes du second groupe de lignes sont perpendiculaires à la seconde ligne de référence et également espacées l'une de l'autre, et dans lequel le processeur est agencé pour déterminer si une courbe fournie par l'utilisateur sur le panneau tactile est la courbe de TGC ou la courbe de LGC, en utilisant les premier et second groupes de lignes.

6. Système à ultrasons de la revendication 4, dans lequel le processeur de paramétrage de TGC/LGC (162) est agencé pour déterminer si la courbe fournie par l'utilisateur est la courbe du TGC ou la courbe du LGC, sur la base d'une comparaison du nombre des occurrences d'intersection entre la courbe et le premier groupe de lignes et le nombre des occurrences d'intersection entre la courbe et le second groupe de lignes.

7. Système à ultrasons de la revendication 5, dans lequel le processeur de paramétrage de TGC/LGC (162) est agencé pour déterminer si la courbe fournie par l'utilisateur est la courbe du TGC ou la courbe du LUGC, sur la base d'une comparaison du nombre des occurrences d'intersection entre la courbe et le premier groupe de lignes et le nombre des occurrences d'intersection entre la courbe et le second groupe de lignes.

FIG. 1

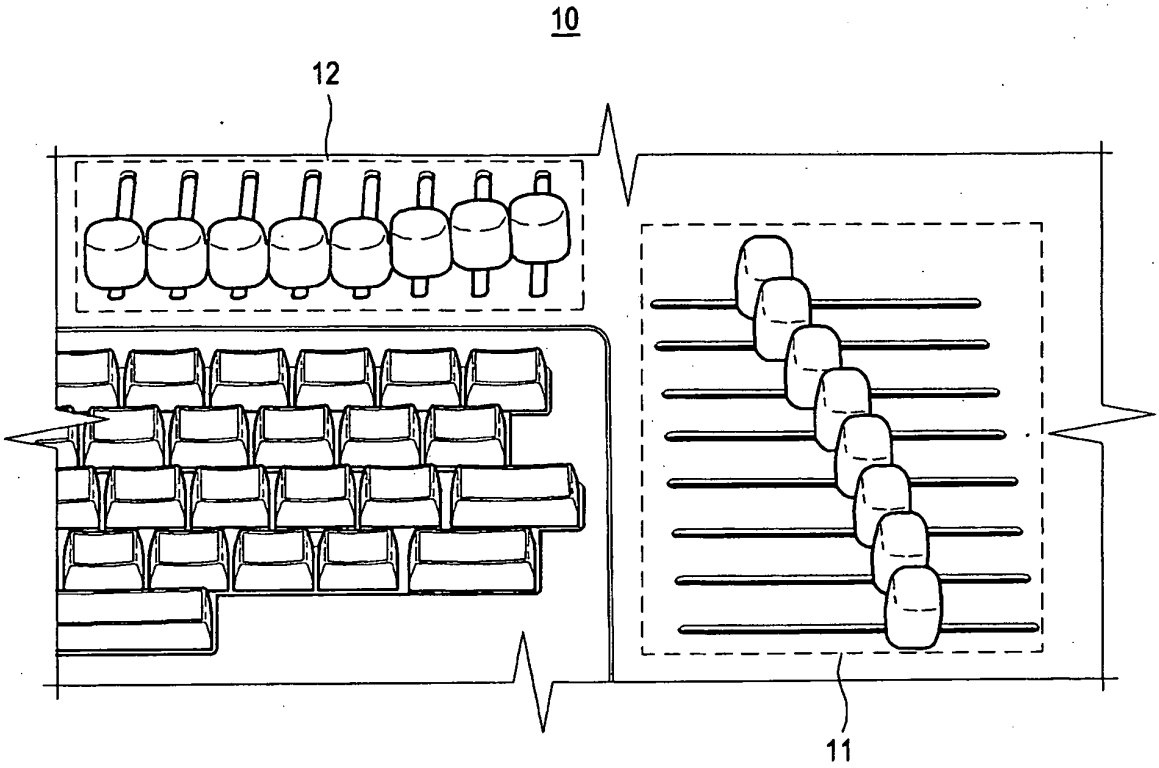


FIG. 2

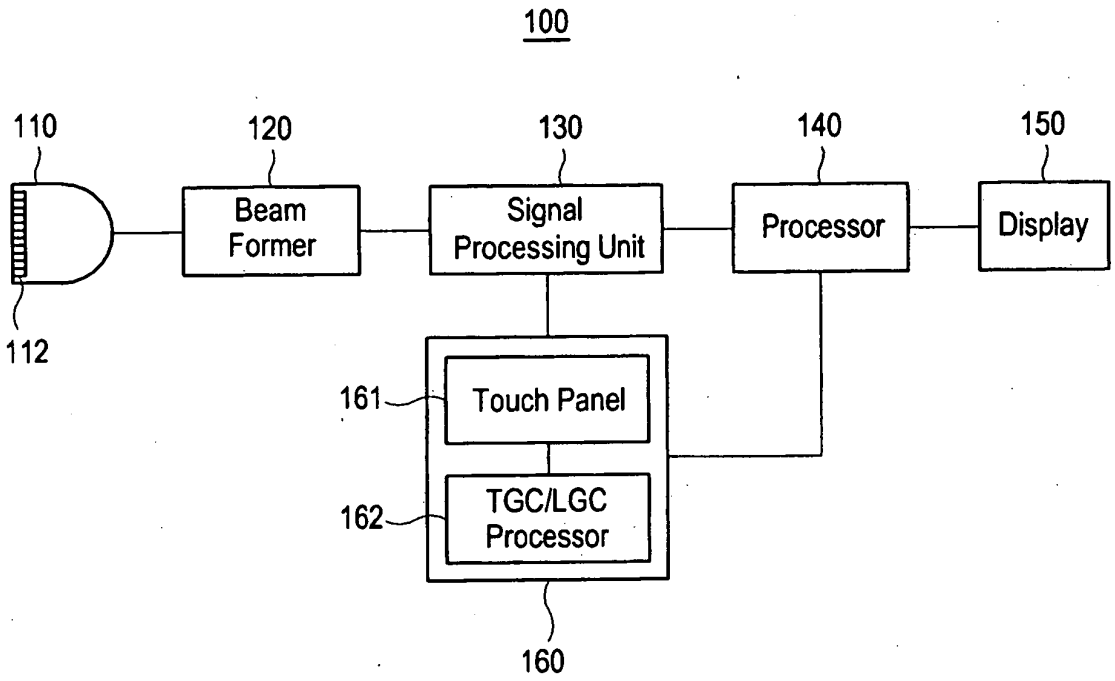

100
110
120
130
140
150
Beam Former
Signal Processing Unit
Processor
Display
112
161
Touch Panel
162
TGC/LGC Processor
160

FIG. 3

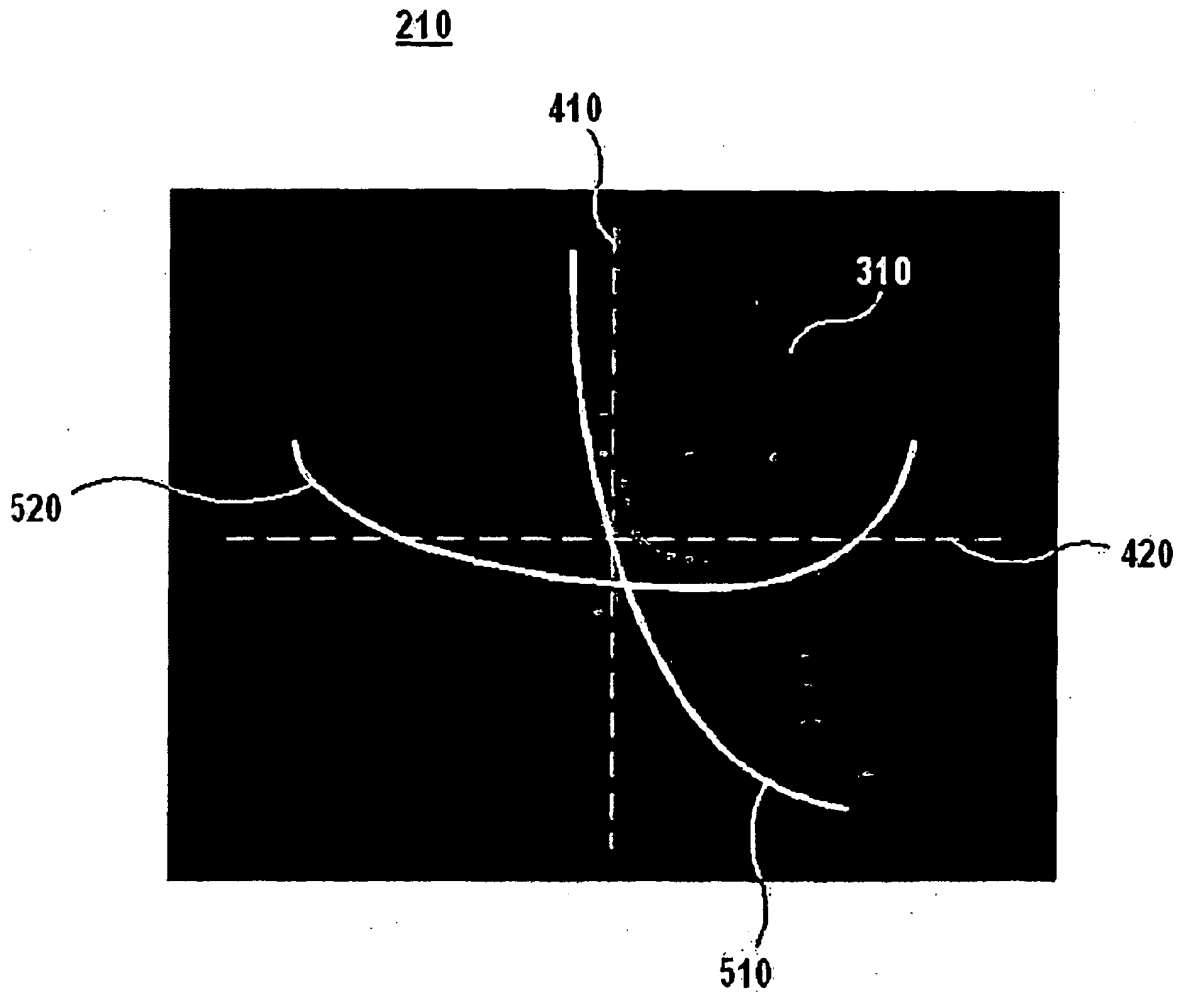


FIG. 4

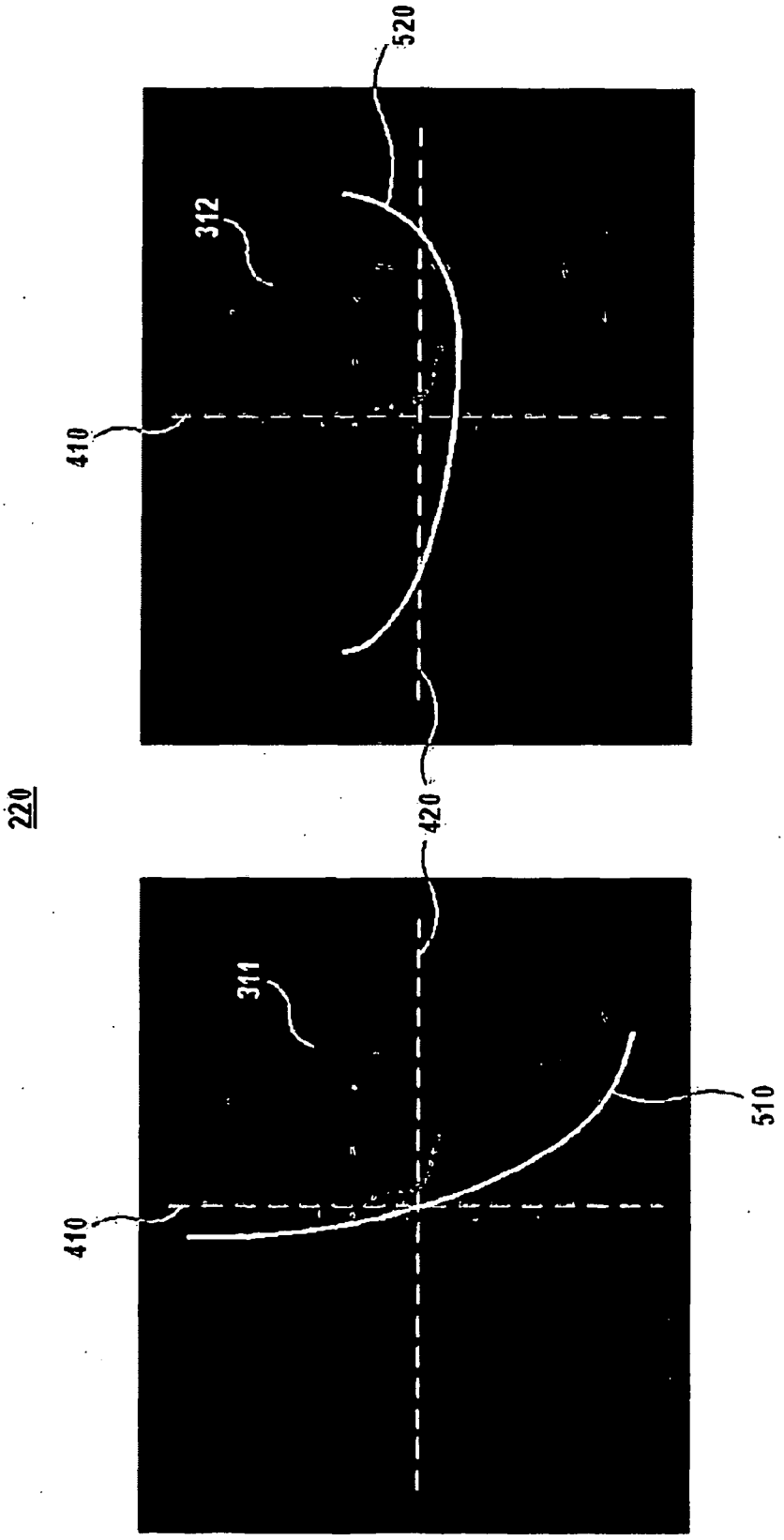


FIG. 5

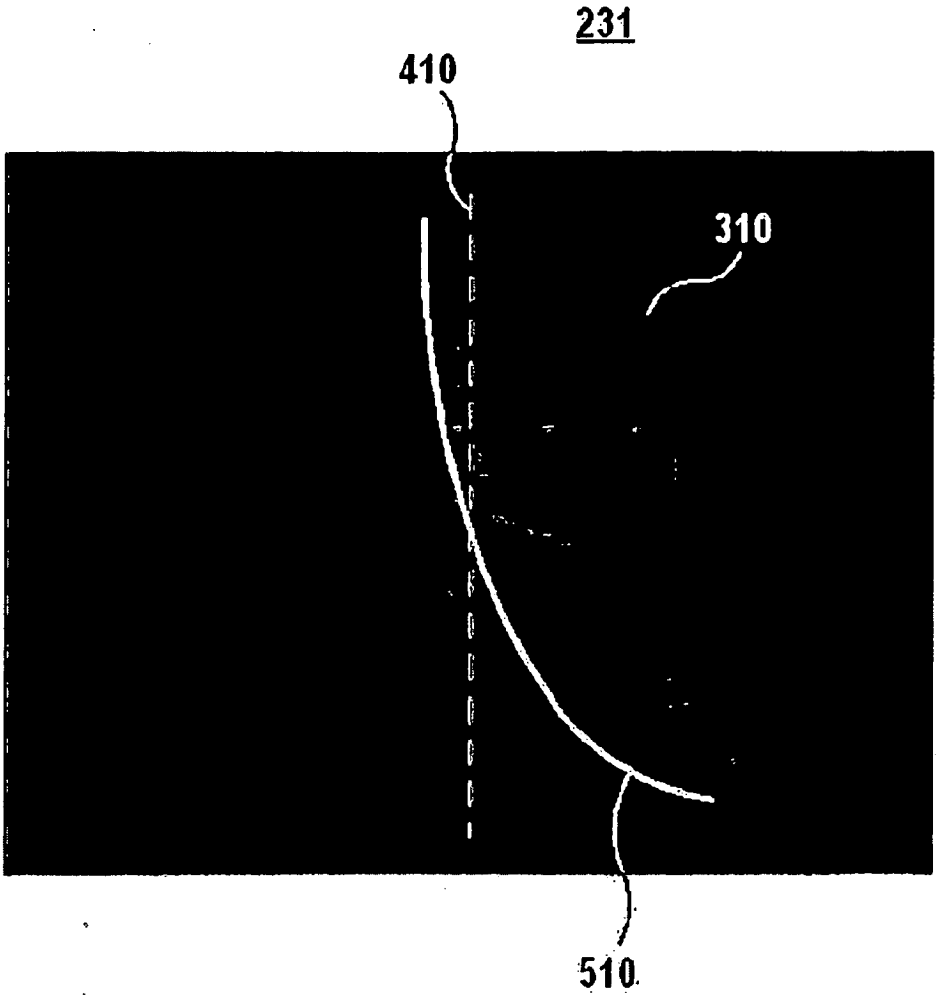


FIG. 6

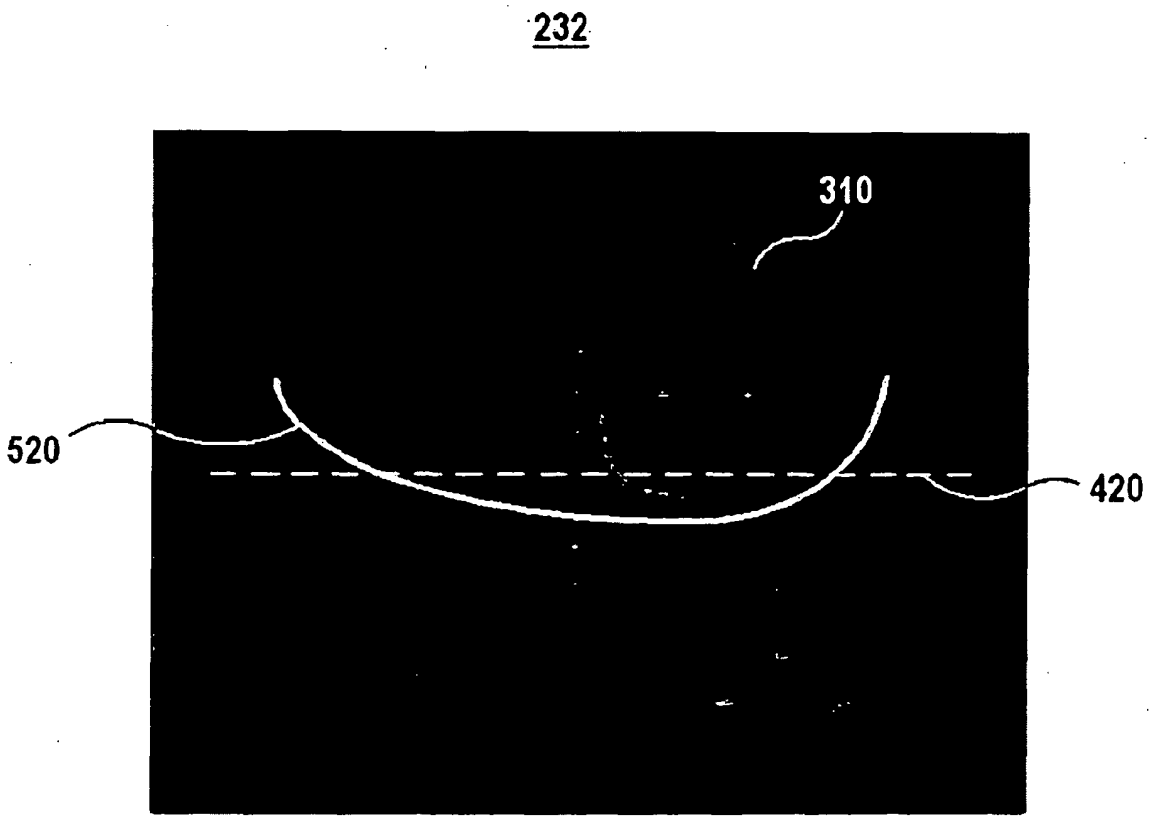


FIG. 7

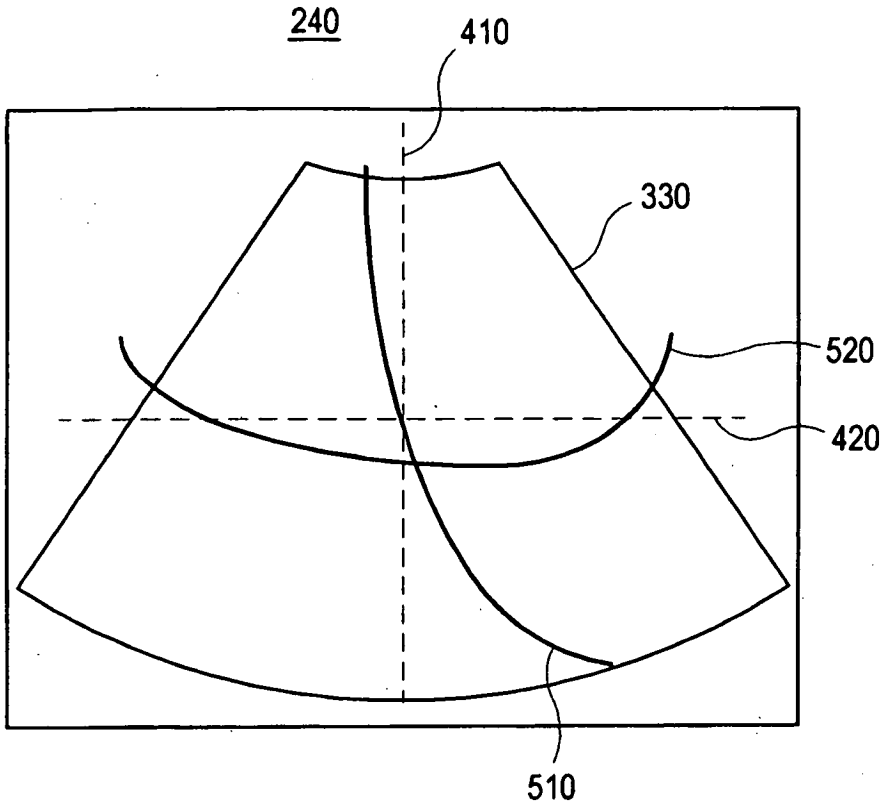
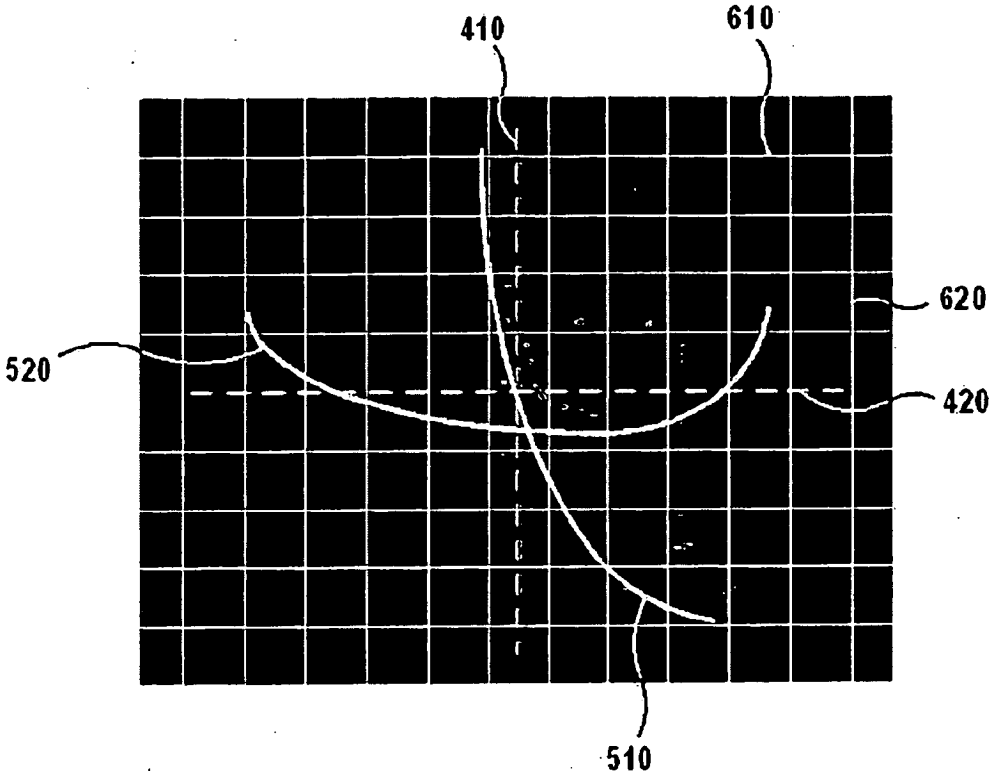


FIG. 8



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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当前申请(专利权)人(译)	MEDISON CO.，LTD.		
[标]发明人	LEE DOO SIK AHN MI JEOUNG		
发明人	LEE, DOO SIK AHN, MI JEOUNG		
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代理机构(译)	SCHMID，WOLFGANG		
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摘要(译)

本发明提供一种超声系统，包括：信号获取单元，用于将超声信号发送到物体并获取从物体反射的回波信号;信号处理单元，用于控制回波信号的TGC（时间增益补偿）和LGC（横向增益补偿）; TGC / LGC设置单元，适于根据用户输入的TGC和LGC曲线设置TGC和LGC值;图像产生单元，适于基于回波信号产生对象的超声图像。信号处理单元还适于基于由TGC / LGC设置单元设置的TGC和LGC值来控制回波信号的TGC和LGC。

FIG. 1