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(54) **ULTRASONIC APPARATUS AND METHOD FOR CONTROLLING THE SAME**

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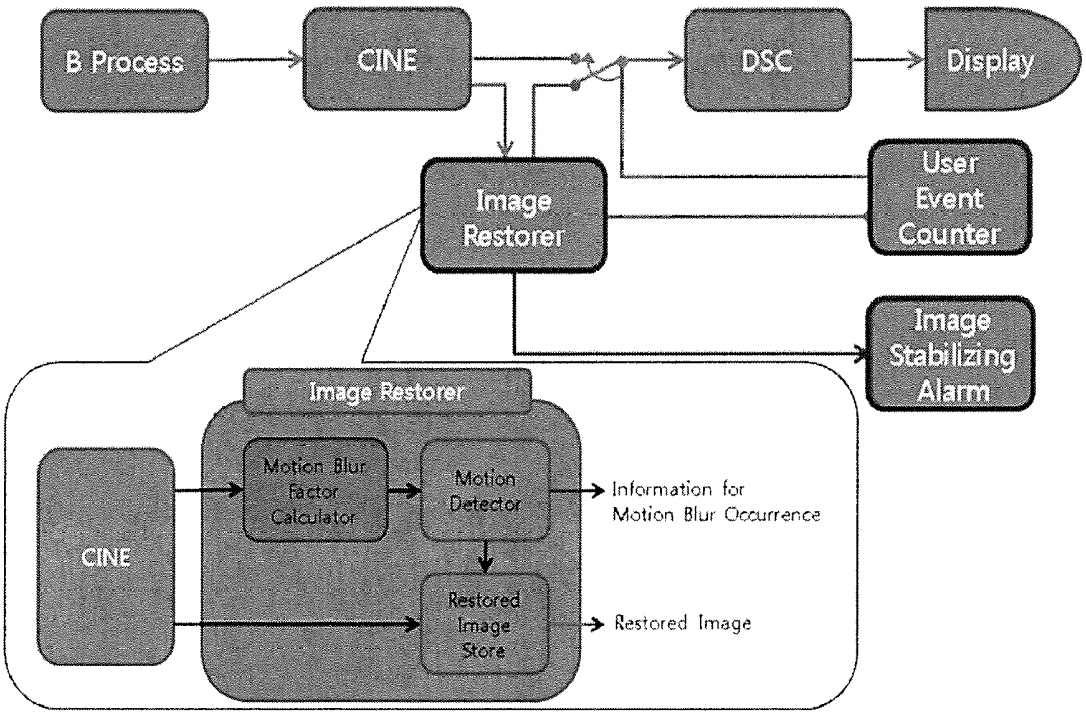
(52) **U.S. Cl.**

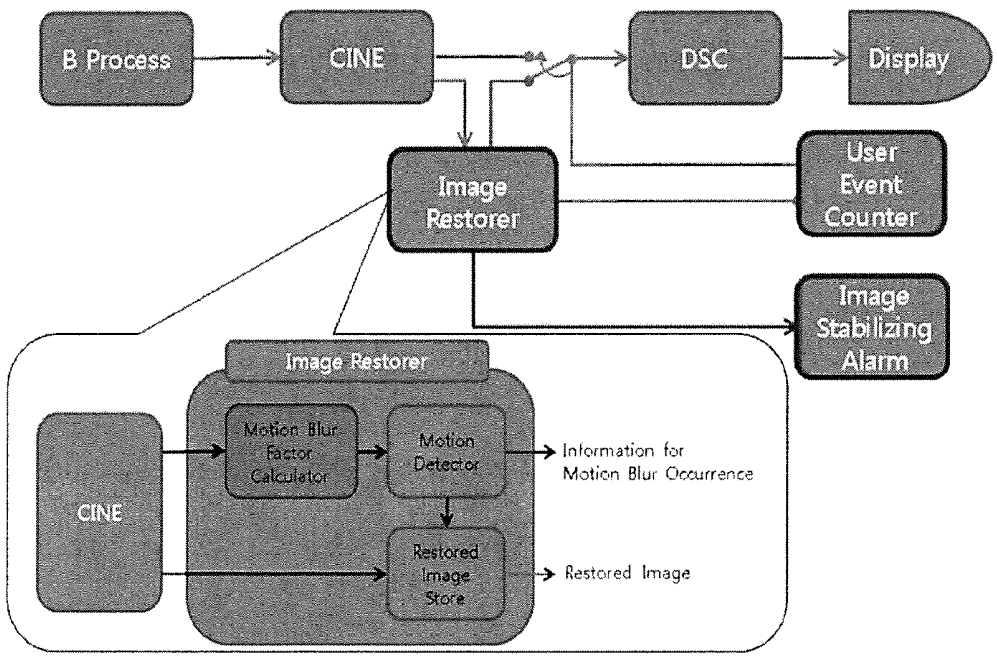
CPC ***G06T 5/003*** (2013.01); ***G06T 3/40*** (2013.01); ***G06T 7/0085*** (2013.01); ***A61B 8/5276*** (2013.01); ***A61B 8/461*** (2013.01); ***A61B 8/4444*** (2013.01); *G06T 2207/10132* (2013.01); *G06T 2200/24* (2013.01); *G06T 2207/10016* (2013.01)

(57) **ABSTRACT**

An object of the present invention is to provide a user with a diagnostic image having a minimized motion blur by correcting motion blur occurring in a freeze image when the user obtains the freeze image through a freeze function of an ultrasonic diagnosis apparatus and then the obtained freeze image is determined as a motion blurred image by measuring a motion blur factor of the obtained freeze image.



【FIG. 1】


B Process
CINE
DSC
Display
Image Restorer
User Event Counter
Image Stabilizing Alarm
Image Restorer
CINE
Motion Blur Factor Calculator
Motion Detector
Information for Motion Blur Occurrence
Restored Image Store
Restored Image

【FIG. 2A】

A_0	A_1	A_2
A_7	$f(j,k)$	A_3
A_6	A_5	A_4

【FIG. 2B】

K=1

-1	-1	-1
1	1	1

-1		1
-1		1
-1		1

; Prewitt operator

K=2

-1	-2	-1
1	2	1

-1		1
-2		2
-1		1

; Sobel operator

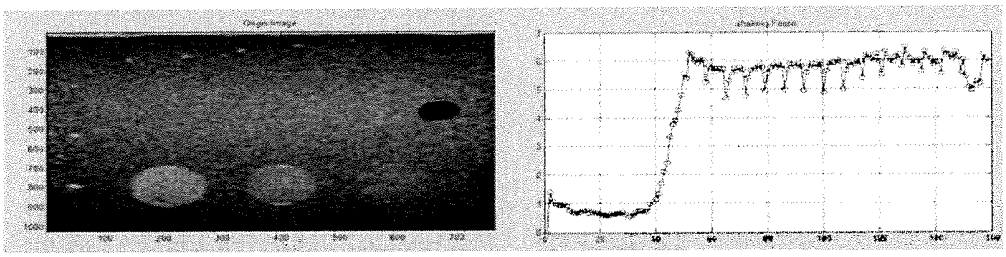
$K=\sqrt{2}$

-1	$-\sqrt{2}$	-1
1	$\sqrt{2}$	1

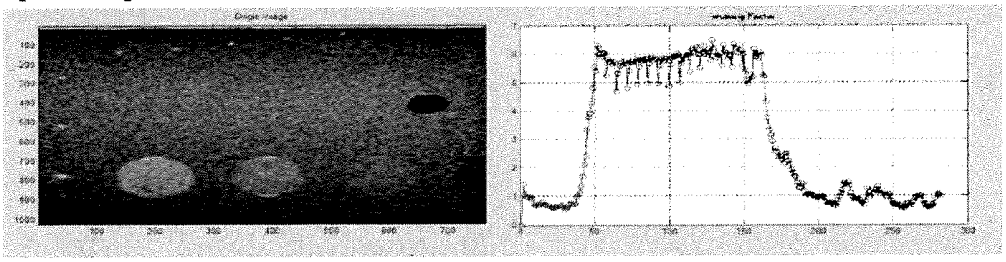
-1		-1
$-\sqrt{2}$		$\sqrt{2}$
1		1

; Chen-Frei operator

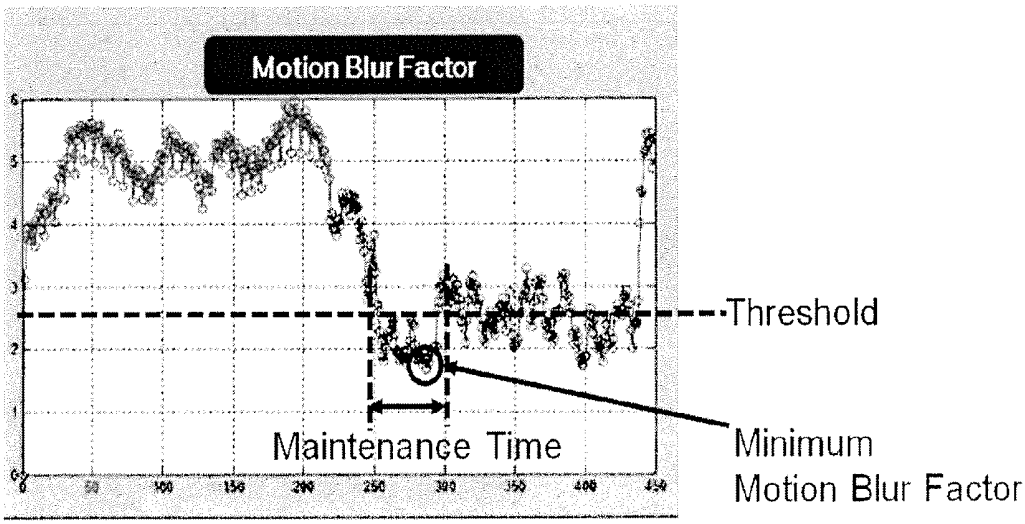
【FIG. 3A】



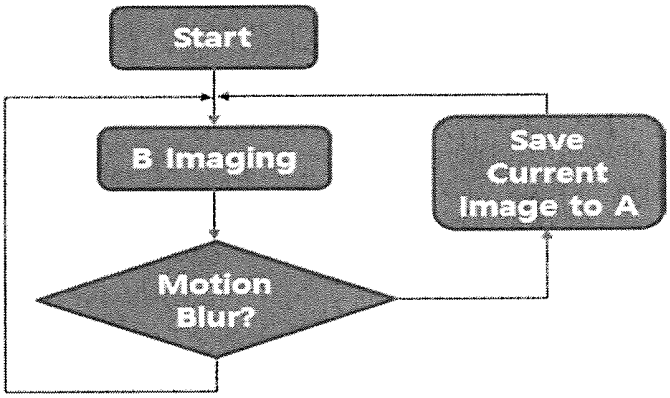
【FIG. 3B】



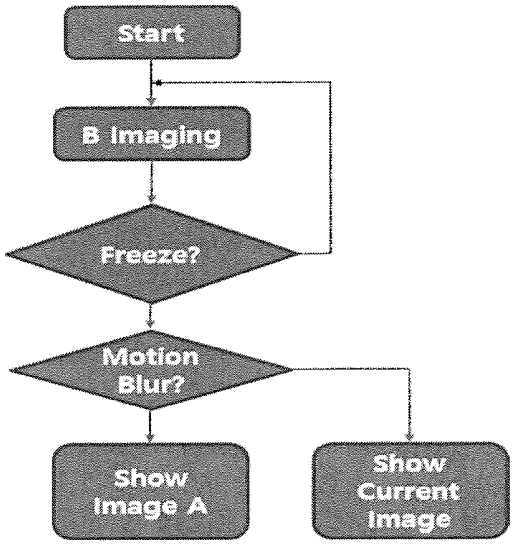
【FIG. 4】


Motion Blur Factor
Threshold
Maintenance Time
Minimum
Motion Blur Factor

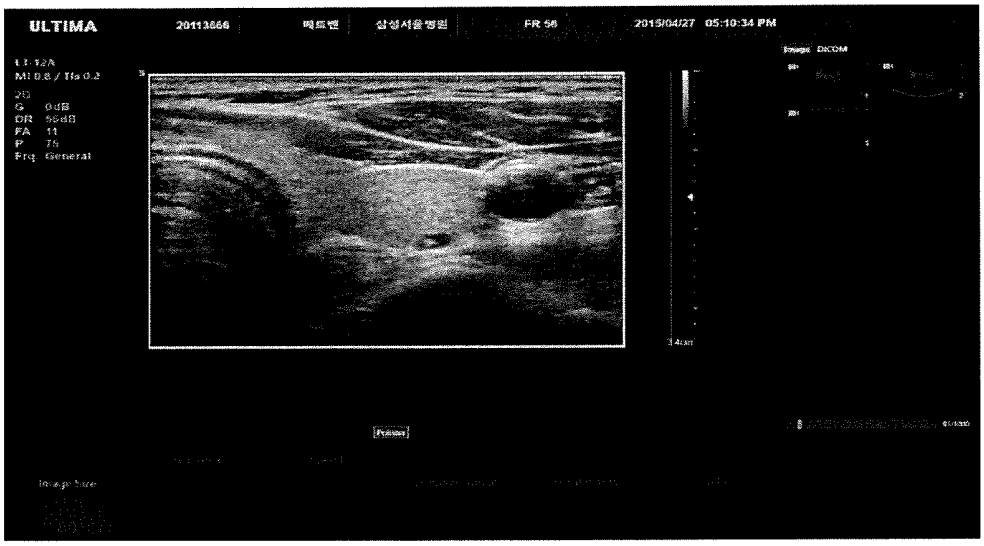
【FIG. 5】



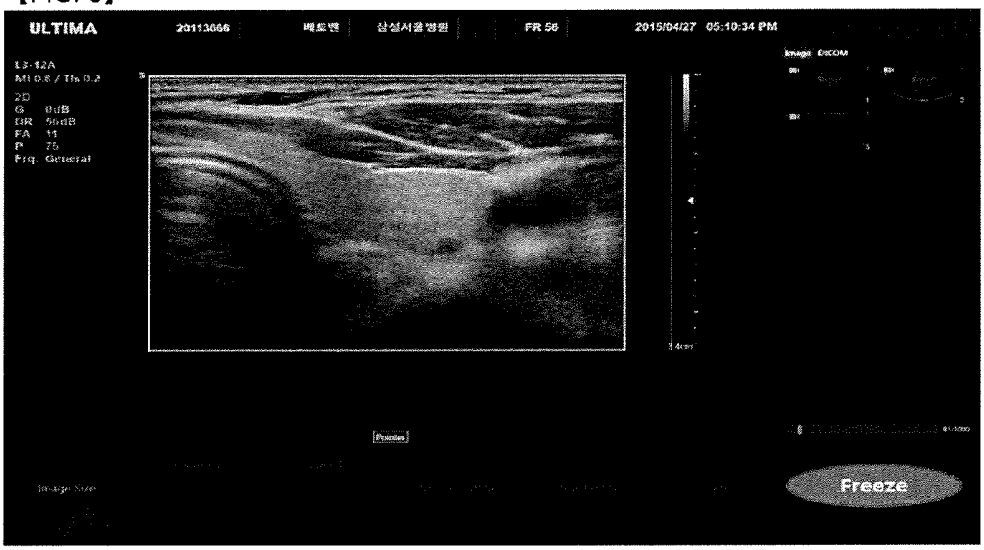
【FIG. 6】


Start
B Imaging
Freeze?
Motion Blur?
Show Image A
Show Current Image

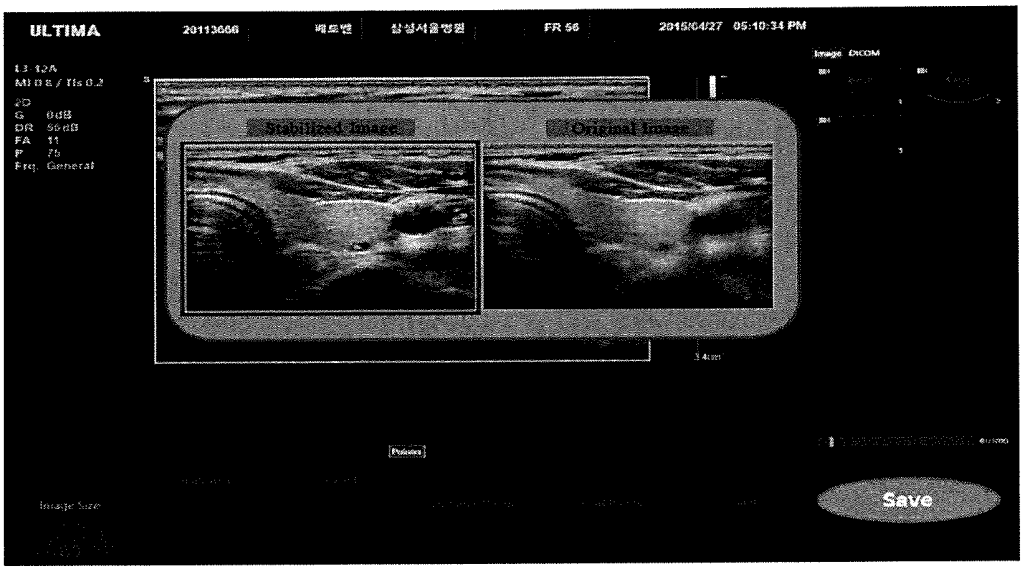
【FIG. 7】


ULTIMA
2015/04/27 05:10:34 PM

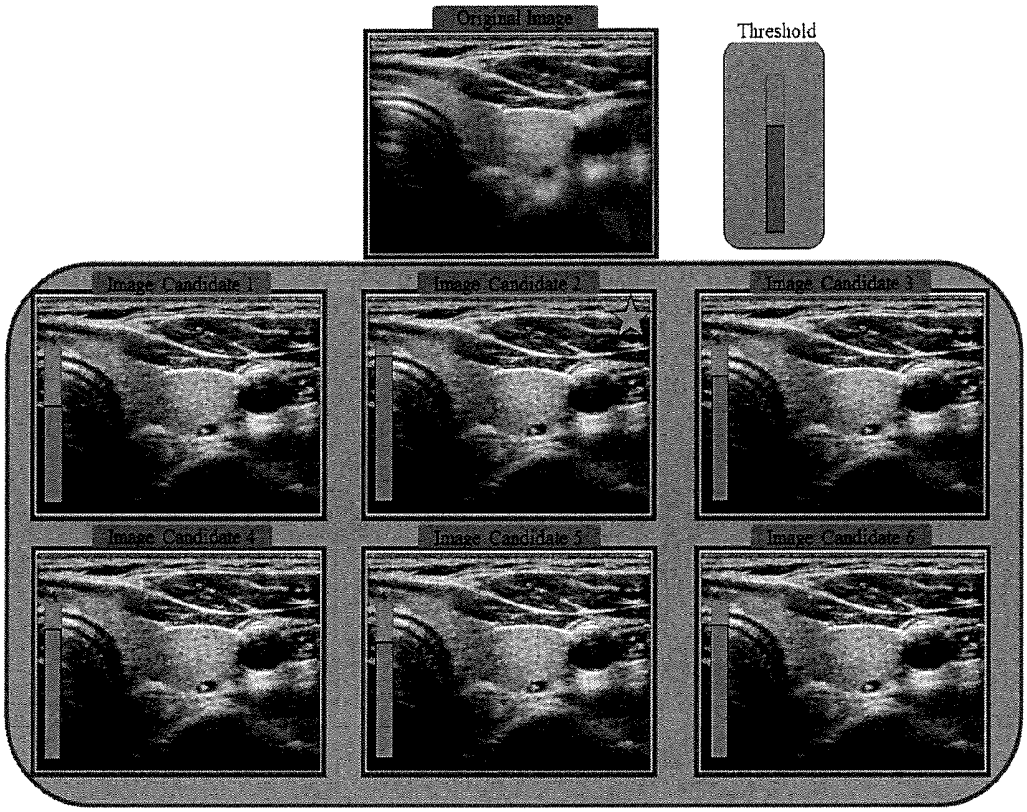
【FIG. 8】


ULTIMA
2015/04/27 05:10:34 PM
Freeze

【FIG. 9】



【FIG. 10】


Original Image
Threshold
Image Candidate 1
Image Candidate 2
Image Candidate 3
Image Candidate 4
Image Candidate 5
Image Candidate 6

ULTRASONIC APPARATUS AND METHOD FOR CONTROLLING THE SAME

TECHNICAL FIELD

[0001] The present invention relates to a method and a device for correcting a motion blurred image upon freezing and storing a diagnostic image in an ultrasonic apparatus.

TECHNICAL BACKGROUND OF INVENTION

[0002] In general, an ultrasonic diagnosis is performed by monitoring a region of interest in real time. Therefore, an ultrasonic apparatus generally not only processes ultrasonic signals in real time so as to monitor a region of interest in real time but also provides a freeze function so as to observe an image in a stationary state in which a target object does not move.

[0003] In a conventional ultrasonic apparatus, a freeze function is performed when a freeze button is pressed. Consequently, there is an inconvenience that a user should press the freeze button with one of both hands while holding a probe in the other hand so as to freeze a diagnostic image being monitored in real time by the user. Therefore, a shaking of the probe occurs frequently due to a button press operation to cause motion blurs in the diagnostic image. As a result, it may be difficult to obtain a diagnostic image meeting a user's expectation such that the user should again obtain a new diagnostic image.

TECHNICAL SOLUTION

[0004] An object of the present invention is to provide a user with a diagnostic image having a minimized motion blur by correcting motion blur occurring in a freeze image when the user obtains the freeze image through a freeze function of an ultrasonic diagnosis apparatus and then the obtained freeze image is determined as a motion blurred image by measuring a motion blur factor of the obtained freeze image.

DESCRIPTION OF DRAWINGS

[0005] FIG. **1** is a block diagram of an ultrasonic apparatus according to the present invention.

[0006] FIG. **2**A is a view illustrating an example of a basic form of a 3×3 edge filter.

[0007] FIG. **2**B is a view for describing an embodiment of an edge filter employed in the present invention.

[0008] FIG. **3** is a view for describing a method for setting a threshold value according to the present invention.

[0009] FIGS. **4**A and **4**B are views illustrating images according to occurrence and nonoccurrence of motion blurs and motion blur factors.

[0010] FIG. **5** is a flowchart of a process for storing non-motion blurred images in real time according to the present invention.

[0011] FIG. **6** is a flowchart of a process for correcting a motion blurred image when a user generates events of an image freezing and an image storing according to the present invention.

[0012] FIG. **7** is a view illustrating an embodiment of an image which the user wants to freeze.

[0013] FIG. **8** is a view illustrating an embodiment of a motion blurred image by the user's mistake.

[0014] FIG. **9** is a view illustrating an example of a method for providing a non-motion blurred image by verifying whether or not motion blurs occur according to the present invention.

[0015] FIG. **10** is a view illustrating an embodiment of a user interface (UI) according to the present invention.

MODES OF THE INVENTION

[0016] Hereinafter, the present invention will be described in detail with reference to the accompanying drawings.

[0017] A configuration according to the present invention is shown in FIG. **1**. An image stabilizer is a block proposed by the present invention, and is arranged behind an image storage CINE and in front of an image output device, which are equipped in a typical ultrasonic diagnosis apparatus. The image stabilizer receives images being currently processed from the image storage in real time, and determines whether or not motion blurs occur in the processed images to output non-motion blurred images.

[0018] As shown in FIG. **1**, the image stabilizer is comprised of three blocks, that is, a motion blur factor calculator, a motion detector, and a stabilized image store. The motion blur factor calculator serves to convert a magnitude of motion blur in a received image into a motion blur factor to transmit the motion blur factor to the motion detector. At this point, the conversion from the magnitude of motion blur into the motion blur factor may be calculated using a variation rate of an edge image of a current image with respect to a previous image.

[0019] The motion blur factor calculator may calculate from edge images (G^N and G^{N-1}) of two images (an $N-1^{th}$ image and an N^{th} image) as follows.

[0020] In particular, the motion blur factor calculator may use a 3×3 edge filter shown in FIG. **2**A so as to calculate a motion blur factor. In FIG. **2**A, f(j,k) may mean a pixel value at a j^{th} column and a k^{th} row of a CINE image. Using the 3×3 edge filter according to Equation 1, a pixel value $G_x(j,k)$ of an X-axis edge image and a pixel value $G_y(j,k)$ of a Y-axis edge image at a j^{th} column and a k^{th} row may be obtained.

$$G_x(j,k) = \frac{1}{K+2}[(A_2 + KA_3 + A_4) - (A_0 + KA_7 + A_5)] \quad \text{[Equation 1]}$$

$$G_y(j,k) = \frac{1}{K+2}[(A_0 + KA_1 + A_2) - (A_6 + KA_5 + A_4)]$$

[0021] In Equation 1, K is determined depending on a kind of an edge filter to be used, and FIG. **2**B shows edge filters employed in the present invention and K values corresponding to the edge filters.

[0022] Once $G_x(j,k)$ and $G_y(j,k)$ are obtained, a motion blur factor may be finally calculated according to Equation 2.

$$F = \sum_{j,k} \{G^{N-1}(j,k) - G^N(j,k)\} \quad \text{[Equation 2]}$$

$$G^N(j,k) = \sqrt{G_x(j,k)^2 + G_y(j,k)^2}$$

[0023] The motion detector may determine whether or not motion blurs occur based on a received motion blur factor, thereby outputting a determination result. FIG. **3**A shows a

motion blurred image and an output motion blur factor, and FIG. **3**B shows a non-motion blurred image and an output motion blur factor.

[0024] With reference to FIG. **4**, the motion detector searches for a section satisfying a threshold set to a motion blur factor and a maintenance time to determine an image having a minimum motion blur factor as a non-motion blurred image. In case of determining a plurality of non-motion blurred images, a determination may be performed in an ascending order of motion blur factors. At this point, if a threshold value is a motion blur factor, a maintenance time may mean a threshold value during a section (time period) equal to or less than the threshold value.

[0025] If the image is determined as a non-motion blurred image, the motion detector stores the image in the stabilized image store. The stabilized image store stores latest images having no motion blur, and outputs one of the latest images stored therein when motion blur occurs in an image being monitored while the user freezes or stores the image being monitored.

[0026] FIG. **5** is a flowchart of a process for storing the non-motion blurred images in real time. After a Brightness mode (B-mode) image is obtained as shown in FIG. **3**, a determination whether or not motion blur occurs in the B-mode image is performed to store the B-mode image as an image A if the B-mode image is determined as a non-motion blurred image. This process is repeated in real time and continuously performed until a freeze event is generated by the user.

[0027] FIG. **6** is a flowchart of a process for correcting a motion blurred image when events for freezing and storing an image are generated by the user. After the B-mode image is obtained as shown in FIG. **4**, a determination for motion blur is performed on the B-mode image if the freeze event is generated by the user by verifying whether or not the B-mode image is frozen. At this point, if motion blur occurs in the B-mode image frozen by the user, the stored image A is provided to the user.

[0028] In accordance with the present invention, information indicating whether or not motion blur occurs in an image designated by the user may be obtained. Moreover, when a motion blurred image is corrected, it may be possible to obtain a non-motion blurred image without image distortion due to the image correction. FIG. **7** shows an image which the user wants to freeze, and FIG. **8** shows a motion blurred image by the user's mistake. As shown in FIG. **9**, in accordance with the present invention, a non-motion blurred image may be provided to the user by verifying motion blur in the frozen image.

[0029] At this point, the ultrasonic apparatus of the present invention may provide the user with a variety of user interfaces (UIs). With reference to FIG. **10**, a UI according to one embodiment of the present invention selects images having small motion blurs and denotes motion blur factors in the form of a bar to allow the user to select one of the images. Alternatively, a UI according to another embodiment of the present invention may receive a threshold value of a motion blur factor, which is input by the user, and the ultrasonic apparatus may determine whether or not motion blur occurs in an image based on the input threshold value. Furthermore, a UI according to still another embodiment of the present invention may automatically display an image having a minimum motion blur factor.

What is claimed is:

1. An ultrasonic apparatus comprising:

an image processor configured to generate a plurality of frame images based on ultrasonic signals;

a display configured to display the plurality of frame images, sequentially;

an input device configured to receive a select instruction for selecting a frame image being displayed on the display among the plurality of frame images; and

a controller configured to control the display to display at least one of frame images, each of which has a motion blur factor equal to or less than a predetermined threshold value and is obtained prior to a select instruction input time, among the plurality of frame images when a motion blur factor of the frame image selected by the select instruction exceeds the threshold value or a substitute image display instruction is input.

2. The ultrasonic apparatus of claim **1**, wherein the controller calculates a motion blur factor of an N^{th} frame image based on a difference between the N^{th} frame image (N is a natural number equal to or greater than 2) and an $N-1^{th}$ frame image, which is a previous frame image of the N^{th} frame image, among the plurality of frame images.

3. The ultrasonic apparatus of claim **1**, wherein the controller controls the display to display a frame image closest to the selected frame image among the frame images, each of which has the motion blur factor equal to or less than the threshold value and is obtained prior to the select instruction input time.

4. The ultrasonic apparatus of claim **1**, wherein the controller controls the display to display at least one frame image obtained during a time period in which a plurality of successive frame images, each of which has a motion blur factor equal to or less than the threshold value, are obtained prior to the select instruction input time, when the time period exceeds a predetermined threshold time.

5. The ultrasonic apparatus of claim **4**, wherein the controller controls the display to display a frame image having a minimum motion blur factor among the plurality of successive frame images obtained during the time period.

6. The ultrasonic apparatus of claim **4**, wherein the controller controls the display to display simultaneously multiple frame images selected based on the motion blur factors among the plurality of successive frame images obtained during the time period.

7. The ultrasonic apparatus of claim **6**, wherein the display displays the motion blur factors of the multiple frame images being simultaneously displayed in association with the multiple frame images.

8. The ultrasonic apparatus of claim **6**, wherein the input device receives a select instruction for selecting one among the multiple frame images being simultaneously displayed, and

wherein the controller controls the display to magnify and display a selected frame image when the select instruction is input to select one among the multiple frame images being simultaneously displayed.

9. The ultrasonic apparatus of claim **1**, wherein the controller controls the display to display information related to a motion blur factor of the selected frame image when the motion blur factor of the selected frame image exceeds the threshold value.

10. The ultrasonic apparatus of claim **1**, further comprising:

an ultrasonic probe configured to obtain the ultrasonic signals containing information of a target object in real time,

wherein the image processor generates the plurality of frame images in real time based on the ultrasonic signals obtained in real time; and

further comprising:

a storage device configured to store at least one among the plurality of frame images generated in real time,

wherein the controller controls the storage device to store frame images, each of which has a motion blur factor equal to or less than the threshold value, among the plurality of frame images generated in real time.

11. A method for controlling an ultrasonic apparatus, comprising the steps of:

displaying sequentially a plurality of frame images generated based on ultrasonic signals;

receiving a select instruction for selecting the frame image being displayed among the plurality of frame images; and

displaying at least one of frame images, each of which has a motion blur factor equal to or less than a predetermined threshold value and is obtained prior to a select instruction input time, among the plurality of frame images when a motion blur factor of the frame image selected by the select instruction exceeds the threshold value or a substitute image display instruction is input.

12. The method of claim **11**, further comprising the step of:

calculating a motion blur factor of an Nth frame image based on a difference between the Nth frame image (N is a natural number equal to or greater than 2) and an N−1th frame image, which is a previous frame image of the Nth frame image, among the plurality of frame images.

13. The method of claim **11**, wherein the displaying of the at least one of the frame images, each of which has the motion blur factor equal to or less than the threshold value and is obtained prior to the select instruction input time, displays a frame image closest to the selected frame image among the frame images, each of which has the motion blur factor equal to or less than the threshold value and is obtained prior to the select instruction input time.

14. The method of claim **11**, wherein the displaying of the at least one of the frame images, each of which has the motion blur factor equal to or less than the threshold value and is obtained prior to the select instruction input time, displays at least one frame image obtained during a time period in which a plurality of successive frame images, each of which has a motion blur factor equal to or less than the threshold value, are obtained prior to the select instruction input time, when the time period exceeds a predetermined threshold time.

15. The method of claim **14**, wherein the displaying of the at least one of the frame images, each of which has the motion blur factor equal to or less than the threshold value and is obtained prior to the select instruction input time, displays a frame image having a minimum motion blur factor among the plurality of successive frame images obtained during the time period.

16. The method of claim **14**, wherein the displaying of the at least one of the frame images, each of which has the motion blur factor equal to or less than the threshold value and is obtained prior to the select instruction input time, includes the steps of:

selecting multiple frame images being simultaneously displayed based on the motion blur factors among the plurality of successive frame images obtained during the time period; and

displaying simultaneously the selected multiple frame images.

17. The method of claim **16**, wherein the displaying of the at least one of the frame images, each of which has the motion blur factor equal to or less than the threshold value and is obtained prior to the select instruction input time, displays the motion blur factors of the multiple frame images being simultaneously displayed in association with the multiple frame images.

18. The method of claim **16**, further comprising the step of:

receiving a select instruction for selecting one among the multiple frame images being simultaneously displayed; and

magnifying and displaying a selected frame image when the select instruction is input to select one among the multiple frame images being simultaneously displayed.

19. The method of claim **11**, further comprising the step of:

displaying information related to a motion blur factor of the selected frame image when the motion blur factor of the selected frame image exceeds the threshold value.

20. The method of claim **11**, wherein the displaying sequentially of the plurality of frame images generated based on the ultrasonic signals includes the steps of:

obtaining the ultrasonic signals containing information of a target object in real time;

generating the plurality of frame images in real time based on the ultrasonic signals obtained in real time;

displaying sequentially the plurality of frame images generated in real time; and

storing at least one among the plurality of frame images generated in real time,

wherein the storing of the at least one among the plurality of frame images generated in real time stores frame images, each of which has a motion blur factor equal to or less than the threshold value, among the plurality of frame images generated in real time.

* * * * *

专利名称(译)	超声波设备及其控制方法		
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[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.		
[标]发明人	LEE JAE SUNG KANG HAK IL PARK SUNG AH		
发明人	LEE, JAE SUNG KANG, HAK-IL PARK, SUNG-AH		
IPC分类号	G06T5/00 A61B8/00 A61B8/08 G06T3/40 G06T7/00		
CPC分类号	G06T5/003 G06T3/40 G06T7/0085 A61B8/5276 G06T2207/10016 A61B8/4444 G06T2207/10132 G06T2200/24 A61B8/461 A61B8/4411 A61B8/463 A61B8/52 A61B8/5223 A61B8/085 A61B8/4405 A61B8/464 A61B8/467 G06T7/13		
优先权	1020150168351 2015-11-30 KR 62/243380 2015-10-19 US		
其他公开文献	US10395346		
外部链接	Espacenet USPTO		

摘要(译)

本发明的一个目的是当用户通过超声诊断设备的冻结功能获得冻结图像然后获得的冻结时，通过校正在冻结图像中发生的运动模糊，为用户提供具有最小化运动模糊的诊断图像。通过测量所获得的冻结图像的运动模糊因子，将图像确定为运动模糊图像。