US 20180235579A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2018/0235579 A1**

Hsu et al. (43) **Pub. Date: Aug. 23, 2018**

(54) **ULTRASOUND SYSTEM AND NOISE ELIMINATING METHOD**

(71) Applicant: **QISDA CORPORATION**, Taoyuan City (TW)

(72) Inventors: **Chih-Hsiang Hsu**, Tainan City (TW); **Chun-Chih Wang**, Hsinchu County (TW); **Chia-En Chuang**, Hsinchu County (TW)

(21) Appl. No.: **15/798,414**

(22) Filed: **Oct. 31, 2017**

(30) **Foreign Application Priority Data**

Feb. 21, 2017 (TW) 106105797

Publication Classification

(51) **Int. Cl.**

A61B 8/08 (2006.01)

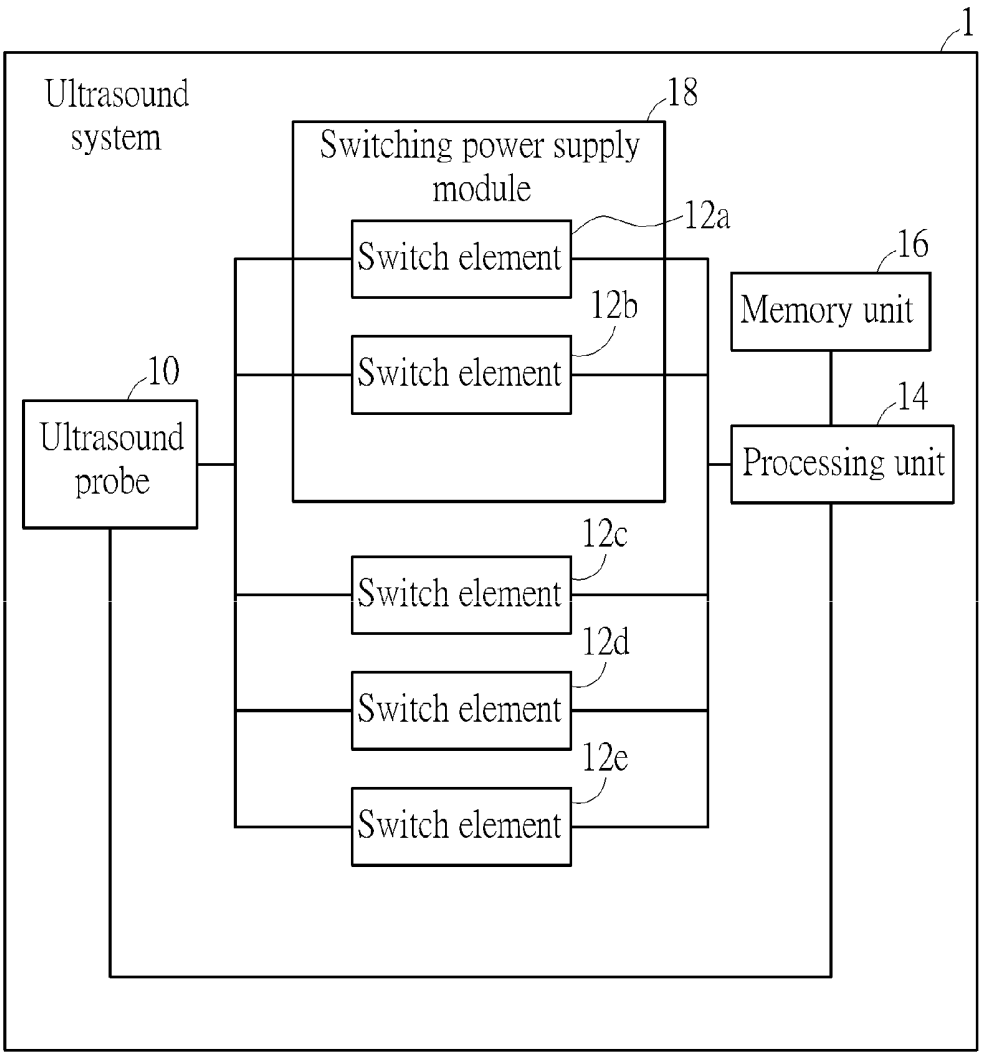
A61B 8/00 (2006.01)

(52) **U.S. Cl.**

CPC ***A61B 8/5269*** (2013.01); ***A61B 8/56*** (2013.01); ***A61B 8/5207*** (2013.01)

(57) **ABSTRACT**

An ultrasound system includes an ultrasound probe, N switch elements and a processing unit, wherein the N switch elements are electrically connected to the ultrasound probe, the processing unit is electrically connected to the ultrasound probe and the N switch elements, and N is a positive integer. The ultrasound probe transmits and receives an ultrasound signal by a scanning frequency. Each of the switch elements has a main output frequency. The processing unit converts the ultrasound signal into an ultrasound image. The processing unit determines whether a noise exists in the ultrasound image. When the processing unit determines that the noise exists in the ultrasound image, the processing unit adjusts the main output frequency of at least one of the N switch elements.



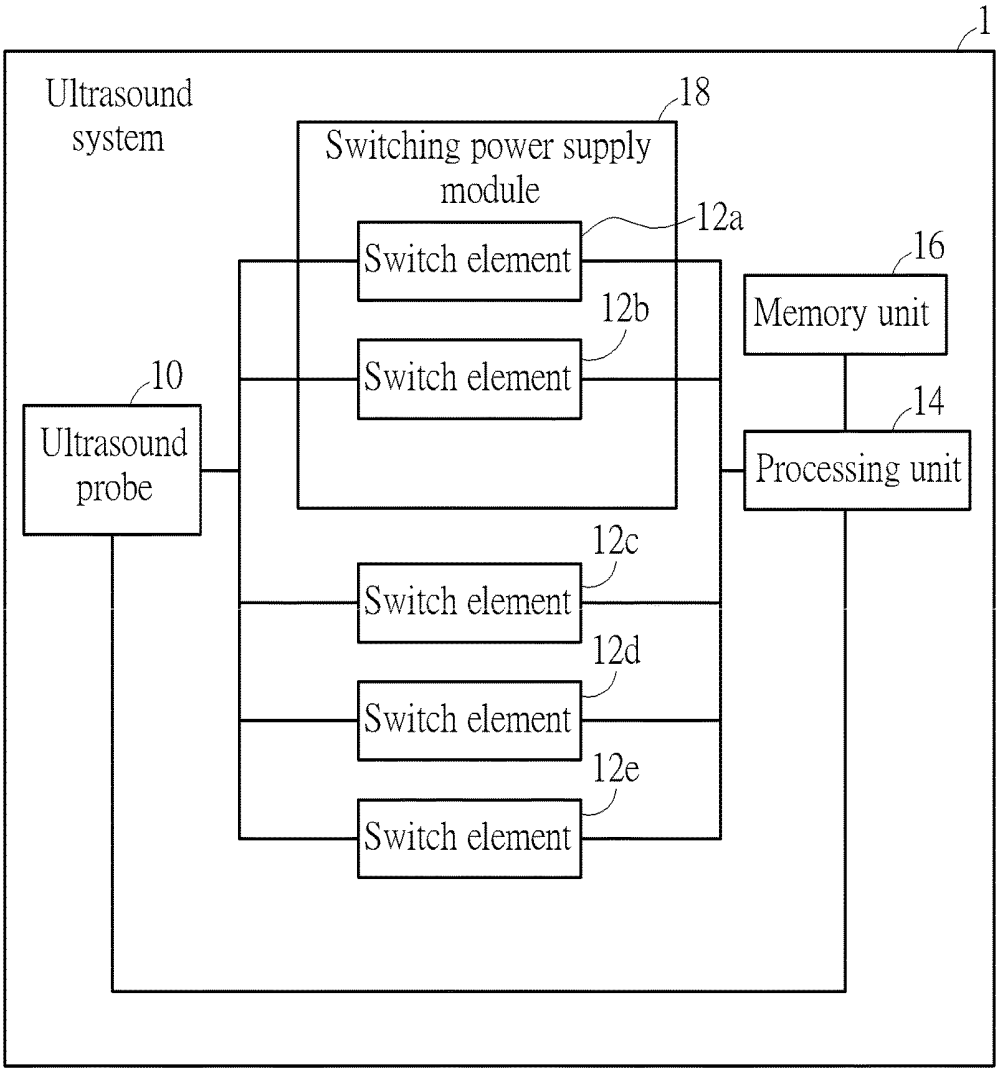

1
Ultrasound system
18
Switching power supply module
12a
Switch element
16
Memory unit
12b
Switch element
10
Ultrasound probe
14
Processing unit
12c
Switch element
12d
Switch element
12e
Switch element

FIG. 1

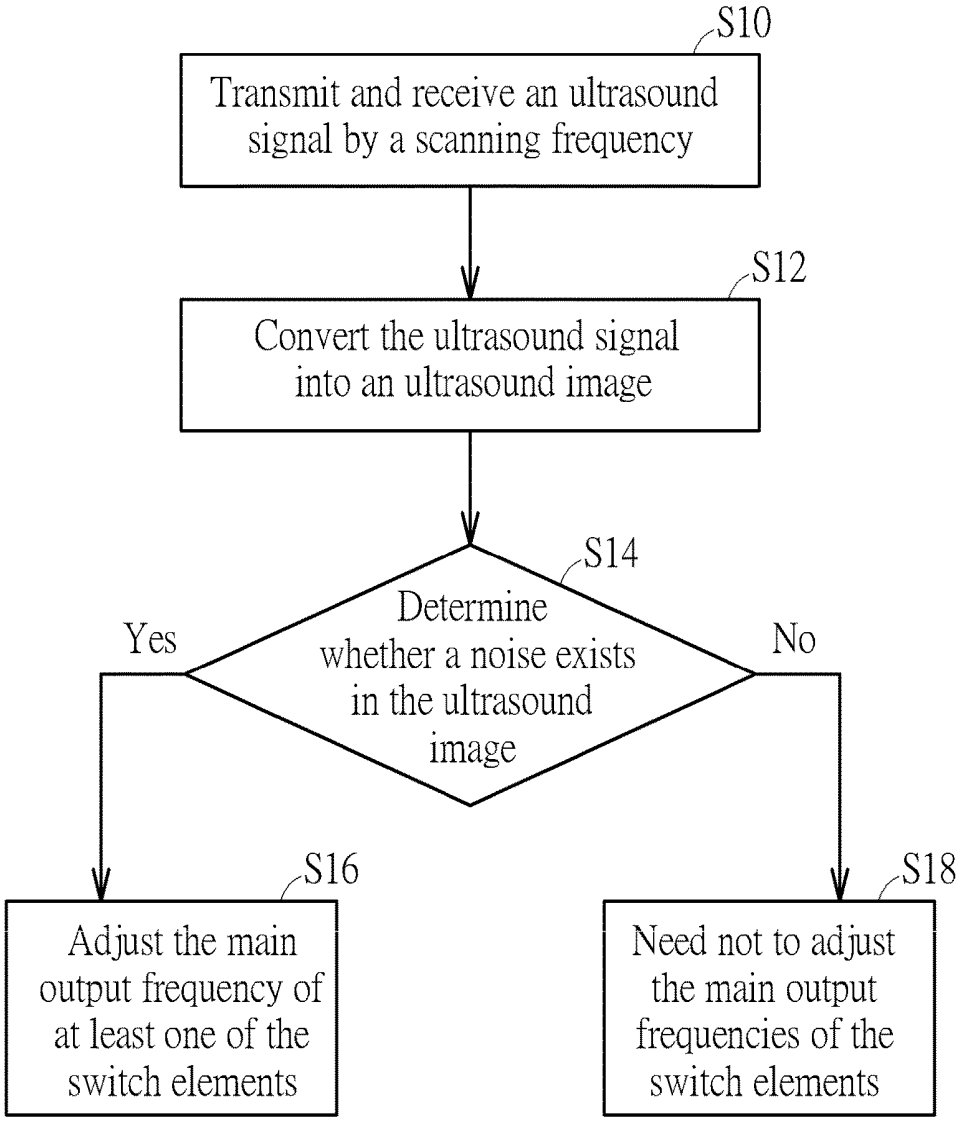

S10
Transmit and receive an ultrasound signal by a scanning frequency
S12
Convert the ultrasound signal into an ultrasound image
S14
Determine whether a noise exists in the ultrasound image
Yes
No
S16
Adjust the main output frequency of at least one of the switch elements
S18
Need not to adjust the main output frequencies of the switch elements

FIG. 2

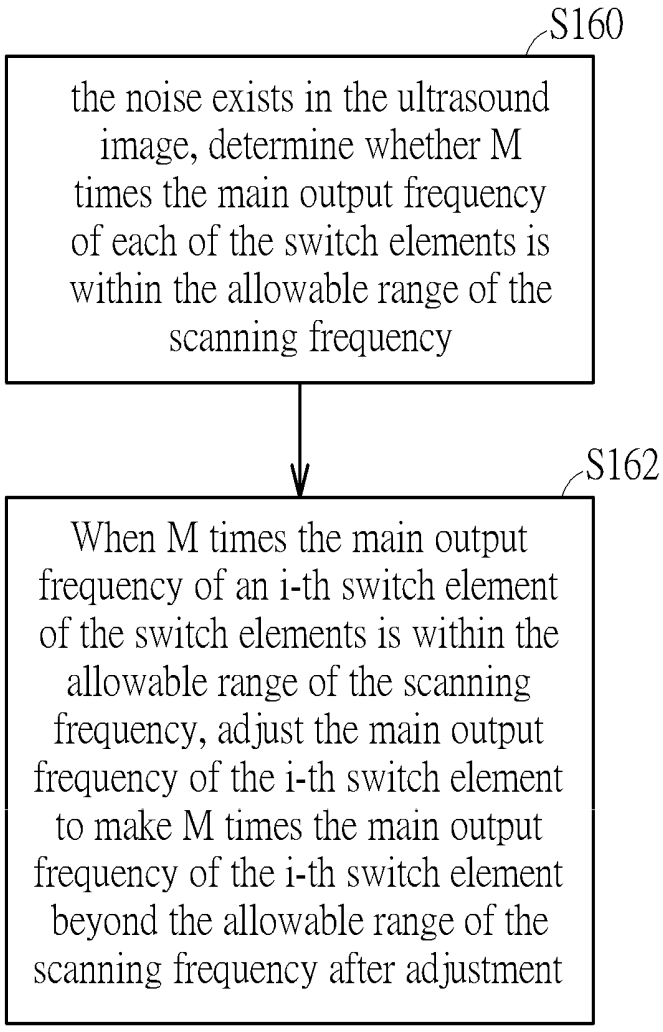

S160
the noise exists in the ultrasound image, determine whether M times the main output frequency of each of the switch elements is within the allowable range of the scanning frequency
S162
When M times the main output frequency of an i-th switch element of the switch elements is within the allowable range of the scanning frequency, adjust the main output frequency of the i-th switch element to make M times the main output frequency of the i-th switch element beyond the allowable range of the scanning frequency after adjustment

FIG. 3

ULTRASOUND SYSTEM AND NOISE ELIMINATING METHOD

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The invention relates to an ultrasound system and a noise eliminating method and, more particularly, to an ultrasound system and a noise eliminating method capable of eliminating a noise from an ultrasound image.

2. Description of the Prior Art

[0002] Since ultrasound scanning equipment does not destroy material structure and cell, the ultrasound scanning equipment is in widespread use for the field of material and clinical diagnosis. To enhance power efficiency, an ultrasound system is usually equipped with a lot of switch elements and different switch elements have different main output frequencies. The main output frequency of the switch element may interfere with an ultrasound image easily to generate a noise in the ultrasound image. Consequently, the interpretation of the ultrasound image will be affected. To prevent the ultrasound system from generating an abnormal ultrasound image, how to prevent the main output frequency of the switch element from generating a noise in the ultrasound image has become a significant design issue.

SUMMARY OF THE INVENTION

[0003] An objective of the invention is to provide an ultrasound system and a noise eliminating method capable of eliminating a noise from an ultrasound image, so as to solve the aforesaid problems.

[0004] According to an embodiment of the invention, an ultrasound system comprises an ultrasound probe, N switch elements and a processing unit, wherein the N switch elements are electrically connected to the ultrasound probe, the processing unit is electrically connected to the ultrasound probe and the N switch elements, and N is a positive integer. The ultrasound probe transmits and receives an ultrasound signal by a scanning frequency. Each of the switch elements has a main output frequency. The processing unit converts the ultrasound signal into an ultrasound image. The processing unit determines whether a noise exists in the ultrasound image. When the processing unit determines that the noise exists in the ultrasound image, the processing unit adjusts the main output frequency of at least one of the N switch elements.

[0005] According to another embodiment of the invention, a noise eliminating method is adapted to an ultrasound system. The ultrasound system comprises an ultrasound probe, N switch elements and a processing unit, wherein the N switch elements are electrically connected to the ultrasound probe, the processing unit is electrically connected to the ultrasound probe and the N switch elements, and N is a positive integer. Each of the switch elements has a main output frequency. The noise eliminating method comprises steps of the ultrasound probe transmitting and receiving an ultrasound signal by a scanning frequency; the processing unit converting the ultrasound signal into an ultrasound image; the processing unit determining whether a noise exists in the ultrasound image; and the processing unit adjusting the main output frequency of at least one of the N switch elements when the processing unit determines that the noise exists in the ultrasound image.

[0006] As mentioned in the above, when a noise exists in the ultrasound image, the noise may be generated by the main output frequency of the switch element. Accordingly, when the noise exists in the ultrasound image, the invention adjusts the main output frequency of the switch element, so as to eliminate the noise from the ultrasound image. It should be noted that if the noise cannot be eliminated from the ultrasound image after adjusting the main output frequencies of all of the switch elements, it represents that the noise is not generated by the main output frequency of the switch element. At this time, the noise has to be eliminated from the ultrasound image by other manners. In other words, the invention is to eliminate the noise generated by the main output frequency of the switch element by means of adjusting the main output frequency of the switch element.

[0007] These and other objectives of the present invention will no doubt become obvious to those of ordinary skill in the art after reading the following detailed description of the preferred embodiment that is illustrated in the various figures and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. **1** is a functional block diagram illustrating an ultrasound system according to an embodiment of the invention.

[0009] FIG. **2** is a flowchart illustrating a noise eliminating method according to an embodiment of the invention.

[0010] FIG. **3** is a flowchart illustrating the step **S16** shown in FIG. **2** in detail according to an embodiment.

DETAILED DESCRIPTION

[0011] Referring to FIGS. **1** and **2**, FIG. **1** is a functional block diagram illustrating an ultrasound system **1** according to an embodiment of the invention and FIG. **2** is a flowchart illustrating a noise eliminating method according to an embodiment of the invention. The noise eliminating method shown in FIG. **2** can be implemented by the ultrasound system **1** shown in FIG. **1**.

[0012] As shown in FIG. **1**, the ultrasound system **1** comprises an ultrasound probe **10**, N switch elements **12***a*-**12***e*, a processing unit **14** and a memory unit **16**, wherein the N switch elements **12***a*-**12***e* are electrically connected to the ultrasound probe **10**, the processing unit **14** is electrically connected to the ultrasound probe **10**, the N switch elements **12***a*-**12***e* and the memory unit **16**, and N is a positive integer. In this embodiment, N is equal to five. In other words, the ultrasound system **1** may comprise one or more switch elements according to practical applications. It should be noted that the ultrasound system **1** may be further equipped with other necessary circuits and components according to practical applications and those will not be depicted herein. Furthermore, the processing unit **14** may be a processor or a controller with signal processing function.

[0013] In this embodiment, the ultrasound system **1** may comprise a switching power supply module **18** electrically connected to the ultrasound probe **10** and the processing unit **14**, wherein the switching power supply module **18** supplies a power for electronic components in the ultrasound system **1**. At least one of the switch elements **12***a*-**12***e* may be an electronic switch in the switching power supply module **18**. As shown in FIG. **1**, the switch elements **12***a*-**12***b* are

electronic switches in the switching power supply module **18**. Still further, each of the switch elements **12***a*-**12***e* has a main output frequency and the memory unit **16** stores the main output frequency of each of the switch elements **12***a*-**12***e*.

[0014] To perform the noise eliminating method of the invention, first of all, the ultrasound probe **10** transmits and receives an ultrasound signal by a scanning frequency (step S**10** in FIG. **2**). Then, the processing unit **14** converts the ultrasound signal into an ultrasound image (step S**12** in FIG. **2**). Then, the processing unit **14** determines whether a noise exists in the ultrasound image (step S**14** in FIG. **2**). When the processing unit **14** determines that the noise exists in the ultrasound image, the processing unit **14** adjusts the main output frequency of at least one of the N switch elements **12***a*-**12***e* (step S**16** in FIG. **2**). It should be noted that when the processing unit **14** determines that no noise exists in the ultrasound image, the processing unit **14** needs not to adjust the main output frequencies of the switch elements **12***a*-**12***e* (step S**18** in FIG. **2**).

[0015] For further explanation, when a noise exists in the ultrasound image, the noise may be generated by the main output frequency of at least one of the switch elements **12***a*-**12***e*. Accordingly, when the noise exists in the ultrasound image, the invention adjusts the main output frequency of at least one of the switch elements **12***a*-**12***e*, so as to eliminate the noise from the ultrasound image. It should be noted that if the noise cannot be eliminated from the ultrasound image after adjusting the main output frequencies of all of the switch elements, it represents that the noise is not generated by the main output frequencies of the switch elements **12***a*-**12***e*. At this time, the noise has to be eliminated from the ultrasound image by other manners. In other words, the invention is to eliminate the noise generated by the main output frequencies of the switch elements **12***a*-**12***e* by means of adjusting the main output frequencies of the switch elements **12***a*-**12***e*.

[0016] In this embodiment, the ultrasound probe **10** transmits and receives the ultrasound signal without aiming at an object. For example, the ultrasound probe **10** may transmit/receive the ultrasound signal to/from the air, such that the processing unit **14** converts the ultrasound signal into a blank ultrasound image. When the processing unit **14** analyzes that there is a solid line segment or a dashed line segment in the ultrasound image, the processing unit **14** may determine that the noise exists in the ultrasound image before the ultrasound probe **10** transmits/receives the ultrasound signal to/from an object.

[0017] In this embodiment, the processing unit **14** may convert the ultrasound signal into the ultrasound image by a pulse wave (PW) mode or a continuous wave (CW) mode. Furthermore, the scanning frequency of the ultrasound probe **10** may have an allowable range. In practical applications, the scanning frequency of the ultrasound probe **10** for transmitting the ultrasound signal may be slightly different from the scanning frequency of the ultrasound probe **10** for receiving the ultrasound signal. However, the scanning frequency of the ultrasound probe **10** for transmitting or receiving the ultrasound signal is still within the aforesaid allowable range. When the scanning frequency of the ultrasound probe **10** for transmitting the ultrasound signal is different from the scanning frequency of the ultrasound probe **10** for receiving the ultrasound signal, the scanning frequency mentioned in the invention represents the scanning frequency of the ultrasound probe **10** for receiving the ultrasound signal.

[0018] Referring to FIG. **3**, FIG. **3** is a flowchart illustrating the step S**16** shown in FIG. **2** in detail according to an embodiment. When the processing unit **14** determines that the noise exists in the ultrasound image, the processing unit **14** may further determine whether M times the main output frequency of each of the switch elements **12***a*-**12***e* is within the allowable range of the scanning frequency (step S**160** in FIG. **3**). When the processing unit **14** determines that M times the main output frequency of an i-th switch element of the switch elements **12***a*-**12***e* is within the allowable range of the scanning frequency, the processing unit **14** adjusts the main output frequency of the i-th switch element to make M times the main output frequency of the i-th switch element beyond the allowable range of the scanning frequency after adjustment (step **5162** in FIG. **3**). In this embodiment, M is a positive integer and i is a positive integer smaller than or equal to N. It should be noted that the processing unit **14** may increase or decrease the main output frequency of the i-th switch element according to practical applications as long as M times the main output frequency of the i-th switch element is beyond the allowable range of the scanning frequency after adjustment.

[0019] For example, provided that the scanning frequency of the ultrasound probe **10** is set to be 1400 KHz, the allowable range is set to be ±50 KHz, and the main output frequency of the switch element **12***a* is set to be 350 KHz. Since four times the main output frequency of the switch element **12***a* (i.e. 350 KHz*4=1400 KHz) is within the allowable range of the scanning frequency (i.e. 1400±50 KHz), the processing unit **14** may increase the main output frequency of the switch element **12***a* to be, for example, 400 KHz or decrease the main output frequency of the switch element **12***a* to be, for example, 300 KHz, so as to make M times the main output frequency of the switch element **12***a* beyond the allowable range of the scanning frequency after adjustment. Accordingly, the invention can prevent the main output frequency of the switch element **12***a* from generating a noise in the ultrasound image.

[0020] It should be noted that when M times the main output frequency of more than one switch element is within the allowable range of the scanning frequency, the processing unit **14** has to adjust the main output frequency of each switch element to make M times the main output frequency of each switch element beyond the allowable range of the scanning frequency after adjustment.

[0021] As mentioned in the above, when a noise exists in the ultrasound image, the noise may be generated by the main output frequency of the switch element. Accordingly, when the noise exists in the ultrasound image, the invention adjusts the main output frequency of the switch element, so as to eliminate the noise from the ultrasound image. It should be noted that if the noise cannot be eliminated from the ultrasound image after adjusting the main output frequencies of all of the switch elements, it represents that the noise is not generated by the main output frequency of the switch element. At this time, the noise has to be eliminated from the ultrasound image by other manners. In other words, the invention is to eliminate the noise generated by the main output frequency of the switch element by means of adjusting the main output frequency of the switch element.

[0022] Those skilled in the art will readily observe that numerous modifications and alterations of the device and method may be made while retaining the teachings of the invention. Accordingly, the above disclosure should be construed as limited only by the metes and bounds of the appended claims.

What is claimed is:

1. An ultrasound system comprising:

an ultrasound probe transmitting and receiving an ultrasound signal by a scanning frequency;

N switch elements electrically connected to the ultrasound probe, each of the switch elements having a main output frequency, N being a positive integer; and

a processing unit electrically connected to the ultrasound probe and the N switch elements, the processing unit converting the ultrasound signal into an ultrasound image, the processing unit determining whether a noise exists in the ultrasound image, the processing unit adjusting the main output frequency of at least one of the N switch elements when the processing unit determines that the noise exists in the ultrasound image.

2. The ultrasound system of claim **1**, wherein the ultrasound probe transmits and receives the ultrasound signal without aiming at an object and the processing unit determines that the noise exists in the ultrasound image when the processing unit analyzes that there is a solid line segment or a dashed line segment in the ultrasound image.

3. The ultrasound system of claim **1**, further comprising a switching power supply module electrically connected to the ultrasound probe and the processing unit and supplying a power, wherein at least one of the N switch elements is an electronic switch in the switching power supply module.

4. The ultrasound system of claim **1**, wherein the processing unit converts the ultrasound signal into the ultrasound image by a pulse wave mode or a continuous wave mode, the scanning frequency has an allowable range; when the processing unit determines that the noise exists in the ultrasound image, the processing unit determines whether M times the main output frequency of each of the switch elements is within the allowable range of the scanning frequency; when the processing unit determines that M times the main output frequency of an i-th switch element of the switch elements is within the allowable range of the scanning frequency, the processing unit adjusts the main output frequency of the i-th switch element to make M times the main output frequency of the i-th switch element beyond the allowable range of the scanning frequency after adjustment; M is a positive integer and i is a positive integer smaller than or equal to N.

5. The ultrasound system of claim **1**, further comprising a memory unit electrically connected to the processing unit, the memory unit storing the main output frequency of each of the switch elements.

6. A noise eliminating method adapted to an ultrasound system, the ultrasound system comprising an ultrasound probe, N switch elements and a processing unit, the N switch elements being electrically connected to the ultrasound probe, the processing unit being electrically connected to the ultrasound probe and the N switch elements, each of the switch elements having a main output frequency, N being a positive integer, the noise eliminating method comprising steps of:

the ultrasound probe transmitting and receiving an ultrasound signal by a scanning frequency;

the processing unit converting the ultrasound signal into an ultrasound image;

the processing unit determining whether a noise exists in the ultrasound image; and

the processing unit adjusting the main output frequency of at least one of the N switch elements when the processing unit determines that the noise exists in the ultrasound image.

7. The noise eliminating method of claim **6**, wherein the ultrasound probe transmits and receives the ultrasound signal without aiming at an object and the processing unit determines that the noise exists in the ultrasound image when the processing unit analyzes that there is a solid line segment or a dashed line segment in the ultrasound image.

8. The noise eliminating method of claim **6**, wherein the ultrasound system further comprises a switching power supply module electrically connected to the ultrasound probe and the processing unit and supplying a power, and at least one of the N switch elements is an electronic switch in the switching power supply module.

9. The noise eliminating method of claim **6**, wherein the processing unit converts the ultrasound signal into the ultrasound image by a pulse wave mode or a continuous wave mode, the scanning frequency has an allowable range, the noise eliminating method further comprises steps of:

when the processing unit determines that the noise exists in the ultrasound image, the processing unit determining whether M times the main output frequency of each of the switch elements is within the allowable range of the scanning frequency, wherein M is a positive integer; and

when the processing unit determines that M times the main output frequency of an i-th switch element of the switch elements is within the allowable range of the scanning frequency, the processing unit adjusting the main output frequency of the i-th switch element to make M times the main output frequency of the i-th switch element beyond the allowable range of the scanning frequency after adjustment, wherein i is a positive integer smaller than or equal to N.

10. The noise eliminating method of claim **6**, wherein the ultrasound system further comprises a memory unit electrically connected to the processing unit and the memory unit stores the main output frequency of each of the switch elements.

* * * * *

专利名称(译)	超声系统和噪声消除方法		
公开(公告)号	US20180235579A1	公开(公告)日	2018-08-23
申请号	US15/798414	申请日	2017-10-31
[标]申请(专利权)人(译)	明基电通股份有限公司		
申请(专利权)人(译)	佳世达科技股份有限公司		
当前申请(专利权)人(译)	佳世达科技股份有限公司		
[标]发明人	HSU CHIH HSIANG WANG CHUN CHIH CHUANG CHIA EN		
发明人	HSU, CHIH-HSIANG WANG, CHUN-CHIH CHUANG, CHIA-EN		
IPC分类号	A61B8/08 A61B8/00		
CPC分类号	A61B8/5269 A61B8/5207 A61B8/56 A61B8/54		
优先权	106105797 2017-02-21 TW		
外部链接	Espacenet USPTO		

摘要(译)

超声系统包括超声探头，N个开关元件和处理单元，其中N个开关元件电连接到超声探头，处理单元电连接到超声探头和N个开关元件，N为正整数。超声探头通过扫描频率发送和接收超声信号。每个开关元件具有主输出频率。处理单元将超声信号转换为超声图像。处理单元确定超声图像中是否存在噪声。当处理单元确定超声图像中存在噪声时，处理单元调整N个开关元件中的至少一个的主输出频率。