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YOO et al.(10) **Pub. No.: US 2011/0184292 A1**(43) **Pub. Date: Jul. 28, 2011**(54) **ULTRASOUND IMAGE ENHANCEMENT IN
AN ULTRASOUND SYSTEM**(75) Inventors: **Jae Heung YOO**, Seoul (KR);
Jeong Sik Kim, Seoul (KR)(73) Assignee: **MEDISON CO., LTD.**(21) Appl. No.: **13/011,470**(22) Filed: **Jan. 21, 2011**(30) **Foreign Application Priority Data**

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Publication Classification(51) **Int. Cl.**
A61B 8/14 (2006.01)(52) **U.S. Cl. 600/447**(57) **ABSTRACT**

Embodiments for spatially compounding ultrasound images for removing seam artifact in an ultrasound system are disclosed. In one embodiment, the ultrasound system includes: an ultrasound data acquisition unit configured to transmit ultrasound beams to a target object, receive ultrasound echoes reflected from the target object and provide a plurality of ultrasound frame data sets for a plurality of frames, said plurality of ultrasound frame data being acquired at different steering angles of scan lines; and a processing unit configured to form a plurality of ultrasound images and form a plurality of mask images corresponding to the respective ultrasound images based on the plurality of ultrasound frame data sets for removing seam artifact and spatially compound the plurality of ultrasound image based on the plurality of mask images to form an ultrasound spatial compound image.

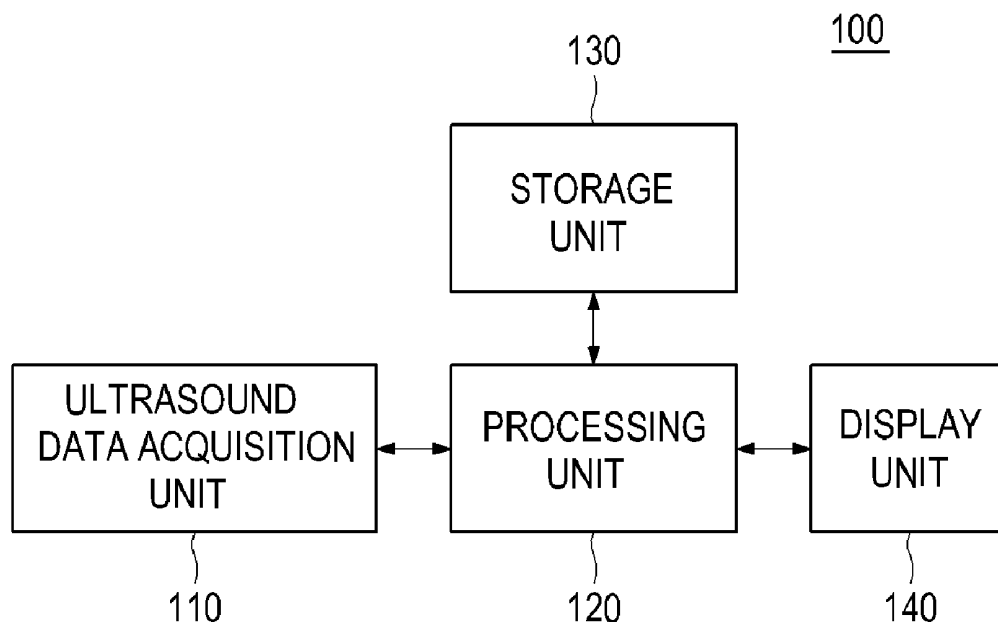


FIG. 1

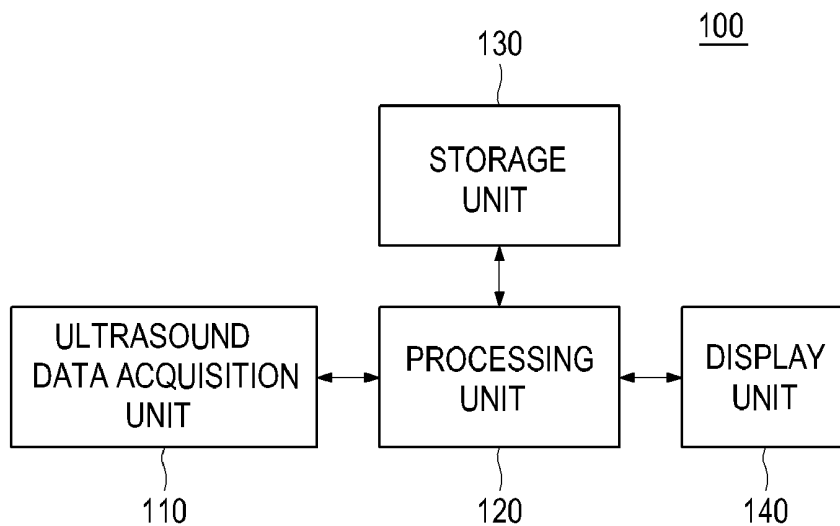


FIG. 2

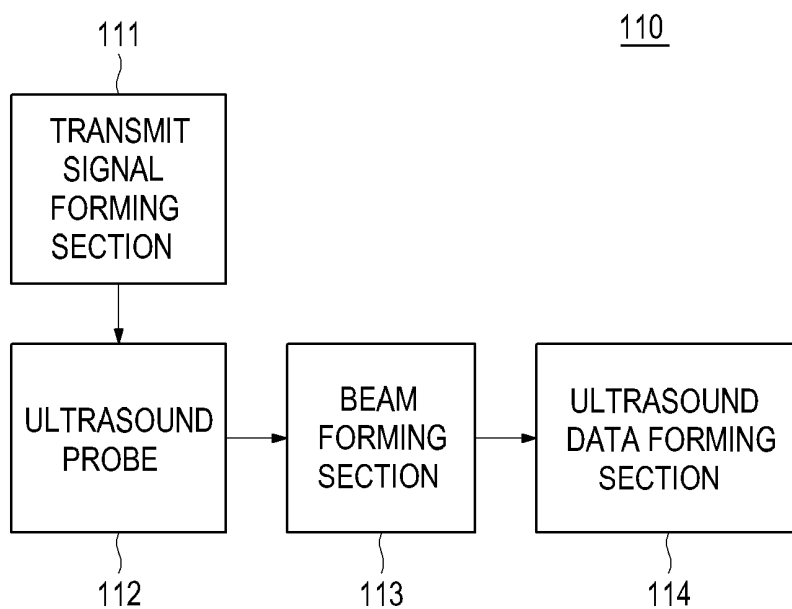


FIG. 3

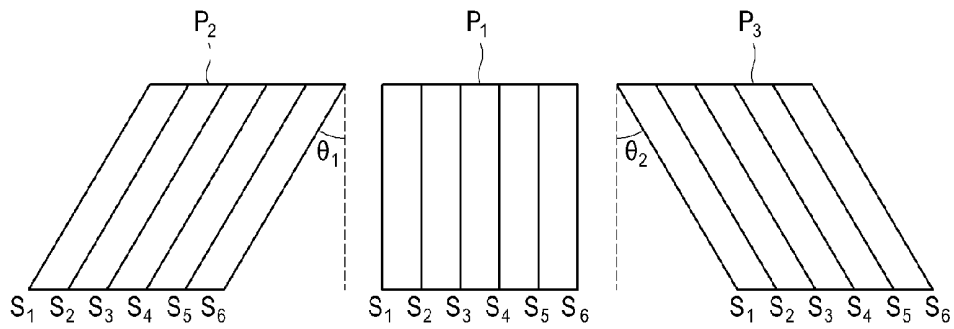


FIG. 4

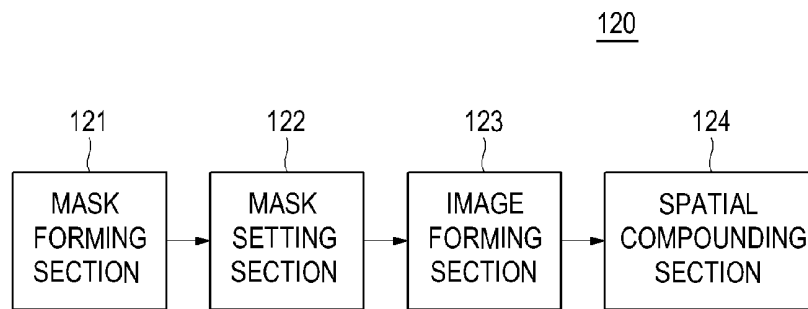
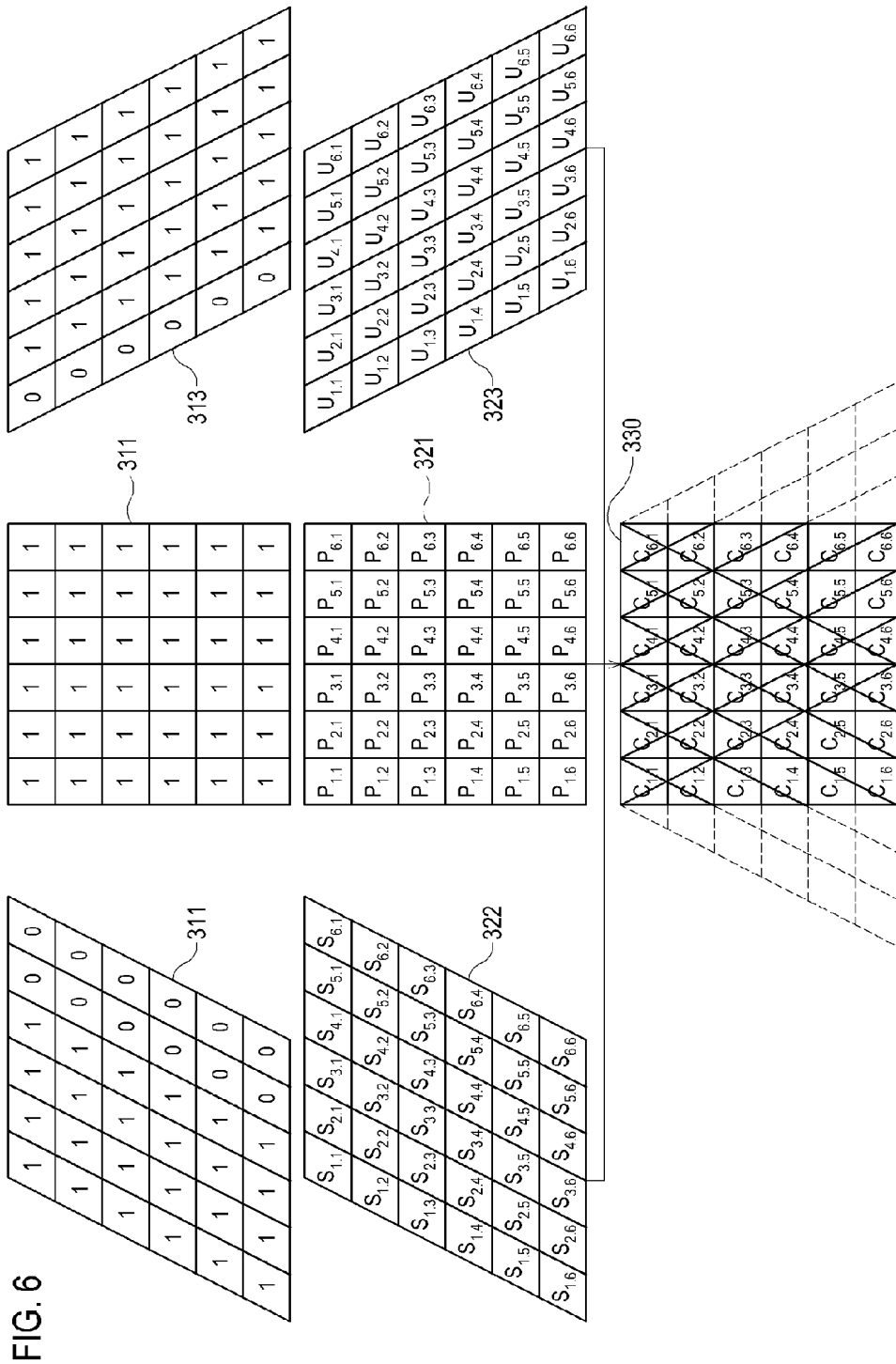


FIG. 5

Figure 1 illustrates three 6x6 grids of bits, labeled 212, 211, and 213, representing different states or configurations. Each grid is a 6x6 matrix of bits (0s and 1s).

- Grid 212:** The first four columns contain all 1s, and the last two columns contain all 0s.
- Grid 211:** All six columns contain all 1s.
- Grid 213:** The first column contains all 0s, and the remaining five columns contain all 1s.



ULTRASOUND IMAGE ENHANCEMENT IN AN ULTRASOUND SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority from Korean Patent Application No. 10-2010-0006412 filed on Jan. 25, 2010, the entire subject matter of which is incorporated herein by reference.

TECHNICAL FIELD

[0002] The present disclosure generally relates to ultrasound image processing, and more particularly to enhancing ultrasound images without lowering a frame rate in an ultrasound system.

BACKGROUND

[0003] An ultrasound system has been extensively used in the medical field due to its non-invasive and non-destructive nature. Modern high-performance ultrasound imaging diagnostic systems and techniques are commonly used to produce two-dimensional or three-dimensional ultrasound images of internal features of patients.

[0004] Recently, spatial compounding has been adopted in the ultrasound system to provide enhanced ultrasound images. The spatial compounding is implemented by compounding a plurality of ultrasound images (e.g., three ultrasound images), which have been successively formed at different steering angles of scan lines, to form a compound image. In such a case, when the ultrasound images are acquired under the condition that a surface of an ultrasound probe is not properly contacted with a surface of a target object, border lines of the ultrasound images may appear in a compound image formed by spatial compounding of the ultrasound images, i.e., seam artifact occurs in the compound image, which may degrade the compound image.

SUMMARY

[0005] Embodiments for spatially compounding ultrasound images for removing seam artifact in an ultrasound system are disclosed herein. In one embodiment, by way of non-limiting example, an ultrasound system comprises: an ultrasound data acquisition unit configured to transmit ultrasound beams to a target object, receive ultrasound echoes reflected from the target object and provide a plurality of ultrasound frame data sets for a plurality of frames, said plurality of ultrasound frame data being acquired at different steering angles of scan lines; and a processing unit configured to form a plurality of ultrasound images and form a plurality of mask images corresponding to the respective ultrasound images based on the plurality of ultrasound frame data sets for removing seam artifact and spatially compound the plurality of ultrasound image based on the plurality of mask images to form an ultrasound spatial compound image.

[0006] In another embodiment, a method of forming an ultrasound spatial compound image in an ultrasound system, comprises: a) transmitting ultrasound beams to a target object, receiving ultrasound echoes reflected from the target object and providing a plurality of ultrasound frame data sets for a plurality of frames, said plurality of ultrasound frame data being acquired at different steering angles of scan lines; b) setting a plurality of masks corresponding to the respective frames based on the plurality of ultrasound frame data sets for

removing seam artifact to form a plurality of mask images corresponding to the respective frames; c) forming a plurality of ultrasound images corresponding to the plurality of frames based on the plurality of frame data sets; and d) spatially compounding the plurality of ultrasound image based on the plurality of mask images to form an ultrasound spatial compound image.

[0007] In yet another embodiment, a computer-readable storage medium storing instructions that, when executed by a computer, cause the computer to provide a method of spatially compounding ultrasound images based on a plurality of ultrasound frame data sets acquired from a target object and at different steering angles of scan lines in an ultrasound system, the method comprises: setting a plurality of masks corresponding to the respective frames based on the plurality of ultrasound frame data sets for removing seam artifact to form a plurality of mask images corresponding to the respective frames; forming a plurality of ultrasound images corresponding to the plurality of frames based on the plurality of frame data sets; and spatially compounding the plurality of ultrasound image based on the plurality of mask images to form an ultrasound spatial compound image.

[0008] The Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key or essential features of the claimed subject matter, nor is it intended to be used in determining the scope of the claimed subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 is a block diagram showing an illustrative embodiment of an ultrasound system.

[0010] FIG. 2 is a block diagram showing an illustrative embodiment of an ultrasound data acquisition unit of FIG. 1.

[0011] FIG. 3 is a schematic diagram showing examples of frames consisting of a scan line group with its scan lines not being steered and scan line groups with their scan lines being steered at predetermined steering angles θ_1 and θ_2 .

[0012] FIG. 4 is a block diagram showing an illustrative embodiment of a processing unit of FIG. 1.

[0013] FIG. 5 is a schematic diagram showing examples of masks.

[0014] FIG. 6 is a schematic diagram showing examples of mask images, ultrasound image and a compound image.

DETAILED DESCRIPTION

[0015] A detailed description may be provided with reference to the accompanying drawings. One of ordinary skill in the art may realize that the following description is illustrative only and is not in any way limiting. Other embodiments of the present invention may readily suggest themselves to such skilled persons having the benefit of this disclosure.

[0016] Referring to FIG. 1, an ultrasound system constructed in accordance with one embodiment is shown. The ultrasound system 100 may include an ultrasound data acquisition unit 110, a processing unit 120, a storage unit 130 and a display unit 140.

[0017] The ultrasound data acquisition unit 110 may be configured to transmit ultrasound beams to a target object and receive ultrasound echoes reflected from the target object to thereby form ultrasound data representative of the target object. An operation of the ultrasound acquisition unit will be described in detail by referring to FIG. 2.

[0018] FIG. 2 is a block diagram showing an illustrative embodiment of the ultrasound data acquisition unit 110. Referring to FIG. 2, the ultrasound data acquisition unit 110 may include a transmit (Tx) signal forming section 111. The Tx signal forming section 121 may generate a plurality of Tx signals and apply delays to the Tx signals. The delays of the Tx signals may be controlled according to a steering angle of scan lines. For example, the Tx signals may include first Tx signals for obtaining a first frame P_1 in which scan lines S_1 - S_6 are not steered, second Tx signals for obtaining a second frame P_2 in which scan lines S_1 - S_6 are steered at a first steering angle of θ_1 and third Tx signals for obtaining a third frame P_3 in which scan lines S_1 - S_6 are steered at a second steering angle of θ_2 , as shown in FIG. 3.

[0019] The ultrasound data acquisition unit 110 may further include an ultrasound probe 112, which is coupled to the Tx signal forming section 111. The ultrasound probe 112 may include an array transducer containing a plurality of transducer elements for reciprocal conversion between electric signals and ultrasound signals. The ultrasound probe 112 may be configured to transmit ultrasound signals in response to the Tx signals. The ultrasound probe 112 may be further configured to receive ultrasound echoes reflected from the target object to thereby output receive signals. In one embodiment, the receive signals may include first receive signals obtained in response to the first Tx signals, second receive signals obtained in response to the second Tx signals and third receive signals obtained in response to the third Tx signals.

[0020] The ultrasound data acquisition unit 110 may further include a beam forming section 113, which is coupled to the ultrasound probe 112. The beam forming section 113 may be configured to digitize the electrical receive signals to obtain digital signals. The beam forming section 113 may also apply delays to the digital signals in consideration of distances between the elements of the ultrasound probe 112 and focal points. The beam forming section 113 may further sum the delayed digital signals to form receive-focused beams. In one embodiment, the beam forming section 113 may form a first receive-focused beam based on the first receive signals, a second receive-focused beam based on the second receive signals and a third receive-focused beam based on the third receive signals.

[0021] The ultrasound data acquisition unit 110 may further include an ultrasound data forming section 114, which is coupled to the beam forming section 113. The ultrasound data forming section 114 may be configured to form ultrasound data corresponding to a plurality of frames based on the receive-focused beams. The ultrasound data may be stored in the storage unit 130. In one embodiment, the ultrasound data forming section 114 may be configured to form a first ultrasound frame data set corresponding to the respective scan lines S_1 - S_6 of the first frame P_1 based on the first receive-focused beams. The ultrasound data forming section 114 may be configured to form a second ultrasound frame data set corresponding to the respective scan lines S_1 - S_6 of the second frame P_2 based on the second receive-focused beams. Further, the ultrasound data forming section 114 may be configured to form a third ultrasound frame data set corresponding to the respective scan lines S_1 - S_6 of the third frame P_3 based on the first receive-focused beams. The ultrasound data forming section 114 may be configured to perform a variety of signal processing (e.g., gain adjustment, etc.), which is necessary for forming the ultrasound data, upon the receive-focused beams.

[0022] Referring back to FIG. 1, the processing unit 120, which is coupled to the ultrasound data acquisition unit 110, may be configured to form ultrasound images and mask images corresponding to the frames of the plurality of steering angles based on the plurality of ultrasound frame data sets. In this case, the mask images are formed to remove seam artifacts appearing in a spatial compound image of the ultrasound images. Further, the processing unit 120 may be configured to spatially compound a plurality of ultrasound images by using the mask images to form an ultrasound spatial compound image. An operation of the processing unit 120 will be described in detail by referring to FIG. 4.

[0023] FIG. 4 is a block diagram showing an illustrative embodiment of the processing unit 120. In one embodiment, the processing unit 120 may include a mask forming section 121, a mask setting section 122, an image forming section 123 and a spatial compounding section 124.

[0024] The mask forming section 121 may be configured to a plurality of masks corresponding to a plurality of frames, respectively, based on the plurality of ultrasound frame data sets. Each of the masks has a size and a pixel number identical to those of each of the frames. In one embodiment, the mask forming section 121 may be configured to a first mask 211 corresponding to the first frame P_1 based on the first ultrasound frame data set as shown in FIG. 5. The mask forming section 121 may be configured to a second mask 212 corresponding to the first frame P_2 based on the second ultrasound frame data set. Further, the mask forming section 121 may be configured to a third mask 213 corresponding to the first frame P_3 based on the third ultrasound frame data set.

[0025] The mask setting section 122, which is coupled to the mask forming section 121, may be configured to determine a pixel value corresponding to each of pixels in each of the masks by using the ultrasound frame data sets. More particularly, the mask setting section 122 may be configured to detect an intensity of the ultrasound frame data corresponding to the scan line S_1 at each of the frame by using the ultrasound frame data sets. The mask setting section 122 may be further configured to compare the detected intensity with a predetermined threshold. If the intensity is equal to or greater than the predetermined threshold, then it is determined that the ultrasound probe 112 is properly contacted with the surface of the target object. This is so that the mask setting section 122 may assign a value of 1 to pixels corresponding to the scan line S_1 .

[0026] On the other hand, if the intensity is less than the predetermined threshold, then it is determined that the ultrasound probe 112 is properly contacted with the surface of the target object. This is so that the mask setting section 122 may assign a value of 0 to pixels corresponding to the scan line S_1 . For example, the mask setting section 122 may be configured to detect intensities of the ultrasound frame data corresponding to each of the scan lines S_1 - S_6 of the first frame P_1 and compare the intensities with the predetermined threshold to thereby assign a value of 1 to pixels corresponding to the scan line S_1 - S_6 , which have the intensities equal to or greater than the predetermined threshold value, as shown in FIG. 5. The mask setting section 122 may be configured to detect intensities of the ultrasound frame data corresponding to each of the scan lines S_1 - S_6 of the second frame P_2 and compare the intensities with the predetermined threshold. The mask setting section 122 may be configured to assign a value of 1 to pixels of the second mask 212 corresponding to the scan line S_1 - S_4 , which have the intensities equal to or greater than the

predetermined threshold value, and a value of 0 to pixels of the second mask **212** corresponding to the scan line S_5 - S_6 , which have the intensities less than the predetermined threshold value. The mask setting section **122** may be configured to detect intensities of the ultrasound frame data corresponding to each of the scan lines S_1 - S_6 of the third frame P_3 and compare the intensities with the predetermined threshold. The mask setting section **122** may be configured to assign a value of 1 to pixels of the third mask **213** corresponding to the scan line S_2 - S_6 , which have the intensities equal to or greater than the predetermined threshold value, and a value of 0 to pixels of the third mask **213** corresponding to the scan line S_1 , which have the intensities less than the predetermined threshold value.

[0027] The image forming section **123**, which is coupled to the mask setting unit **122**, may be configured to form a plurality of mask images based on the plurality of masks provided from the mask setting unit **122**. Also, the image forming section **123** may be further configured to form a plurality of ultrasound images corresponding to the plurality of mask images by using the ultrasound frame data sets provided from the ultrasound data acquisition unit **110**. In one embodiment, the image forming section **123** may be configured to form a first mask image **311**, a second mask image **312** and a third mask image **313** by using the first mask **211**, the second mask **212** and the third mask **213**, as shown in FIG. 6. Further, the image forming section **123** may be configured to form first to third ultrasound images **321** to **323** corresponding to the first to third frames P_1 - P_3 by using the first to third ultrasound frame data sets.

[0028] The spatial compounding section **124** may be configured to form an ultrasound spatial compound image by compounding the plurality of ultrasound images by using the plurality of mask images. The spatial compounding section **124** may be configured to sum values of pixels identically positioned in the plurality of ultrasound images to obtain first summation values, and sum values of pixels identically positioned in the plurality of mask images to obtain second summation values. The spatial compound section **124** may be configured to determine pixel values of the ultrasound spatial compound image.

[0029] In one embodiment, the spatial compound image **124** may be configured to sum a pixel value of a pixel $P_{1,1}$ of the first ultrasound image **321**, a pixel value of a pixel $S_{1,1}$ of the second ultrasound image **322** and a pixel value of a pixel $U_{1,1}$ of the third ultrasound image **323**, with respect to a pixel $C_{1,1}$ of an ultrasound spatial compound image **330**, thereby obtaining a first summation value. The spatial compound image **124** may be further configured to sum a pixel value of 1 of the first mask image **311**, which corresponds to the pixel $P_{1,1}$ of the first ultrasound image **321**, a pixel value of 1 of the second mask image **312**, which corresponds to the pixel $S_{1,1}$ of the second ultrasound image, and a pixel value of 0 of the third mask image **313**, which corresponds to the pixel $U_{1,1}$ of the third ultrasound image, thereby obtaining a second summation value of 2. The spatial compounding section **124** is further configured to divide the first summation value by the second summation value (i.e., first summation value/second summation value) to thereby determine a pixel value of a pixel $C_{1,1}$ of the ultrasound spatial compound image **330**. In the same manner, the spatial compounding section **124** may be configured to determine pixel values of pixels $C_{1,2}$ and $C_{1,3}$ of the ultrasound spatial compound image **330**.

[0030] With respect to a pixel $C_{1,4}$ of the ultrasound spatial compound image **330**, the spatial compounding section **124** may be configured to sum a pixel value of a pixel $P_{1,4}$ of the first ultrasound image **321** and a pixel value of a pixel $S_{2,4}$ of the second ultrasound image **322**, thereby obtaining a first summation value. The spatial compound image **124** may be further configured to sum a pixel value of 1 of the first mask image **311**, which corresponds to the pixel $P_{1,4}$ of the first ultrasound image **321**, and a pixel value of 1 of the second mask image **312**, which corresponds to the pixel $S_{2,4}$ of the second ultrasound image, thereby obtaining a second summation value of 2. The spatial compounding section **124** is further configured to divide the first summation value by the second summation value (i.e., first summation value/second summation value) to thereby determine a pixel value of a pixel $C_{1,4}$ of the ultrasound spatial compound image **330**. In the same manner, the spatial compounding section **124** may be configured to determine pixel values of pixels $C_{1,5}$ and $C_{1,6}$ of the ultrasound spatial compound image **330**.

[0031] With respect to a pixel $C_{2,1}$ of the ultrasound spatial compound image **330**, the spatial compound image **124** may be configured to sum a pixel value of a pixel $P_{2,1}$ of the first ultrasound image **321**, a pixel value of a pixel $S_{2,1}$ of the second ultrasound image **322** and a pixel value of a pixel $U_{2,1}$ of the third ultrasound image **323**, thereby obtaining a first summation value. The spatial compound image **124** may be further configured to sum a pixel value of 1 of the first mask image **311**, which corresponds to the pixel $P_{2,1}$ of the first ultrasound image **321**, a pixel value of 1 of the second mask image **312**, which corresponds to the pixel $S_{2,1}$ of the second ultrasound image, and a pixel value of 1 of the third mask image **313**, which corresponds to the pixel $U_{2,1}$ of the third ultrasound image, thereby obtaining a second summation value of 3. The spatial compounding section **124** is further configured to divide the first summation value by the second summation value (i.e., first summation value/second summation value) to thereby determine a pixel value of a pixel $C_{2,1}$ of the ultrasound spatial compound image **330**. In the same manner, the spatial compounding section **124** may be configured to determine pixel values of pixels $C_{2,2}$, $C_{2,3}$, $C_{2,4}$, $C_{2,5}$, $C_{2,6}$, $C_{3,1}$, $C_{3,2}$, $C_{3,3}$, $C_{3,4}$, $C_{3,5}$, $C_{3,6}$, $C_{4,1}$, $C_{4,2}$, $C_{4,3}$, $C_{4,4}$, $C_{4,5}$, $C_{4,6}$, $C_{5,1}$, $C_{5,2}$, $C_{5,3}$, $C_{5,4}$, $C_{5,5}$, $C_{5,6}$, $C_{6,1}$, $C_{6,2}$ and $C_{6,3}$ of the ultrasound spatial compound image **330**.

[0032] With respect to a pixel $C_{6,4}$ of the ultrasound spatial compound image **330**, the spatial compounding section **124** may be configured to sum a pixel value of a pixel $P_{6,4}$ of the first ultrasound image **321** and a pixel value of a pixel $U_{5,4}$ of the second ultrasound image **323**, thereby obtaining a first summation value. The spatial compound image **124** may be further configured to sum a pixel value of 1 of the first mask image **311**, which corresponds to the pixel $P_{6,4}$ of the first ultrasound image **321**, and a pixel value of 1 of the third mask image **313**, which corresponds to the pixel $U_{5,4}$ of the third ultrasound image, thereby obtaining a second summation value of 2. The spatial compounding section **124** is further configured to divide the first summation value by the second summation value (i.e., first summation value/second summation value) to thereby determine a pixel value of a pixel $C_{6,4}$ of the ultrasound spatial compound image **330**. In the same manner, the spatial compounding section **124** may be configured to determine pixel values of pixels $C_{6,5}$ and $C_{6,6}$ of the ultrasound spatial compound image **330**.

[0033] Referring back to FIG. 1, the storage unit **130**, which is coupled to the processing unit **120**, may be configured to

store the ultrasound data sets, which have been acquired in the ultrasound data acquisition unit 110. The storage unit 130 may further store the plurality of ultrasound images, which have been formed in the processing unit 120. The display unit 140 may display the ultrasound spatial compound image.

[0034] In another embodiment, there is provided a computer-readable storage medium storing instructions that, when executed by a computer, cause the computer to provide a method of spatially compounding ultrasound images based on a plurality of ultrasound frame data sets acquired from a target object and at different steering angles of scan lines in an ultrasound system, the method comprising: setting a plurality of masks corresponding to the respective frames based on the plurality of ultrasound frame data sets for removing seam artifact to form a plurality of mask images corresponding to the respective frames; forming a plurality of ultrasound images corresponding to the plurality of frames based on the plurality of frame data sets; and spatially compounding the plurality of ultrasound image based on the plurality of mask images to form an ultrasound spatial compound image.

[0035] Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this disclosure. More particularly, numerous variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

What is claimed is:

1. An ultrasound system, comprising:
 - an ultrasound data acquisition unit configured to transmit ultrasound beams to a target object, receive ultrasound echoes reflected from the target object and provide a plurality of ultrasound frame data sets for a plurality of frames, said plurality of ultrasound frame data being acquired at different steering angles of scan lines; and
 - a processing unit configured to form a plurality of ultrasound images and form a plurality of mask images corresponding to the respective ultrasound images based on the plurality of ultrasound frame data sets for removing seam artifact and spatially compound the plurality of ultrasound image based on the plurality of mask images to form an ultrasound spatial compound image.
2. The ultrasound system of claim 1, wherein the mask images have identical sizes and pixel numbers to those of the corresponding ultrasound images.
3. The ultrasound system of claim 1, wherein the processing unit includes:
 - a mask forming section configured to form masks corresponding to the respective frames based on the ultrasound frame data sets;
 - a mask setting section configured to determine pixel values of pixels of each of the mask based on intensities of the ultrasound frame data sets;
 - an image forming section configured to form the plurality of mask images based on the masks and the plurality of ultrasound images based on the ultrasound frame data sets; and

a spatial compounding section configured to spatially compound the plurality of ultrasound image based on the plurality of mask images.

4. The ultrasound system of claim 3, wherein the mask setting section is configured to detect an intensity of each of the frames corresponding to the respective scan lines by using the ultrasound frame data sets, compare the detected intensity with a predetermined threshold, assign, when the intensity is equal to or greater than a predetermined threshold, a value of 1 to pixels corresponding to the scan line, and assign, when the intensity is less than the predetermined threshold, a value of 0 to pixels corresponding to the scan line.

5. The ultrasound system of claim 3, wherein the spatial compounding section is configured to sum pixel values of pixels overlapped at the ultrasound images to obtain a first summation value, sum pixel values of pixel overlapped at the mask images to obtain a second summation value and divide the first summation value by the second summation value to determine a pixel value at a corresponding pixel of the ultrasound spatial compound image.

6. A method of forming an ultrasound spatial compound image in an ultrasound system, comprising:

- a) transmitting ultrasound beams to a target object, receiving ultrasound echoes reflected from the target object and providing a plurality of ultrasound frame data sets for a plurality of frames, said plurality of ultrasound frame data being acquired at different steering angles of scan lines;
 - b) setting a plurality of masks corresponding to the respective frames based on the plurality of ultrasound frame data sets for removing seam artifact to form a plurality of mask images corresponding to the respective frames;
 - c) forming a plurality of ultrasound images corresponding to the plurality of frames based on the plurality of frame data sets; and
 - d) spatially compounding the plurality of ultrasound image based on the plurality of mask images to form an ultrasound spatial compound image.
7. The method of claim 6, wherein the masks have identical sizes and pixel numbers to those of the corresponding ultrasound images.
8. The method of claim 6, wherein the step b) includes:
- b1) forming masks corresponding to the respective frames based on the ultrasound frame data sets; and
 - b2) determining pixel values of pixels of each of the mask based on intensities of the ultrasound frame data sets.
9. The method of claim 8, wherein the b2) includes:
- detecting an intensity of each of the frames corresponding to the respective scan lines by using the ultrasound frame data sets;
- comparing the detected intensity with a predetermined threshold,
- assigning, when the intensity is equal to or greater than a predetermined threshold, a value of 1 to pixels corresponding to the scan line; and
- assigning, when the intensity is less than the predetermined threshold, a value of 0 to pixels corresponding to the scan line.
10. The method of claim 6, wherein the d) includes:
- summing pixel values of pixels overlapped at the ultrasound images to obtain a first summation value;
- summing pixel values of pixel overlapped at the mask images to obtain a second summation value; and

dividing the first summation value by the second summation value to determine a pixel value at a corresponding pixel of the ultrasound spatial compound image.

11. A computer-readable storage medium storing instructions that, when executed by a computer, cause the computer to provide a method of spatially compounding ultrasound images based on a plurality of ultrasound frame data sets acquired from a target object and at different steering angles of scan lines in an ultrasound system, the method comprising: setting a plurality of masks corresponding to the respective frames based on the plurality of ultrasound frame data

sets for removing seam artifact to form a plurality of mask images corresponding to the respective frames; forming a plurality of ultrasound images corresponding to the plurality of frames based on the plurality of frame data sets; and spatially compounding the plurality of ultrasound image based on the plurality of mask images to form an ultrasound spatial compound image.

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专利名称(译)	超声系统中的超声图像增强		
公开(公告)号	US20110184292A1	公开(公告)日	2011-07-28
申请号	US13/011470	申请日	2011-01-21
申请(专利权)人(译)	MEDISON CO. , LTD.		
当前申请(专利权)人(译)	MEDISON CO. , LTD.		
[标]发明人	YOO JAE HEUNG KIM JEONG SIK		
发明人	YOO, JAE HEUNG KIM, JEONG SIK		
IPC分类号	A61B8/14		
CPC分类号	A61B8/00 A61B8/5223 A61B8/5253 G01S15/8995 A61B8/5269 A61B8/5238 G16H50/30		
优先权	1020100006412 2010-01-25 KR		
外部链接	Espacenet USPTO		

摘要(译)

公开了用于在超声系统中空间复合超声图像以去除缝线伪影的实施例。在一个实施例中，超声系统包括：超声数据获取单元，被配置为将超声波束发送到目标对象，接收从目标对象反射的超声回波，并为多个帧提供多个超声帧数据集，所述多个超帧。在扫描线的不同转向角处获取超声帧数据；处理单元，被配置为基于所述多个超声帧数据集形成多个超声图像并形成与各个超声图像对应的多个掩模图像，用于去除缝合伪影并基于所述多个超声图像在空间上复合所述多个超声图像掩模图像形成超声空间复合图像。

