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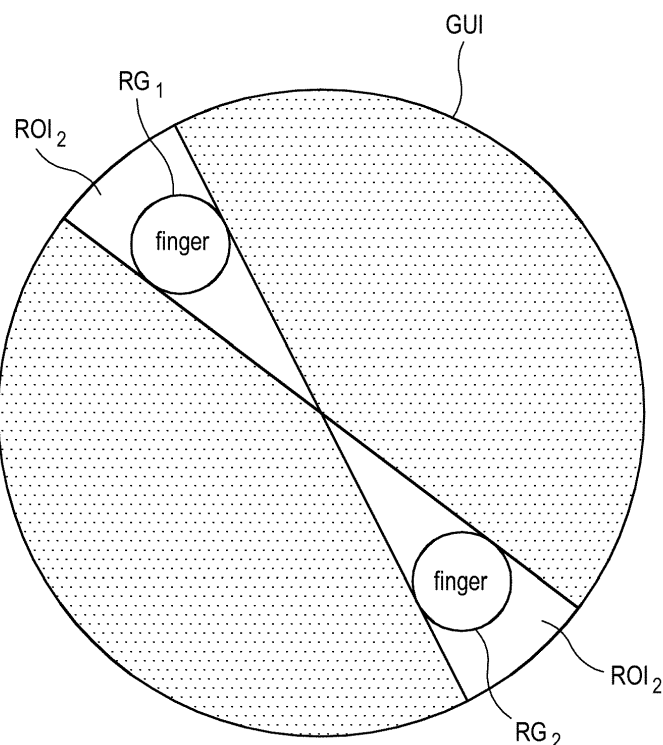
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(54) **Providing user interface in ultrasound system**

(57) There are provided embodiments for providing a user interface for performing a filtering process upon a vector Doppler image. In one embodiment, by way of nonlimiting example, an ultrasound system comprises: a

processing unit configured to form vector information of a target object based on ultrasound data corresponding to the target object and form a user interface for performing the filtering process upon the vector Doppler image based on the vector information.

FIG. 20



Description

CROSS-REFERENCE TO RELATED APPLICATIONS

- 5 **[0001]** The present application claims priority from Korean Patent Application No. 10-2011-0144476 filed on December 28, 2011.

TECHNICAL FIELD

- 10 **[0002]** The present disclosure generally relates to ultrasound systems, and more particularly to providing a user interface for performing a filtering process upon a vector Doppler image in an ultrasound system.

BACKGROUND

- 15 **[0003]** 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 non-destructive 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-dimensional or three-dimensional ultrasound images of internal features of target objects (e.g., human organs).

- 20 **[0004]** The ultrasound system provides ultrasound images of various modes including a brightness mode image representing reflection coefficients of ultrasound signals (i.e., ultrasound echo signals) reflected from a target object of a living body with a two-dimensional image, a Doppler mode image representing velocity of a moving target object with spectral Doppler by using a Doppler effect, a color Doppler mode image representing velocity of the moving target object with colors by using the Doppler effect, an elastic image representing mechanical characteristics of tissues before and after applying compression thereto and the like.

- 25 **[0005]** The ultrasound system transmits the ultrasound signals to the living body and receives the ultrasound echo signals from the living body to form Doppler signals corresponding to a region of interest, which is set on the brightness mode image. The ultrasound system further forms the color Doppler mode image representing the velocity of the moving target object with colors based on the Doppler signals. In particular, the color Doppler image represents the motion of the target object (e.g., blood flow) with the colors. The color Doppler image is used to diagnose diseases of blood vessels, heart and the like. However, it is difficult to represent an accurate motion of the target object (e.g., blood flow) since the respective colors indicated by a motion value is a function of the velocity of the target object, which moves forward in a transmission direction of the ultrasound signals and moves backward in the transmission direction of the ultrasound signals.

- 30 **[0006]** To resolve this problem, a vector Doppler method capable of obtaining the velocity and direction of the blood flow is used. A cross beam-based method of the vector Doppler method acquires velocity magnitude components from at least two different directions, and combine the velocity magnitude components to detect vector information having a two-dimensional or three-dimensional direction information and a magnitude information.

SUMMARY

- 40 **[0007]** There are provided embodiments for providing a user interface for performing a filtering process upon a vector Doppler image.

- 45 **[0008]** In one embodiment, by way of non-limiting example, an ultrasound system comprises: a processing unit configured to form vector information of a target object based on ultrasound data corresponding to the target object, and form a user interface for performing a filtering process upon a vector Doppler image based on the vector information.

- [0009]** In another embodiment, there is provided a method of providing a user interface, comprising: a) forming vector information of a target object based on ultrasound data corresponding to the target object; and b) forming a user interface for performing a filtering process upon a vector Doppler image based on the vector information.

- 50 **[0010]** 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

- 55 **[0011]**

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

FIG. 2 is a schematic diagram showing an example of a brightness mode image and a first region of interest.

FIG. 3 is a block diagram showing an illustrative embodiment of an ultrasound data acquiring unit.

FIGS. 4 to 7 are schematic diagrams showing examples of transmission directions and reception directions.

FIG. 8 is a schematic diagram showing an example of sampling data and pixels of an ultrasound image.

FIGS. 9 to 12 are schematic diagrams showing examples of performing a reception beam-forming.

FIG. 13 is a schematic diagram showing an example of setting weights.

FIG. 14 is a schematic diagram showing an example of setting a sampling data set.

FIG. 15 is a flow chart showing a process of providing a user interface for a filtering process upon a vector Doppler image.

FIG. 16 is a schematic diagram showing an example of the transmission directions, the reception directions, the vector information and an over-determined problem.

FIG. 17 is a schematic diagram showing an example of the brightness mode image, the vector Doppler image and the user interface.

FIGS. 18 to 20 are schematic diagrams showing an example of the user interface.

DETAILED DESCRIPTION

[0012] 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.

[0013] Referring to FIG. 1, an ultrasound system 100 in accordance with an illustrative embodiment is shown. As depicted therein, the ultrasound system 100 includes a user input unit 110.

[0014] The user input unit 110 is configured to receive input information from a user. In one embodiment, the input information includes first input information for setting a first region of interest ROI_1 on a brightness mode image BI, as shown in FIG. 2. The first region of interest ROI_1 includes a color box for obtaining a Doppler mode image. The Doppler mode image includes a vector Doppler image corresponding to motion (i.e., velocity and direction) of a target object. The input information further includes second input information for setting at least one region for representing only the motion of target in a specific direction on the vector Doppler image. However, it should be noted herein that the input information may not be limited thereto. In FIG. 2, the reference numeral BV represents a blood vessel. The user input unit 110 includes a control panel, a track ball, a touch screen, a keyboard, a mouse and the like.

[0015] The ultrasound system 100 further includes an ultrasound data acquiring unit 120.

[0016] The ultrasound data acquiring unit 120 is configured to transmit ultrasound signals to a living body. The living body includes the target object (e.g., blood flow, blood vessel, heart, etc.). The ultrasound data acquiring unit 120 is further configured to receive ultrasound signals (i.e., ultrasound echo signals) from the living body to acquire ultrasound data corresponding to an ultrasound image.

[0017] FIG. 3 is a block diagram showing an illustrative embodiment of the ultrasound data acquiring unit 120. Referring to FIG. 3, the ultrasound data acquiring unit 120 includes an ultrasound probe 310.

[0018] The ultrasound probe 310 includes a plurality of elements 311 (see FIG. 4) for reciprocally converting between ultrasound signals and electrical signals. The ultrasound probe 310 is configured to transmit the ultrasound signals to the living body. The ultrasound signals transmitted from the ultrasound probe 310 are plane wave signals that the ultrasound signals are not focused at a focusing point, or focused signals that the ultrasound signals are focused at the focusing point. However, it should be noted herein that the ultrasound signals may not be limited thereto. The ultrasound probe 310 is further configured to receive the ultrasound echo signals from the living body to output electrical signals (hereinafter referred to as "reception signals"). The reception signals are analog signals. The ultrasound probe 310 includes a convex probe, a linear probe and the like.

[0019] The ultrasound data acquiring unit 120 further includes a transmitting section 320. The transmitting section 320 is configured to control the transmission of the ultrasound signals. The transmitting section 320 is also configured to generate electrical signals (hereinafter referred to as "transmission signals") in consideration of the elements 311. In one embodiment, the transmitting section 320 is configured to generate transmission signals (hereinafter referred to as "brightness mode transmission signals") for obtaining the brightness mode image BI in consideration of the elements 311. Thus, the ultrasound probe 310 is configured to convert the brightness mode transmission signals provided from the transmitting section 320 into the ultrasound signals, transmit the ultrasound signals to the living body, and receive the ultrasound echo signals from the living body to output reception signals (hereinafter referred to as "brightness mode reception signals").

[0020] The transmitting section 320 is further configured to generate transmission signals (hereinafter referred to as "Doppler mode transmission signals") corresponding to an ensemble number in consideration of the elements 311 and at least one transmission direction of the ultrasound signals (i.e., transmission beam). Thus, the ultrasound probe 310 is configured to convert the Doppler mode transmission signals provided from the transmitting section 320 into the ultrasound signals, transmit the ultrasound signals to the living body in the at least one transmission direction, and

receive the ultrasound echo signals from the living body to output reception signals (hereinafter referred to as "Doppler mode reception signals"). The ensemble number represents the number of transmitting and receiving the ultrasound signals to and from the living body.

[0021] As one example, the transmitting section 320 is configured to generate the Doppler mode transmission signals corresponding to the ensemble number in consideration of a transmission direction Tx and the elements 311, as shown in FIG. 4. The transmission direction is one of a direction (i.e., 0 degree) perpendicular to a longitudinal direction of the elements 311 to a maximum steering direction of the transmission beam.

[0022] As another example, the transmitting section 320 is configured to generate first Doppler mode transmission signals corresponding to the ensemble number in consideration of a first transmission direction Tx_1 and the elements 311, as shown in FIG. 5. Thus, the ultrasound probe 310 is configured to convert the first Doppler mode transmission signals provided from the transmitting section 320 into the ultrasound signals, transmit the ultrasound signals to the living body in the first transmission direction Tx_1 , and receive the ultrasound echo signals from the living body to output first Doppler mode reception signals. The transmitting section 320 is further configured to generate second Doppler mode transmission signals corresponding to the ensemble number in consideration of a second transmission direction Tx_2 and the elements 311, as shown in FIG. 5. Thus, the ultrasound probe 310 is configured to convert the second Doppler mode transmission signals provided from the transmitting section 320 into the ultrasound signals, transmit the ultrasound signals to the living body in the second transmission direction Tx_2 , and receive the ultrasound echo signals from the living body to output second Doppler mode reception signals. In FIG. 5, the reference numeral PRI represents a pulse repeat interval.

[0023] In another embodiment, the transmitting section 320 is configured to generate the brightness mode transmission signals for obtaining the brightness mode image BI in consideration of the elements 311. Thus, the ultrasound probe 310 is configured to convert the brightness mode transmission signals provided from the transmitting section 320 into the ultrasound signals, transmit the ultrasound signals to the living body, and receive the ultrasound echo signals from the living body to output the brightness mode reception signals.

[0024] The transmitting section 320 is further configured to generate the Doppler mode transmission signals corresponding to the ensemble number in consideration of the at least one transmission direction and the elements 311. Thus, the ultrasound probe 310 is configured to convert the Doppler mode transmission signals provided from the transmitting section 320 into the ultrasound signals, transmit the ultrasound signals to the living body, and receive the ultrasound echo signals from the living body to output the Doppler mode reception signals. The ultrasound signals are transmitted in an interleaved transmission scheme. The interleaved transmission scheme will be described below in detail.

[0025] For example, the transmitting section 320 is configured to generate the first Doppler mode transmission signals in consideration of the first transmission direction Tx_1 and the elements 311, as shown in FIG. 6. Thus, the ultrasound probe 310 is configured to convert the first Doppler mode transmission signals provided from the transmitting section 320 into the ultrasound signals, and transmit the ultrasound signals to the living body in the first transmission direction Tx_1 . The transmitting section 320 is further configured to generate the second Doppler mode transmission signals in consideration of the second transmission direction Tx_2 and the elements 311, as shown in FIG. 6. Thus, the ultrasound probe 310 is configured to convert the second Doppler mode transmission signals provided from the transmitting section 320 into the ultrasound signals, and transmit the ultrasound signals to the living body in the second transmission direction Tx_2 . The ultrasound probe 310 is further configured to receive the ultrasound echo signals (i.e., ultrasound echo signals corresponding to first Doppler mode transmission signals) from the living body to output the first Doppler mode reception signals. The ultrasound probe 310 is further configured to receive the ultrasound echo signals (i.e., ultrasound echo signals corresponding to second Doppler mode transmission signals) from the living body to output the second Doppler mode reception signals.

[0026] Thereafter, the transmitting section 320 is configured to generate the first Doppler mode transmission signals based on the pulse repeat interval, as shown in FIG. 6. Thus, the ultrasound probe 310 is configured to convert the first Doppler mode transmission signals provided from the transmitting section 320 into the ultrasound signals, and transmit the ultrasound signals to the living body in the first transmission direction Tx_1 . Then, the transmitting section 320 is further configured to generate the second Doppler mode transmission signals based on the pulse repeat interval, as shown in FIG. 6. Accordingly, the ultrasound probe 310 is configured to convert the second Doppler mode transmission signals provided from the transmitting section 320 into the ultrasound signals, and transmit the ultrasound signals to the living body in the second transmission direction Tx_2 . The ultrasound probe 310 is further configured to receive the ultrasound echo signals (i.e., ultrasound echo signals corresponding to first Doppler mode transmission signals) from the living body to output the first Doppler mode reception signals. The ultrasound probe 310 is further configured to receive the ultrasound echo signals (i.e., ultrasound echo signals corresponding to second Doppler mode transmission signals) from the living body to output the second Doppler mode reception signals.

[0027] As described above, the transmitting section 320 is configured to generate the first Doppler mode transmission signals and the second Doppler mode transmission signals corresponding to the ensemble number.

[0028] In yet another embodiment, the transmitting section 320 is configured to generate the brightness mode trans-

mission signals for obtaining the brightness mode image BI in consideration of the elements 311. Thus, the ultrasound probe 310 is configured to convert the brightness mode transmission signals provided from the transmitting section 320 into the ultrasound signals, transmit the ultrasound signals to the living body, and receive the ultrasound echo signals from the living body to output the brightness mode reception signals.

[0029] The transmitting section 320 is further configured to generate the Doppler mode transmission signals corresponding to the ensemble number in consideration of the at least one transmission direction and the elements 311. Thus, the ultrasound probe 310 is configured to convert the Doppler mode transmission signals provided from the transmitting section 320 into the ultrasound signals, transmit the ultrasound signals to the living body in the at least one transmission direction, and receive the ultrasound echo signals from the living body to output the Doppler mode reception signals. The ultrasound signals are transmitted according to the pulse repeat interval.

[0030] For example, the transmitting section 320 is configured to generate the first Doppler mode transmission signals in consideration of the first transmission direction Tx_1 and the elements 311 based on the pulse repeat interval, as shown in FIG. 7. Thus, the ultrasound probe 310 is configured to convert the first Doppler mode transmission signals provided from the transmitting section 320 into the ultrasound signals, transmit the ultrasound signals to living body in the first transmission direction Tx_1 , and receive the ultrasound echo signals from the living body to output the first Doppler mode reception signals. The transmitting section 320 is further configured to generate the second Doppler mode transmission signals in consideration of the second transmission direction Tx_2 and the elements 311 based on the pulse repeat interval, as shown in FIG. 7. Thus, the ultrasound probe 310 is configured to convert the second Doppler mode transmission signals provided from the transmitting section 320 into the ultrasound signals, transmit the ultrasound signals to the living body in the second transmission direction Tx_2 , and receive the ultrasound echo signals from the living body to output the second Doppler mode reception signals.

[0031] As described above, the transmitting section 320 is configured to generate the first Doppler mode transmission signals and the second Doppler mode transmission signals corresponding to the ensemble number based on the pulse repeat interval.

[0032] Referring back to FIG. 3, the ultrasound data acquiring unit 120 further includes a receiving section 330. The receiving section 330 is configured to perform an analog-digital conversion upon the reception signals provided from the ultrasound probe 310 to form sampling data. The receiving section 330 is further configured to perform a reception beam-forming upon the sampling data in consideration of the elements 311 to form reception-focused data. The reception beam-forming will be described below in detail.

[0033] In one embodiment, the receiving section 330 is configured to perform the analog-digital conversion upon the brightness mode reception signals provided from the ultrasound probe 310 to form sampling data (hereinafter referred to as "brightness mode sampling data"). The receiving section 330 is further configured to perform the reception beam-forming upon the brightness mode sampling data to form reception-focused data (hereinafter referred to as "brightness mode reception-focused data").

[0034] The receiving section 330 is further configured to perform the analog-digital conversion upon the Doppler mode reception signals provided from the ultrasound probe 310 to form sampling data (hereinafter referred to as "Doppler mode sampling data"). The receiving section 330 is further configured to perform the reception beam-forming upon the Doppler mode sampling data to form reception-focused data (hereinafter referred to as "Doppler mode reception-focused data") corresponding to at least one reception direction of the ultrasound echo signals (i.e., reception beam).

[0035] As one example, the receiving section 330 is configured to perform the analog-digital conversion upon the Doppler mode reception signals provided from the ultrasound probe 310 to form the Doppler mode sampling data. The receiving section 330 is further configured to perform the reception beam-forming upon the Doppler mode sampling data to form first Doppler mode reception-focused data corresponding to a first reception direction Rx_1 and second Doppler mode reception-focused data corresponding to a second reception direction Rx_2 , as shown in FIG. 4.

[0036] As another example, the receiving section 330 is configured to perform the analog-digital conversion upon the first Doppler mode reception signals provided from the ultrasound probe 310 to form first Doppler mode sampling data corresponding to the first transmission direction Tx_1 , as shown in FIG. 5. The receiving section 330 is further configured to perform the reception beam-forming upon the first Doppler mode sampling data to form the first Doppler mode reception-focused data corresponding to the first reception direction Rx_1 . The receiving section 330 is also configured to perform the analog-digital conversion upon the second Doppler mode reception signals provided from the ultrasound probe 310 to form second Doppler mode sampling data corresponding to the second transmission direction Tx_2 , as shown in FIG. 5. The receiving section 330 is further configured to perform the reception beam-forming upon the second Doppler mode sampling data to form the second Doppler mode reception-focused data corresponding to the second reception direction Rx_2 . If the reception direction is perpendicular to the elements 311 of the ultrasound probe 310, then a maximum aperture size is used.

[0037] The reception beam-forming is described with reference to the accompanying drawings.

[0038] In one embodiment, the receiving section 330 is configured to perform the analog-digital conversion upon the reception signals provided through a plurality of channels CH_k , wherein $1 \leq k \leq N$, from the ultrasound probe 310 to form

sampling data $S_{i,j}$, wherein the i and j are a positive integer, as shown in FIG. 8. The sampling data $S_{i,j}$ are stored in a storage unit 140. The receiving section 330 is further configured to detect pixels corresponding to the sampling data based on positions of the elements 311 and positions (orientation) of pixels of the ultrasound image UI with respect to the elements 311. That is, the receiving section 330 selects the pixels, which the respective sampling data are used as pixel data thereof, during the reception beam-forming based on the positions of the elements 311 and the orientation of the respective pixels of the ultrasound image UI with respect to the elements 311. The receiving section 330 is configured to cumulatively assign the sampling data corresponding to the selected pixels as the pixel data.

[0039] For example, the receiving section 330 is configured to set a curve (hereinafter referred to as "reception beam-forming curve") $CV_{6,3}$ for selecting pixels, which the sampling data $S_{6,3}$ are used as the pixel data thereof, during the reception beam-forming based on the positions of the elements 311 and the orientation of the respective pixels of the ultrasound image UI with respect to the elements 311, as shown in FIG. 9. The receiving section 330 is further configured to detect the pixels $P_{3,1}, P_{3,2}, P_{4,2}, P_{4,3}, P_{4,4}, P_{4,5}, P_{4,6}, P_{4,7}, P_{4,8}, P_{4,9}, \dots, P_{3,N}$ corresponding to the reception beam-forming curve $CV_{6,3}$ from the pixels $P_{a,b}$ of the ultrasound image UI, wherein $1 \leq a \leq M, 1 \leq b \leq N$. That is, the receiving section 330 selects the pixels $P_{3,1}, P_{3,2}, P_{4,2}, P_{4,3}, P_{4,4}, P_{4,5}, P_{4,6}, P_{4,7}, P_{4,8}, P_{4,9}, \dots, P_{3,N}$ on which the reception beam-forming curve $CV_{6,3}$ passes among the pixels $P_{a,b}$ of the ultrasound image UI. The receiving section 330 is also configured to assign the sampling data $S_{6,3}$ to the selected pixels $P_{3,1}, P_{3,2}, P_{4,2}, P_{4,3}, P_{4,4}, P_{4,5}, P_{4,6}, P_{4,7}, P_{4,8}, P_{4,9}, \dots, P_{3,N}$, as shown in FIG. 10.

[0040] Thereafter, the receiving section 330 is configured to set a reception beam-forming curve $CV_{6,4}$ for selecting pixels, which the sampling data $S_{6,4}$ are used as the pixel data thereof, during the reception beam-forming based on the positions of the elements 311 and the orientation of the respective pixels of the ultrasound image UI with respect to the elements 311, as shown in FIG. 11. The receiving section 330 is further configured to detect the pixels $P_{2,1}, P_{3,1}, P_{3,2}, P_{4,2}, P_{4,3}, P_{4,4}, P_{5,4}, P_{5,5}, P_{5,6}, P_{5,7}, P_{5,8}, P_{4,9}, P_{5,9}, \dots, P_{4,N}, P_{3,N}$ corresponding to the reception beam-forming curve $CV_{6,4}$ from the pixels $P_{a,b}$ of the ultrasound image UI. That is, the receiving section 330 selects the pixels $P_{2,1}, P_{3,1}, P_{3,2}, P_{4,2}, P_{4,3}, P_{4,4}, P_{5,4}, P_{5,5}, P_{5,6}, P_{5,7}, P_{5,8}, P_{4,9}, P_{5,9}, \dots, P_{4,N}, P_{3,N}$ on which the reception beam-forming curve $CV_{6,4}$ passes among the pixels $P_{a,b}$ of the ultrasound image UI. The receiving section 330 is additionally configured to assign the sampling data $S_{6,4}$ to the selected pixels $P_{2,1}, P_{3,1}, P_{3,2}, P_{4,2}, P_{4,3}, P_{4,4}, P_{5,4}, P_{5,5}, P_{5,6}, P_{5,7}, P_{5,8}, P_{4,9}, P_{5,9}, \dots, P_{4,N}, P_{3,N}$, as shown in FIG. 12. In this way, the respective sampling data, which are used as the pixel data, are cumulatively assigned to the pixels as the pixel data.

[0041] The receiving section 330 is configured to perform the reception beam-forming (i.e., summing) upon the sampling data, which are cumulatively assigned to the respective pixels $P_{a,b}$ of the ultrasound image UI to form the reception-focused data.

[0042] In another embodiment, the receiving section 330 is configured to perform the analog-digital conversion upon the reception signals provided through the plurality of channels CH_k from the ultrasound probe 310 to form the sampling data $S_{i,j}$, as shown in FIG. 8. The sampling data $S_{i,j}$ are stored in the storage unit 140. The receiving section 330 is further configured to detect pixels corresponding to the sampling data based on the positions of the elements 311 and the positions (orientation) of the pixels of the ultrasound image UI with respect to the elements 311. That is, the receiving section 330 selects the pixels, which the respective sampling data are used as the pixel data thereof, during the reception beam-forming based on the positions of the elements 311 and the orientation of the respective pixels of the ultrasound image UI with respect to the elements 311. The receiving section 330 is configured to cumulatively assign the sampling data corresponding to the selected pixels as the pixel data. The receiving section 330 is further configured to determine pixels existing in the same column among the selected pixels. The receiving section 330 is also configured to set weights corresponding to the respective determined pixels. The receiving section 330 is additionally configured to apply the weights to the sampling data of the respective pixels.

[0043] For example, the receiving section 330 is configured to set the reception beam-forming curve $CV_{6,3}$ for selecting pixels, which the sampling data $S_{6,3}$ are used as the pixel data thereof, during the reception beam-forming based on the positions of the elements 311 and the orientation of the respective pixels of the ultrasound image UI with respect to the elements 311, as shown in FIG. 9. The receiving section 330 is further configured to detect the pixels $P_{3,1}, P_{3,2}, P_{4,2}, P_{4,3}, P_{4,4}, P_{4,5}, P_{4,6}, P_{4,7}, P_{4,8}, P_{4,9}, \dots, P_{3,N}$ corresponding to the reception beam-forming curve $CV_{6,3}$ from the pixels $P_{a,b}$ of the ultrasound image UI, wherein $1 \leq a \leq M, 1 \leq b \leq N$. That is, the receiving section 330 selects the pixels $P_{3,1}, P_{3,2}, P_{4,2}, P_{4,3}, P_{4,4}, P_{4,5}, P_{4,6}, P_{4,7}, P_{4,8}, P_{4,9}, \dots, P_{3,N}$ on which the reception beam-forming curve $CV_{6,3}$ passes among the pixels $P_{a,b}$ of the ultrasound image UI. The receiving section 330 is also configured to assign the sampling data $S_{6,3}$ to the selected pixels $P_{3,1}, P_{3,2}, P_{4,2}, P_{4,3}, P_{4,4}, P_{4,5}, P_{4,6}, P_{4,7}, P_{4,8}, P_{4,9}, \dots, P_{3,N}$ as shown in FIG. 10. The receiving section 330 is further configured to determine pixels $P_{3,2}$ and $P_{4,2}$, which exist in the same column among the selected pixels $P_{3,1}, P_{3,2}, P_{4,2}, P_{4,3}, P_{4,4}, P_{4,5}, P_{4,6}, P_{4,7}, P_{4,8}, P_{4,9}, \dots, P_{3,N}$. The receiving section 330 is further configured to calculate a distance W_1 from a center of the determined pixel $P_{3,2}$ to the reception beam-forming curve $CV_{6,3}$ and a distance W_2 from a center of the determined pixel $P_{4,2}$ to the reception beam-forming curve $CV_{6,3}$, as shown in FIG. 13. The receiving section 330 is additionally configured to set a first weight α_1 corresponding to the pixel $P_{3,2}$ based on the distance W_1 and a second weight α_2 corresponding to the pixel $P_{4,2}$ based on the distance W_2 . The first weight α_1 and the second

weight α_2 are set to be in proportional to or in inverse proportional to the calculated distances. The receiving section 330 is further configured to apply the first weight α_1 to the sampling data $S_{6,3}$ assigned to the pixel $P_{3,2}$ and to apply the second weight α_2 to the sampling data $S_{6,3}$ assigned to the pixel $P_{4,2}$. The receiving section 330 is configured to perform the above process upon the remaining sampling data.

[0044] The receiving section 330 is configured to perform the reception beam-forming upon the sampling data, which are cumulatively assigned to the respective pixels $P_{a,b}$ of the ultrasound image UI to form the reception-focused data.

[0045] In yet another embodiment, the receiving section 330 is configured to perform the analog-digital conversion upon the reception signals provided through the plurality of channels CH_k from the ultrasound probe 310 to form the sampling data $S_{i,j}$, as shown in FIG. 8. The sampling data $S_{i,j}$ are stored in the storage unit 140. The receiving section 330 is further configured to set a sampling data set based on the sampling data $S_{i,j}$. That is, the receiving section 330 sets the sampling data set for selecting pixels, which the sampling data $S_{i,j}$ are used as the pixel data thereof, during the reception beam-forming.

[0046] For example, the receiving section 330 is configured to set the sampling data $S_{1,1}, S_{1,4}, \dots, S_{1,t}, S_{2,1}, S_{2,4}, \dots, S_{2,t}, \dots, S_{p,t}$ as the sampling data set (denoted by a box) for selecting the pixels, which the sampling data $S_{i,j}$ are used as the pixel data thereof, during the reception beam-forming, as shown in FIG. 14.

[0047] The receiving section 330 is further configured to detect the pixels corresponding to the respective sampling data of the sampling data set based on the positions of the elements 311 and the positions (orientation) of the respective pixels of the ultrasound image UI with respect to the elements 311. That is, the receiving section 330 selects the pixels, which the respective sampling data of the sampling data set are used as the pixel data thereof, during the reception beam-forming based on the positions of the elements 311 and the orientation of the respective pixels of the ultrasound image UI with respect to the elements 311. The receiving section 330 is further configured to cumulatively assign the sampling data to the selected pixels in the same manner as the above embodiments. The receiving section 330 is also configured to perform the reception beam-forming upon the sampling data, which are cumulatively assigned to the respective pixels of the ultrasound image UI to form the reception-focused data.

[0048] In yet another embodiment, the receiving section 330 is configured to perform down-sampling upon the reception signals provided through the plurality of channels CH_k from the ultrasound probe 310 to form down-sampled data. As described above, the receiving section 330 is further configured to detect the pixels corresponding to the respective sampling data based on the positions of the elements 311 and the positions (orientation) of the respective pixels of the ultrasound image UI with respect to the elements 311. That is, the receiving section 330 selects the pixels, which the respective sampling data are used as the pixel data thereof, during the reception beam-forming based on the positions of the elements 311 and the orientation of the pixels of the ultrasound image UI with respect to the elements 311. The receiving section 330 is further configured to cumulatively assign the respective sampling data to the selected pixels in the same manner as the above embodiments. The receiving section 330 is further configured to perform the reception beam-forming upon the sampling data, which are cumulatively assigned to the respective pixels of the ultrasound image UI to form the reception-focused data.

[0049] However, it should be noted herein that the reception beam-forming may not be limited thereto.

[0050] Referring back to FIG. 3, the ultrasound data acquiring unit 120 further includes an ultrasound data forming section 340. The ultrasound data forming section 340 is configured to form the ultrasound data corresponding to the ultrasound image based on the reception-focused data provided from the receiving section 330. The ultrasound data forming section 340 is further configured to perform a signal process (e.g., gain control, etc) upon the reception-focused data.

[0051] In one embodiment, the ultrasound data forming section 340 is configured to form ultrasound data (hereinafter referred to as "brightness mode ultrasound data") corresponding to the brightness mode image based on the brightness mode reception-focused data provided from the receiving section 330. The brightness mode ultrasound data include radio frequency data.

[0052] The ultrasound data forming section 340 is further configured to form ultrasound data (hereinafter referred to as "Doppler mode ultrasound data") corresponding to the first region of interest ROI_1 based on the Doppler mode reception-focused data provided from the receiving section 330. The Doppler mode ultrasound data include in-phase/quadrature data. However, it should be noted herein that the Doppler mode ultrasound data may not be limited thereto.

[0053] For example, the ultrasound data forming section 340 forms first Doppler mode ultrasound data based on the first Doppler mode reception-focused data provided from the receiving section 330. The ultrasound data forming section 340 further forms second Doppler mode ultrasound data based on the second Doppler mode reception-focused data provided from the receiving section 330.

[0054] Referring back to FIG. 1, the ultrasound system 100 further includes a processing unit 130 in communication with the user input unit 110 and the ultrasound data acquiring unit 120. The processing unit 130 includes a central processing unit, a microprocessor, a graphic processing unit and the like.

[0055] FIG. 15 is a flow chart showing a process of providing the user interface. The processing unit 130 is configured to form the brightness mode image BI based on the brightness mode ultrasound data provided from the ultrasound data

acquiring unit 120, at step S1502 in FIG. 15. The brightness mode image BI is displayed on a display unit 150.

[0056] The processing unit 130 is configured to set the first region of interest ROI_1 on the brightness mode image BI based on the input information (i.e., first input information) provided from the user input unit 110, at step S 1504 in FIG. 15. Thus, the ultrasound data acquiring unit 120 is configured to transmit the ultrasound signals to the living body and receive the ultrasound echo signals from the living body to acquire the Doppler mode ultrasound data corresponding to the first region of interest ROI_1 .

[0057] The processing unit 130 is configured to form vector information based on the Doppler mode ultrasound data provided from the ultrasound data acquiring unit 120, at step S1506 in FIG. 15. That is, the processing unit 130 forms the vector information corresponding to the motion (i.e., velocity and direction) of the target object based on the Doppler mode ultrasound data.

[0058] Generally, when the transmission direction of the ultrasound signals is equal to the reception direction of the ultrasound echo signals and a Doppler angle is θ , the following relationship is established:

$$X \cos \theta = \frac{C_0 f_d}{2 f_0} \quad (1)$$

[0059] In equation 1, X represents a reflector velocity (i.e., velocity of target object), C_0 represents a sound speed in the living body, f_d represents a Doppler shift frequency, and f_0 represents an ultrasound frequency.

[0060] The Doppler shift frequency f_d is calculated by the difference between a frequency of the ultrasound signals (i.e., transmission beam) and a frequency of the ultrasound echo signals (i.e., reception beam). Also, the velocity component $X \cos \theta$ projected to the transmission direction is calculated by equation 1.

[0061] When the transmission direction of the ultrasound signals (i.e., transmission beam) is different from the reception direction of the ultrasound echo signals (i.e., reception beam), the following relationship is established:

$$X \cos \theta_T + X \cos \theta_R = \frac{C_0 f_d}{f_0} \quad (2)$$

[0062] In equation 2, θ_T represents an angle between the ultrasound signals (i.e., transmission beam) and the blood flow, and θ_R represents an angle between the ultrasound echo signals (i.e., reception beam) and the blood flow.

[0063] FIG. 16 is a schematic diagram showing an example of the transmission directions, the reception directions, the vector information and an over-determined problem. Referring to FIG. 16, when the ultrasound signals (i.e., transmission beam) are transmitted in a first direction D1 and the ultrasound echo signals (i.e., reception beam) are received in the first direction D1, the following relationship is established:

$$\vec{\alpha}_1 \vec{X} = \alpha_{11} x_1 + \alpha_{12} x_2 = y_1 = X \cos \theta \quad (3)$$

[0064] In equation 3, $\vec{\alpha}_1 = (\alpha_{11}, \alpha_{12})$ represents a unit vector of the first direction D1, $\vec{X} = (x_1, x_2)$ represents variables, and y_1 is calculated by equation 1.

[0065] When the ultrasound signals (i.e., transmission beam) are transmitted in a second direction D2 and the ultrasound echo signals (i.e., reception beam) are received in a third direction D3, the following relationship is established:

$$(\alpha_{21} + \alpha_{31})x_1 + (\alpha_{22} + \alpha_{32})x_2 = (y_2 + y_3) = X \cos \theta_2 + X \cos \theta_3 \quad (4)$$

[0066] Equations 3 and 4 assume a two-dimensional environment. However, equations 3 and 4 are expanded to a three-dimensional environment. That is, when expanding equations 3 and 4 to the three-dimensional environment, the following relationship is established:

$$\alpha_{11}x_1 + \alpha_{12}x_2 + \alpha_{13}x_3 = y \quad (5)$$

[0067] In the case of the two-dimensional environment (i.e., two-dimensional vector), at least two equations are required to calculate the variables x_1 and x_2 . For example, when the ultrasound signals (i.e., transmission beam) are transmitted in the third direction D3 and the ultrasound echo signals (i.e., reception beam) are received in the second direction D2 and a fourth direction D4 as shown in FIG. 16, the following equations are established:

$$\begin{aligned} (\alpha_{31} + \alpha_{21})x_1 + (\alpha_{32} + \alpha_{22})x_2 &= (y_3 + y_2) \\ (\alpha_{31} + \alpha_{41})x_1 + (\alpha_{32} + \alpha_{42})x_2 &= (y_3 + y_4) \end{aligned} \quad (6)$$

[0068] The vector $\vec{X} = (x_1, x_2)$ is calculated by the equations of equation 6.

[0069] When the reception beam-forming is performed in at least two angles (i.e., at least two reception directions), at least two equations are obtained and represented as the over-determined problem, as shown in FIG. 16. The over-determined problem is well known in the art. Thus, it has not been described in detail so as not to unnecessarily obscure the present disclosure. The over-determined problem is solved by a pseudo inverse method, a weighted least square method and the like based on noise characteristics added to the Doppler shift frequency. That is, $M \times N$ equations are obtained by M transmission directions and the reception beam-forming of N reception directions at every transmission.

[0070] The processing unit 130 is configured to form a vector Doppler image VDI as shown in FIG. 17 based on the vector information, at step S 1508 in FIG. 15. The methods of forming the vector Doppler image VDI are well known in the art. Thus, they have not been described in detail so as not to unnecessarily obscure the present disclosure.

[0071] Optionally, the processing unit 130 is configured to compound the brightness mode image BI and the vector Doppler image VDI to form a compound image.

[0072] The processing unit 130 is configured to form the user interface GUI as shown in FIG. 17 based on the vector information, at step S 1510 in FIG. 15. The user interface GUI is an interface mapping the vector information corresponding to the motion (i.e., velocity and direction) of the target object to colors. That is, the user interface GUI is an interface for performing a filtering process upon the vector Doppler image VDI. The user interface GUI is displayed on the display unit 150.

[0073] The processing unit 130 is configured to set a second region of interest on the user interface GUI based on the input information (i.e., second input information), at step S 1512 in FIG. 15.

[0074] As one example, when the second input information for setting a region RG on the user interface GUI in touch type as shown in FIGS. 18 and 19 is provided from the user input unit 110, the processing unit 130 is configured to set the second region of interest ROI_2 including the region RG corresponding to the second input information with respect to a center of the user interface GUI.

[0075] As another example, the second input information for setting two regions RG_1, RG_2 on the user interface GUI in the touch type as shown in FIG. 20 is provided from the user input unit 110, and the processing unit 130 is configured to set the second region of interest ROI_2 including the two regions RG_1, RG_2 corresponding to the second input information based on the center of the user interface GUI.

[0076] The processing unit 130 is configured to perform a filtering process upon the vector Doppler image VDI based on the second region of interest ROI_2 , at step S 1514 in FIG. 15. In one embodiment, the processing unit 130 is configured to perform the filtering process for representing only the vector information (i.e., velocity and direction of the target object) corresponding to the second region of interest ROI_2 upon the vector Doppler image VDI. That is, the processing unit 130 performs the filtering process for not representing the vector information not corresponding to the second region of interest ROI_2 upon the vector Doppler image VDI.

[0077] In the above embodiment, the filtering process for representing only the vector information corresponding to the second region of interest ROI_2 is performed upon the vector Doppler image VDI. However, it should be noted herein that the filtering process may not be limited thereto.

[0078] Referring back to FIG. 1, the ultrasound system 100 further includes the storage unit 140. The storage unit 140 stores the ultrasound data (i.e., brightness mode ultrasound data and Doppler mode ultrasound data) acquired by the ultrasound data acquiring unit 120. The storage unit 140 additionally stores the vector information formed by the processing unit 130.

[0079] The ultrasound system 100 further includes the display unit 150. The display unit 150 is configured to display the brightness mode image BI formed by the processing unit 130. The display unit 150 is also configured to display the

vector Doppler image VDI formed by the processing unit 130. The display unit 150 is additionally configured to display the user interface GUI formed by the processing unit 130.

[0080] 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 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.

Claims

1. An ultrasound system, comprising:

a processing unit configured to form vector information of a target object based on ultrasound data corresponding to the target object, the processing unit being further configured to form a user interface for performing a filtering process upon a vector Doppler image based on the vector information.

2. The ultrasound system of Claim 1, wherein the processing unit is configured to form the vector information corresponding to a velocity and a direction of the target object in consideration of at least one transmission direction and at least one reception direction corresponding to the at least one transmission direction based on the ultrasound data.

3. The ultrasound system of Claim 1, wherein the user interface includes an interface mapping the vector information to colors.

4. The ultrasound system of Claim 1, further comprising:

a user input unit configured to receive input information for setting at least one region on the user interface from a user.

5. The ultrasound system of Claim 4, wherein the processing unit is configured to:

set a region of interest including the at least one region with respect to a center of the user interface; and perform the filtering process upon the vector Doppler image based on vector information corresponding to the region of interest.

6. The ultrasound system of Claim 5, wherein the processing unit is configured to perform the filtering process for representing vector information corresponding to the region of interest upon the vector Doppler image.

7. The ultrasound system of Claim 1, further comprising:

an ultrasound data acquiring unit configured to transmit ultrasound signals to a living body including the target object in at least one transmission direction, the ultrasound data acquiring unit being further configured to receive ultrasound echo signals from the living body in at least one reception direction to acquire the ultrasound data corresponding to the at least one reception direction.

8. A method of providing a user interface, comprising:

a) forming vector information of a target object based on ultrasound data corresponding to the target object; and b) forming a user interface for performing a filtering process upon a vector Doppler image based on the vector information.

9. The method of Claim 8, wherein the step a) comprises:

forming the vector information corresponding to a velocity and a direction of the target object in consideration of at least one transmission direction and at least one reception direction corresponding to the at least one transmission direction based on the ultrasound data.

10. The method of Claim 9, wherein the user interface includes an interface mapping the vector information to colors.

11. The method of Claim 9, further comprising:

5 c) receiving input information for setting at least one region on the user interface from a user.

12. The method of Claim 11, further comprising:

10 setting a region of interest including the at least one region with respect to a center of the user interface; and
performing the filtering process upon the vector Doppler image based on vector information corresponding to
the region of interest.

13. The method of Claim 12, wherein the step of performing the filtering process comprises:

15 performing the filtering process for representing vector information corresponding to the region of interest upon
the vector Doppler image.

14. The method of Claim 8, further comprising:

20 transmitting ultrasound signals to a living body including the target object in at least one transmission direction
and receiving ultrasound echo signals from the living body in at least one reception direction to acquire the
ultrasound data corresponding to the at least one reception direction, prior to performing the step a).

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FIG. 1

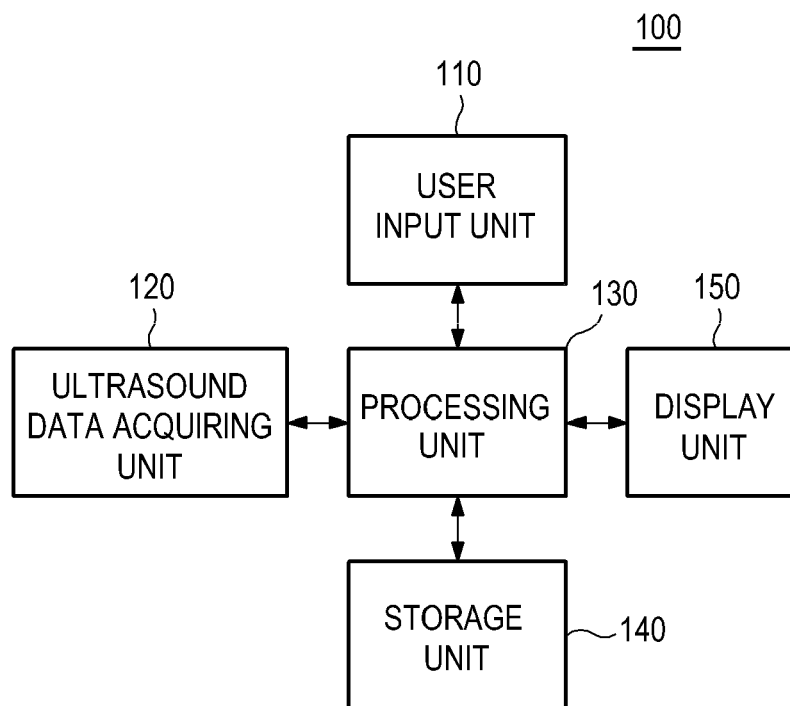


FIG. 2

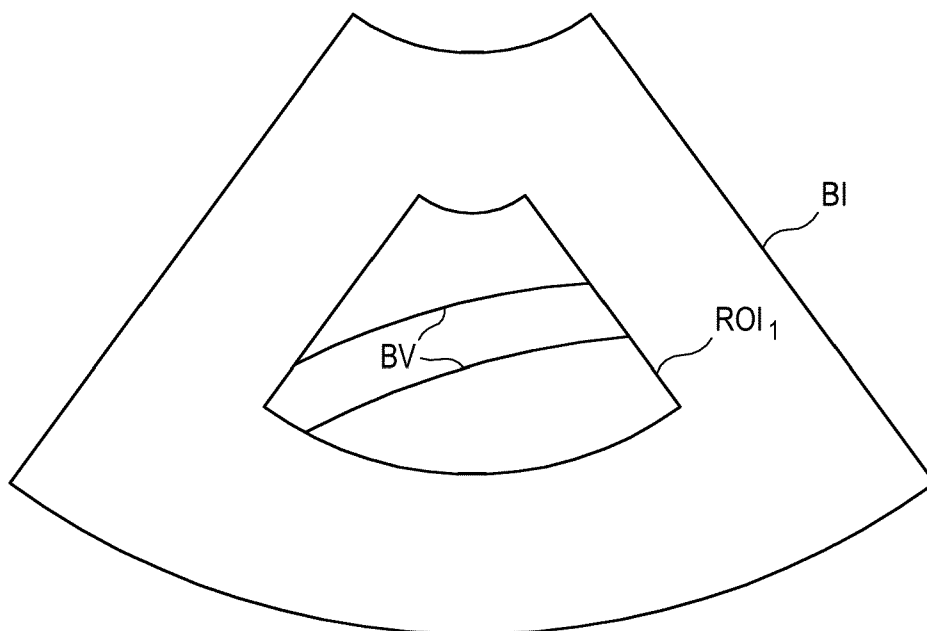


FIG. 3

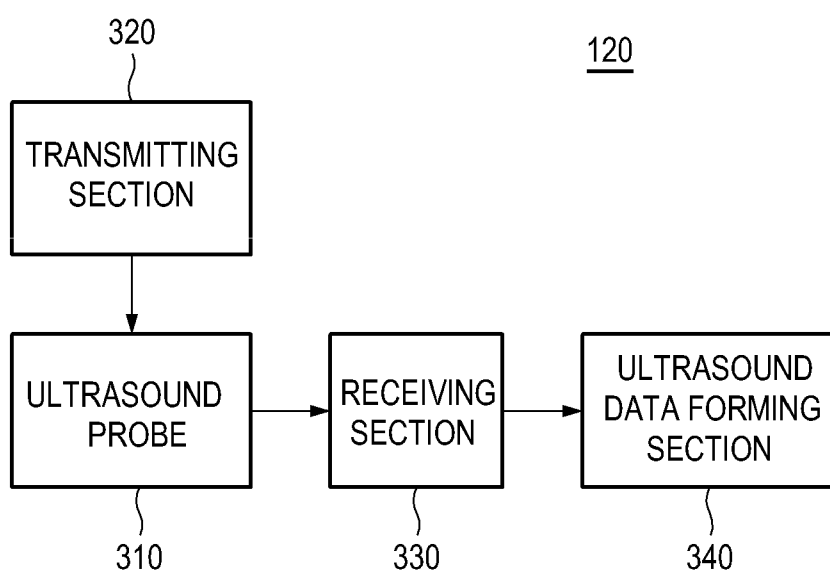


FIG. 4

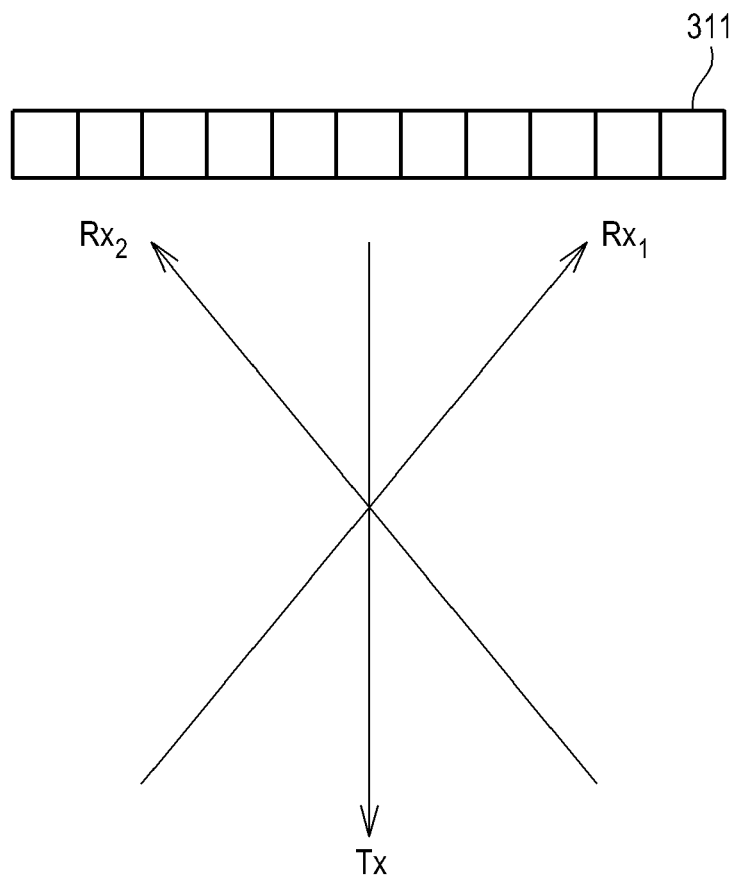


FIG. 5

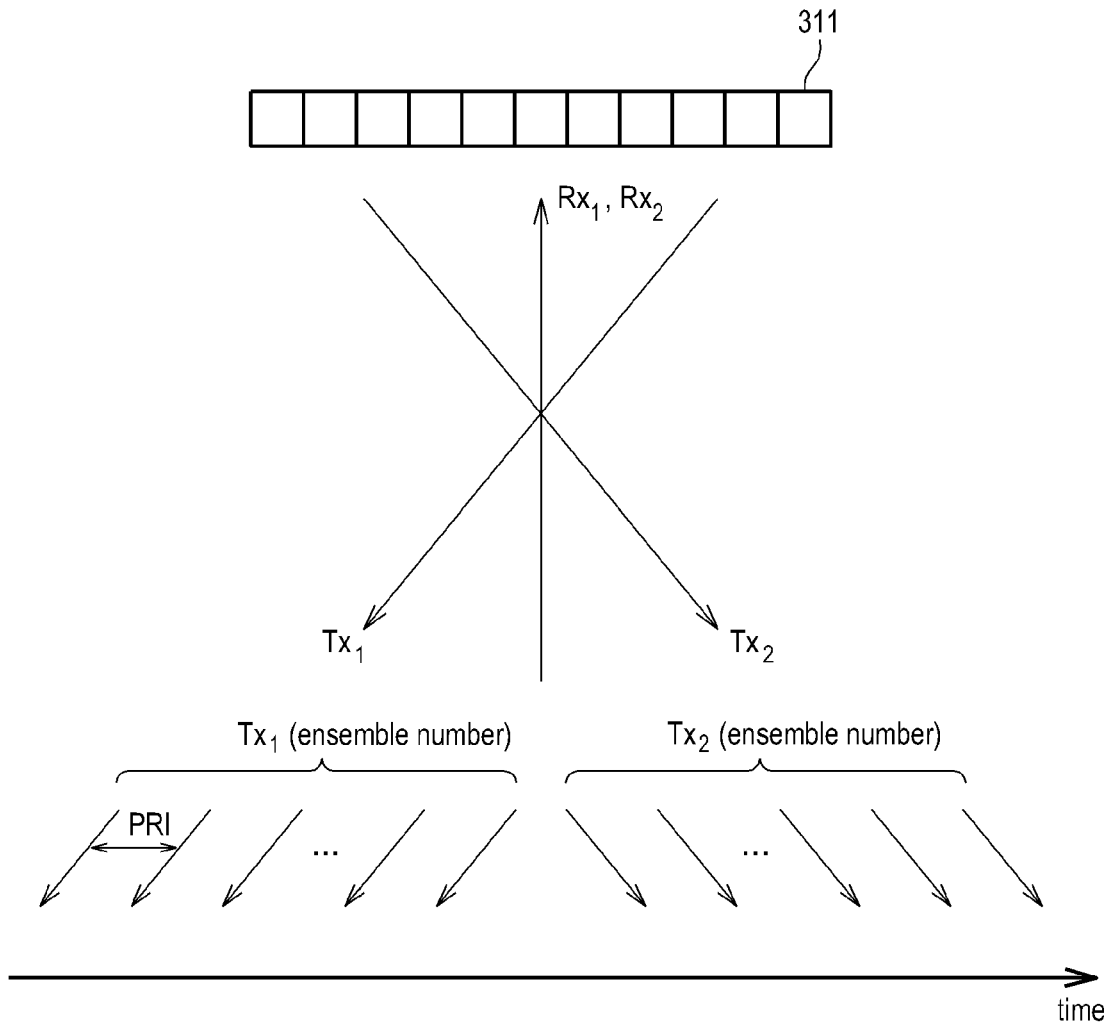


FIG. 6

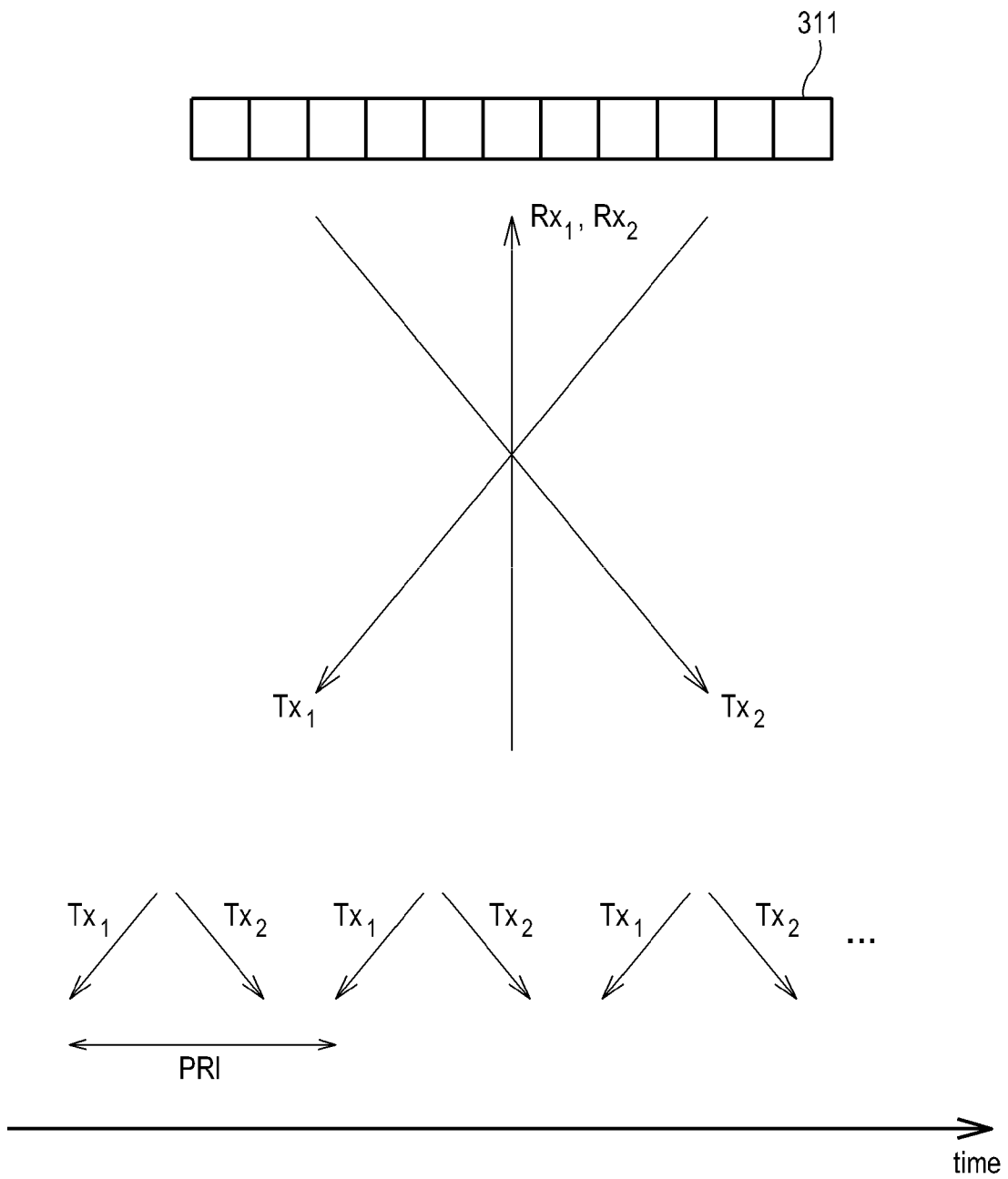


FIG. 7

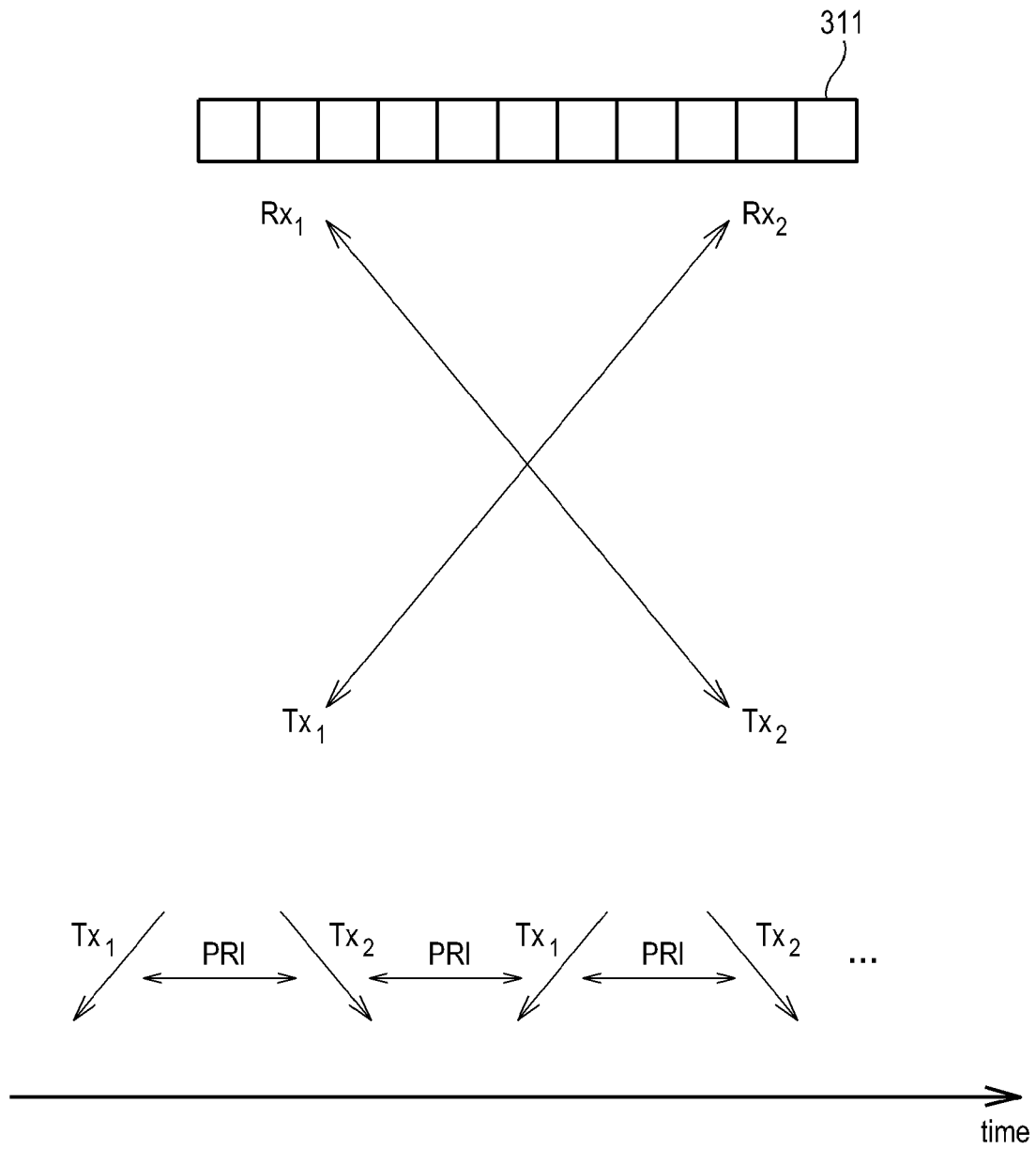


FIG. 8

$S_{1,t}$	$S_{2,t}$	$S_{3,t}$	$S_{4,t}$	$S_{5,t}$	$S_{6,t}$	$S_{7,t}$	$S_{8,t}$	$S_{9,t}$	$S_{10,t}$	$S_{11,t}$	...	$S_{p,t}$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$S_{1,6}$	$S_{2,6}$	$S_{3,6}$	$S_{4,6}$	$S_{5,6}$	$S_{6,6}$	$S_{7,6}$	$S_{8,6}$	$S_{9,6}$	$S_{10,6}$	$S_{11,6}$	...	$S_{p,6}$
$S_{1,5}$	$S_{2,5}$	$S_{3,5}$	$S_{4,5}$	$S_{5,5}$	$S_{6,5}$	$S_{7,5}$	$S_{8,5}$	$S_{9,5}$	$S_{10,5}$	$S_{11,5}$	...	$S_{p,5}$
$S_{1,4}$	$S_{2,4}$	$S_{3,4}$	$S_{4,4}$	$S_{5,4}$	$S_{6,4}$	$S_{7,4}$	$S_{8,4}$	$S_{9,4}$	$S_{10,4}$	$S_{11,4}$	...	$S_{p,4}$
$S_{1,3}$	$S_{2,3}$	$S_{3,3}$	$S_{4,3}$	$S_{5,3}$	$S_{6,3}$	$S_{7,3}$	$S_{8,3}$	$S_{9,3}$	$S_{10,3}$	$S_{11,3}$	...	$S_{p,3}$
$S_{1,2}$	$S_{2,2}$	$S_{3,2}$	$S_{4,2}$	$S_{5,2}$	$S_{6,2}$	$S_{7,2}$	$S_{8,2}$	$S_{9,2}$	$S_{10,2}$	$S_{11,2}$	...	$S_{p,2}$
$S_{1,1}$	$S_{2,1}$	$S_{3,1}$	$S_{4,1}$	$S_{5,1}$	$S_{6,1}$	$S_{7,1}$	$S_{8,1}$	$S_{9,1}$	$S_{10,1}$	$S_{11,1}$	...	$S_{p,1}$
CH ₁	CH ₂	CH ₃	CH ₄	CH ₅	CH ₆	CH ₇	CH ₈	CH ₉	CH ₁₀	CH ₁₁	...	CH _p

P _{1,1}	P _{1,2}	P _{1,3}	P _{1,4}	P _{1,5}	P _{1,6}	P _{1,7}	P _{1,8}	P _{1,9}	...	P _{1,N}
P _{2,1}	P _{2,2}	P _{2,3}	P _{2,4}	P _{2,5}	P _{2,6}	P _{2,7}	P _{2,8}	P _{2,9}	...	P _{2,N}
P _{3,1}	P _{3,2}	P _{3,3}	P _{3,4}	P _{3,5}	P _{3,6}	P _{3,7}	P _{3,8}	P _{3,9}	...	P _{3,N}
P _{4,1}	P _{4,2}	P _{4,3}	P _{4,4}	P _{4,5}	P _{4,6}	P _{4,7}	P _{4,8}	P _{4,9}	...	P _{4,N}
P _{5,1}	P _{5,2}	P _{5,3}	P _{5,4}	P _{5,5}	P _{5,6}	P _{5,7}	P _{5,8}	P _{5,9}	...	P _{5,N}
P _{6,1}	P _{6,2}	P _{6,3}	P _{6,4}	P _{6,5}	P _{6,6}	P _{6,7}	P _{6,8}	P _{6,9}	...	P _{6,N}
P _{7,1}	P _{7,2}	P _{7,3}	P _{7,4}	P _{7,5}	P _{7,6}	P _{7,7}	P _{7,8}	P _{7,9}	...	P _{7,N}
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
P _{M,1}	P _{M,2}	P _{M,3}	P _{M,4}	P _{M,5}	P _{M,6}	P _{M,7}	P _{M,8}	P _{M,9}	...	P _{M,N}

UI

FIG. 9

$S_{1,t}$	$S_{2,t}$	$S_{3,t}$	$S_{4,t}$	$S_{5,t}$	$S_{6,t}$	$S_{7,t}$	$S_{8,t}$	$S_{9,t}$	$S_{10,t}$	$S_{11,t}$	...	$S_{p,t}$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$S_{1,6}$	$S_{2,6}$	$S_{3,6}$	$S_{4,6}$	$S_{5,6}$	$S_{6,6}$	$S_{7,6}$	$S_{8,6}$	$S_{9,6}$	$S_{10,6}$	$S_{11,6}$	...	$S_{p,6}$
$S_{1,5}$	$S_{2,5}$	$S_{3,5}$	$S_{4,5}$	$S_{5,5}$	$S_{6,5}$	$S_{7,5}$	$S_{8,5}$	$S_{9,5}$	$S_{10,5}$	$S_{11,5}$	...	$S_{p,5}$
$S_{1,4}$	$S_{2,4}$	$S_{3,4}$	$S_{4,4}$	$S_{5,4}$	$S_{6,4}$	$S_{7,4}$	$S_{8,4}$	$S_{9,4}$	$S_{10,4}$	$S_{11,4}$	...	$S_{p,4}$
$S_{1,3}$	$S_{2,3}$	$S_{3,3}$	$S_{4,3}$	$S_{5,3}$	$S_{6,3}$	$S_{7,3}$	$S_{8,3}$	$S_{9,3}$	$S_{10,3}$	$S_{11,3}$	...	$S_{p,3}$
$S_{1,2}$	$S_{2,2}$	$S_{3,2}$	$S_{4,2}$	$S_{5,2}$	$S_{6,2}$	$S_{7,2}$	$S_{8,2}$	$S_{9,2}$	$S_{10,2}$	$S_{11,2}$	...	$S_{p,2}$
$S_{1,1}$	$S_{2,1}$	$S_{3,1}$	$S_{4,1}$	$S_{5,1}$	$S_{6,1}$	$S_{7,1}$	$S_{8,1}$	$S_{9,1}$	$S_{10,1}$	$S_{11,1}$	...	$S_{p,1}$
CH_1	CH_2	CH_3	CH_4	CH_5	CH_6	CH_7	CH_8	CH_9	CH_{10}	CH_{11}	...	CH_p

$P_{1,1}$	$P_{1,2}$	$P_{1,3}$	$P_{1,4}$	$P_{1,5}$	$P_{1,6}$	$P_{1,7}$	$P_{1,8}$	$P_{1,9}$	...	$P_{1,N}$
$P_{2,1}$	$P_{2,2}$	$P_{2,3}$	$P_{2,4}$	$P_{2,5}$	$P_{2,6}$	$P_{2,7}$	$P_{2,8}$	$P_{2,9}$	...	$P_{2,N}$
$P_{3,1}$	$P_{3,2}$	$P_{3,3}$	$P_{3,4}$	$P_{3,5}$	$P_{3,6}$	$P_{3,7}$	$P_{3,8}$	$P_{3,9}$	...	$P_{3,N}$
$P_{4,1}$	$P_{4,2}$	$P_{4,3}$	$P_{4,4}$	$P_{4,5}$	$P_{4,6}$	$P_{4,7}$	$P_{4,8}$	$P_{4,9}$	...	$P_{4,N}$
$P_{5,1}$	$P_{5,2}$	$P_{5,3}$	$P_{5,4}$	$P_{5,5}$	$P_{5,6}$	$P_{5,7}$	$P_{5,8}$	$P_{5,9}$	...	$P_{5,N}$
$P_{6,1}$	$P_{6,2}$	$P_{6,3}$	$P_{6,4}$	$P_{6,5}$	$P_{6,6}$	$P_{6,7}$	$P_{6,8}$	$P_{6,9}$	...	$P_{6,N}$
$P_{7,1}$	$P_{7,2}$	$P_{7,3}$	$P_{7,4}$	$P_{7,5}$	$P_{7,6}$	$P_{7,7}$	$P_{7,8}$	$P_{7,9}$	...	$P_{7,N}$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$P_{M,1}$	$P_{M,2}$	$P_{M,3}$	$P_{M,4}$	$P_{M,5}$	$P_{M,6}$	$P_{M,7}$	$P_{M,8}$	$P_{M,9}$	...	$P_{M,N}$

CV_{6,3}

UI

FIG. 10

$S_{6,3}$	$S_{6,3}$									$S_{6,3}$
	$S_{6,3}$	$S_{6,3}$	$S_{6,3}$	$S_{6,3}$	$S_{6,3}$	$S_{6,3}$	$S_{6,3}$	$S_{6,3}$	...	

UI

FIG. 11

$S_{1,t}$	$S_{2,t}$	$S_{3,t}$	$S_{4,t}$	$S_{5,t}$	$S_{6,t}$	$S_{7,t}$	$S_{8,t}$	$S_{9,t}$	$S_{10,t}$	$S_{11,t}$	...	$S_{p,t}$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$S_{1,6}$	$S_{2,6}$	$S_{3,6}$	$S_{4,6}$	$S_{5,6}$	$S_{6,6}$	$S_{7,6}$	$S_{8,6}$	$S_{9,6}$	$S_{10,6}$	$S_{11,6}$	...	$S_{p,6}$
$S_{1,5}$	$S_{2,5}$	$S_{3,5}$	$S_{4,5}$	$S_{5,5}$	$S_{6,5}$	$S_{7,5}$	$S_{8,5}$	$S_{9,5}$	$S_{10,5}$	$S_{11,5}$	...	$S_{p,5}$
$S_{1,4}$	$S_{2,4}$	$S_{3,4}$	$S_{4,4}$	$S_{5,4}$	$S_{6,4}$	$S_{7,4}$	$S_{8,4}$	$S_{9,4}$	$S_{10,4}$	$S_{11,4}$	...	$S_{p,4}$
$S_{1,3}$	$S_{2,3}$	$S_{3,3}$	$S_{4,3}$	$S_{5,3}$	$S_{6,3}$	$S_{7,3}$	$S_{8,3}$	$S_{9,3}$	$S_{10,3}$	$S_{11,3}$	...	$S_{p,3}$
$S_{1,2}$	$S_{2,2}$	$S_{3,2}$	$S_{4,2}$	$S_{5,2}$	$S_{6,2}$	$S_{7,2}$	$S_{8,2}$	$S_{9,2}$	$S_{10,2}$	$S_{11,2}$	...	$S_{p,2}$
$S_{1,1}$	$S_{2,1}$	$S_{3,1}$	$S_{4,1}$	$S_{5,1}$	$S_{6,1}$	$S_{7,1}$	$S_{8,1}$	$S_{9,1}$	$S_{10,1}$	$S_{11,1}$	...	$S_{p,1}$
CH_1	CH_2	CH_3	CH_4	CH_5	CH_6	CH_7	CH_8	CH_9	CH_{10}	CH_{11}	...	CH_p

$P_{1,1}$	$P_{1,2}$	$P_{1,3}$	$P_{1,4}$	$P_{1,5}$	$P_{1,6}$	$P_{1,7}$	$P_{1,8}$	$P_{1,9}$	...	$P_{1,N}$
$P_{2,1}$	$P_{2,2}$	$P_{2,3}$	$P_{2,4}$	$P_{2,5}$	$P_{2,6}$	$P_{2,7}$	$P_{2,8}$	$P_{2,9}$	...	$P_{2,N}$
$P_{3,1}$	$P_{3,2}$	$P_{3,3}$	$P_{3,4}$	$P_{3,5}$	$P_{3,6}$	$P_{3,7}$	$P_{3,8}$	$P_{3,9}$	...	$P_{3,N}$
$P_{4,1}$	$P_{4,2}$	$P_{4,3}$	$P_{4,4}$	$P_{4,5}$	$P_{4,6}$	$P_{4,7}$	$P_{4,8}$	$P_{4,9}$	...	$P_{4,N}$
$P_{5,1}$	$P_{5,2}$	$P_{5,3}$	$P_{5,4}$	$P_{5,5}$	$P_{5,6}$	$P_{5,7}$	$P_{5,8}$	$P_{5,9}$	...	$P_{5,N}$
$P_{6,1}$	$P_{6,2}$	$P_{6,3}$	$P_{6,4}$	$P_{6,5}$	$P_{6,6}$	$P_{6,7}$	$P_{6,8}$	$P_{6,9}$	...	$P_{6,N}$
$P_{7,1}$	$P_{7,2}$	$P_{7,3}$	$P_{7,4}$	$P_{7,5}$	$P_{7,6}$	$P_{7,7}$	$P_{7,8}$	$P_{7,9}$	...	$P_{7,N}$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$P_{M,1}$	$P_{M,2}$	$P_{M,3}$	$P_{M,4}$	$P_{M,5}$	$P_{M,6}$	$P_{M,7}$	$P_{M,8}$	$P_{M,9}$	...	$P_{M,N}$

CV_{6,4}

UI

FIG. 12

$S_{6,4}$										
$S_{6,3}$ $S_{6,4}$	$S_{6,3}$ $S_{6,4}$									$S_{6,3}$ $S_{6,4}$
	$S_{6,3}$ $S_{6,4}$	$S_{6,3}$ $S_{6,4}$	$S_{6,3}$ $S_{6,4}$	$S_{6,3}$	$S_{6,3}$	$S_{6,3}$	$S_{6,3}$	$S_{6,3}$ $S_{6,4}$	...	
			$S_{6,4}$	$S_{6,4}$	$S_{6,4}$	$S_{6,4}$	$S_{6,4}$	$S_{6,4}$		

UI

FIG. 13

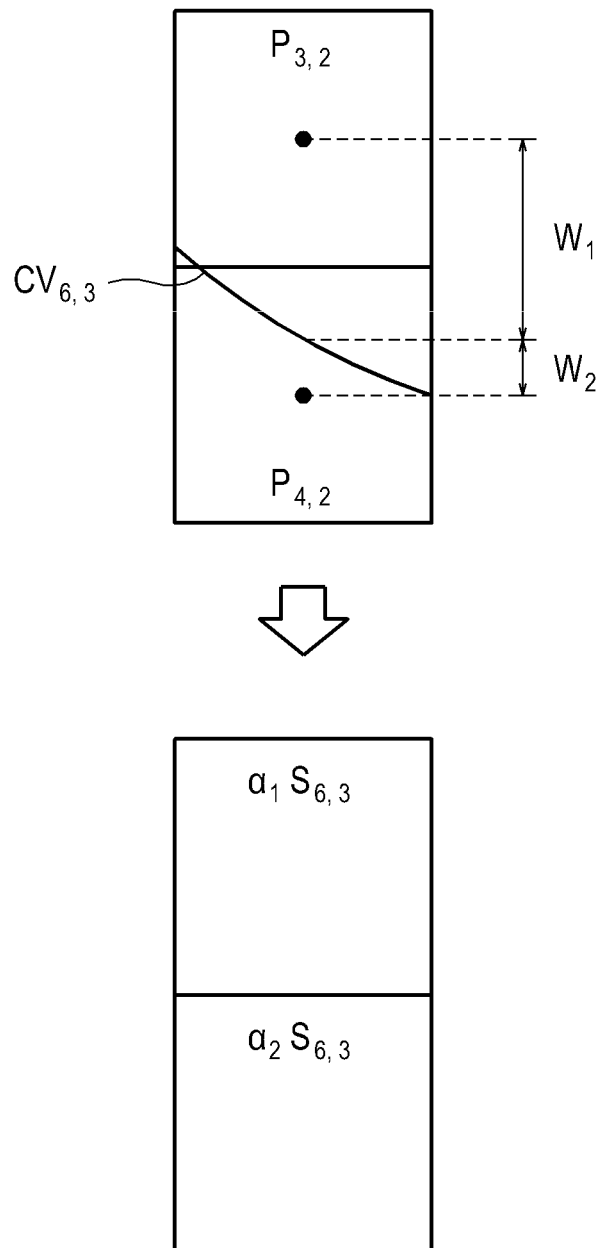


FIG. 14

$S_{1,t}$	$S_{2,t}$	$S_{3,t}$	$S_{4,t}$	$S_{5,t}$	$S_{6,t}$	$S_{7,t}$	$S_{8,t}$	$S_{9,t}$	$S_{10,t}$	$S_{11,t}$	...	$S_{p,t}$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$S_{1,6}$	$S_{2,6}$	$S_{3,6}$	$S_{4,6}$	$S_{5,6}$	$S_{6,6}$	$S_{7,6}$	$S_{8,6}$	$S_{9,6}$	$S_{10,6}$	$S_{11,6}$	...	$S_{p,6}$
$S_{1,5}$	$S_{2,5}$	$S_{3,5}$	$S_{4,5}$	$S_{5,5}$	$S_{6,5}$	$S_{7,5}$	$S_{8,5}$	$S_{9,5}$	$S_{10,5}$	$S_{11,5}$	...	$S_{p,5}$
$S_{1,4}$	$S_{2,4}$	$S_{3,4}$	$S_{4,4}$	$S_{5,4}$	$S_{6,4}$	$S_{7,4}$	$S_{8,4}$	$S_{9,4}$	$S_{10,4}$	$S_{11,4}$	...	$S_{p,4}$
$S_{1,3}$	$S_{2,3}$	$S_{3,3}$	$S_{4,3}$	$S_{5,3}$	$S_{6,3}$	$S_{7,3}$	$S_{8,3}$	$S_{9,3}$	$S_{10,3}$	$S_{11,3}$	...	$S_{p,3}$
$S_{1,2}$	$S_{2,2}$	$S_{3,2}$	$S_{4,2}$	$S_{5,2}$	$S_{6,2}$	$S_{7,2}$	$S_{8,2}$	$S_{9,2}$	$S_{10,2}$	$S_{11,2}$	...	$S_{p,2}$
$S_{1,1}$	$S_{2,1}$	$S_{3,1}$	$S_{4,1}$	$S_{5,1}$	$S_{6,1}$	$S_{7,1}$	$S_{8,1}$	$S_{9,1}$	$S_{10,1}$	$S_{11,1}$	...	$S_{p,1}$
CH_1	CH_2	CH_3	CH_4	CH_5	CH_6	CH_7	CH_8	CH_9	CH_{10}	CH_{11}	...	CH_p

$P_{1,1}$	$P_{1,2}$	$P_{1,3}$	$P_{1,4}$	$P_{1,5}$	$P_{1,6}$	$P_{1,7}$	$P_{1,8}$	$P_{1,9}$	...	$P_{1,N}$
$P_{2,1}$	$P_{2,2}$	$P_{2,3}$	$P_{2,4}$	$P_{2,5}$	$P_{2,6}$	$P_{2,7}$	$P_{2,8}$	$P_{2,9}$	...	$P_{2,N}$
$P_{3,1}$	$P_{3,2}$	$P_{3,3}$	$P_{3,4}$	$P_{3,5}$	$P_{3,6}$	$P_{3,7}$	$P_{3,8}$	$P_{3,9}$	...	$P_{3,N}$
$P_{4,1}$	$P_{4,2}$	$P_{4,3}$	$P_{4,4}$	$P_{4,5}$	$P_{4,6}$	$P_{4,7}$	$P_{4,8}$	$P_{4,9}$	...	$P_{4,N}$
$P_{5,1}$	$P_{5,2}$	$P_{5,3}$	$P_{5,4}$	$P_{5,5}$	$P_{5,6}$	$P_{5,7}$	$P_{5,8}$	$P_{5,9}$	...	$P_{5,N}$
$P_{6,1}$	$P_{6,2}$	$P_{6,3}$	$P_{6,4}$	$P_{6,5}$	$P_{6,6}$	$P_{6,7}$	$P_{6,8}$	$P_{6,9}$	...	$P_{6,N}$
$P_{7,1}$	$P_{7,2}$	$P_{7,3}$	$P_{7,4}$	$P_{7,5}$	$P_{7,6}$	$P_{7,7}$	$P_{7,8}$	$P_{7,9}$	...	$P_{7,N}$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
$P_{M,1}$	$P_{M,2}$	$P_{M,3}$	$P_{M,4}$	$P_{M,5}$	$P_{M,6}$	$P_{M,7}$	$P_{M,8}$	$P_{M,9}$	...	$P_{M,N}$

UI

FIG. 15

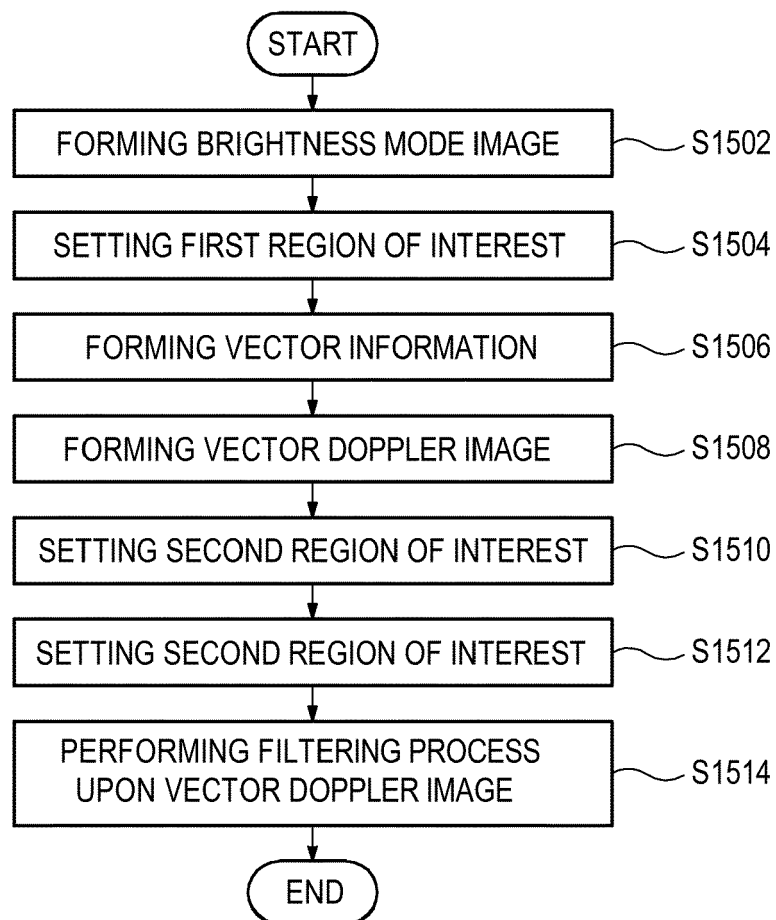


FIG. 17

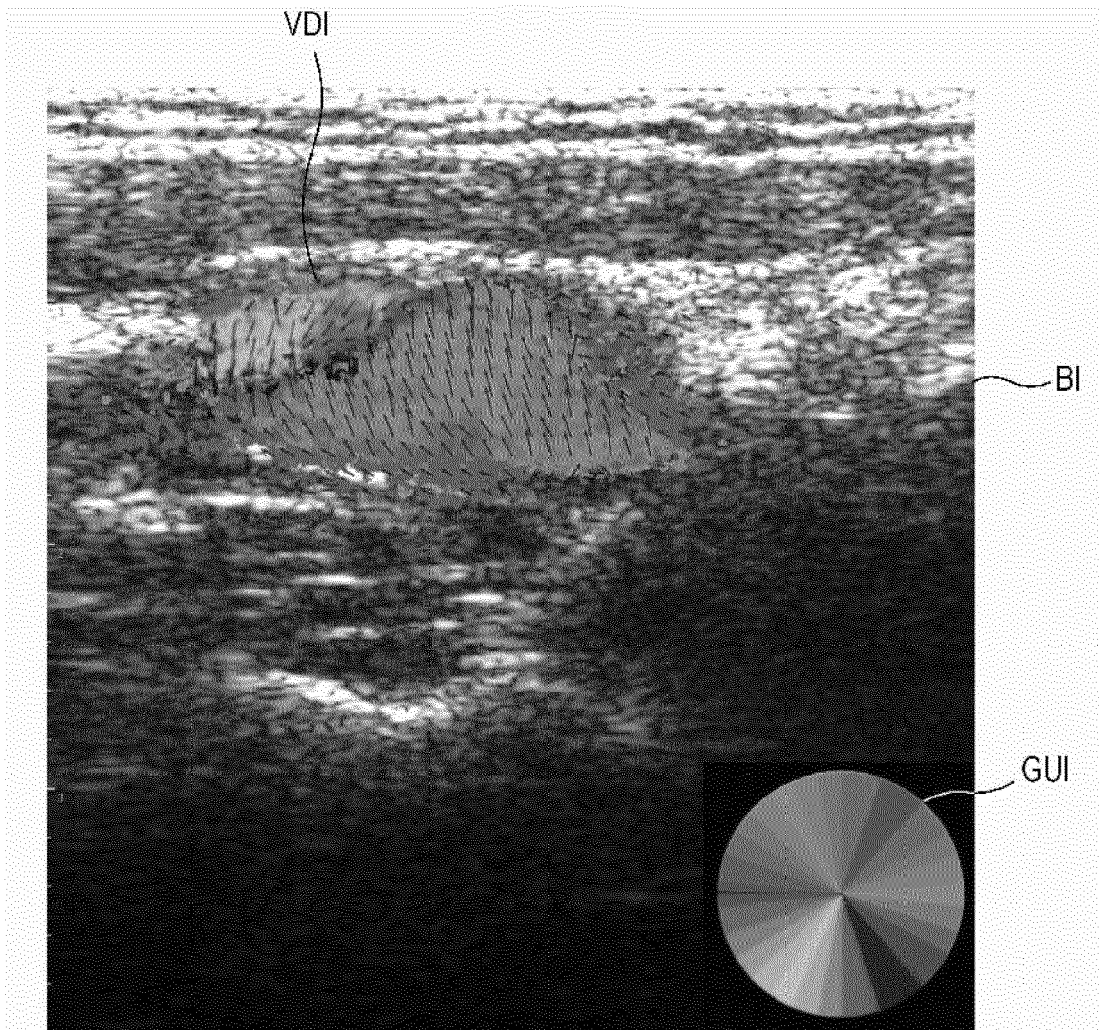


FIG. 18

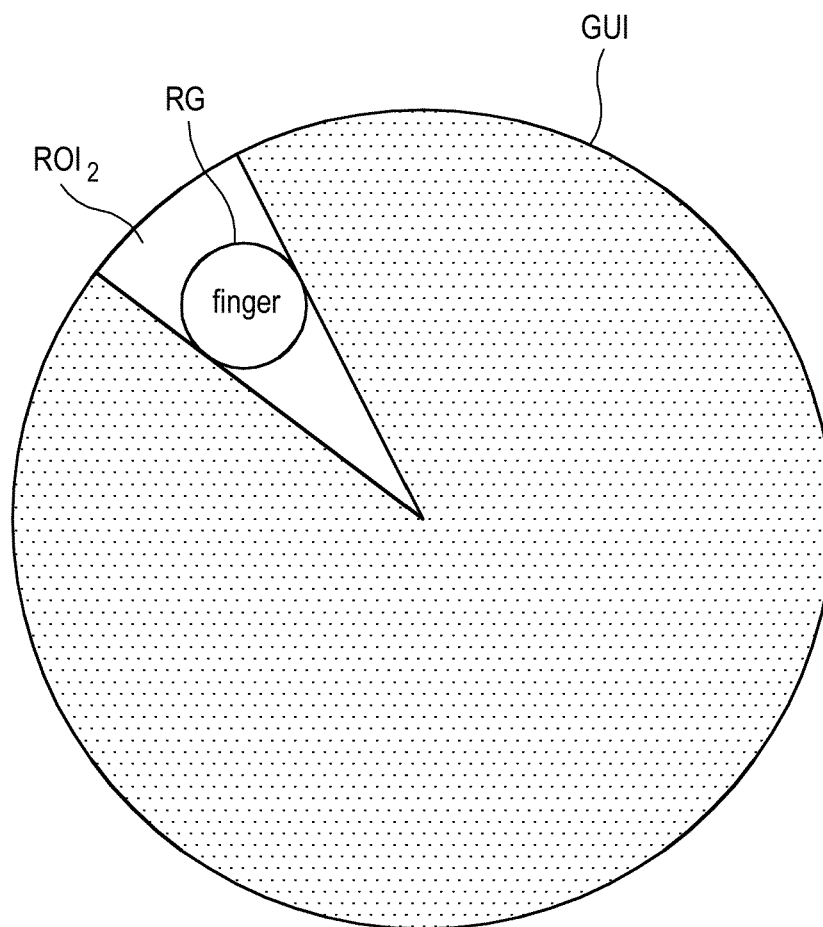


FIG. 19

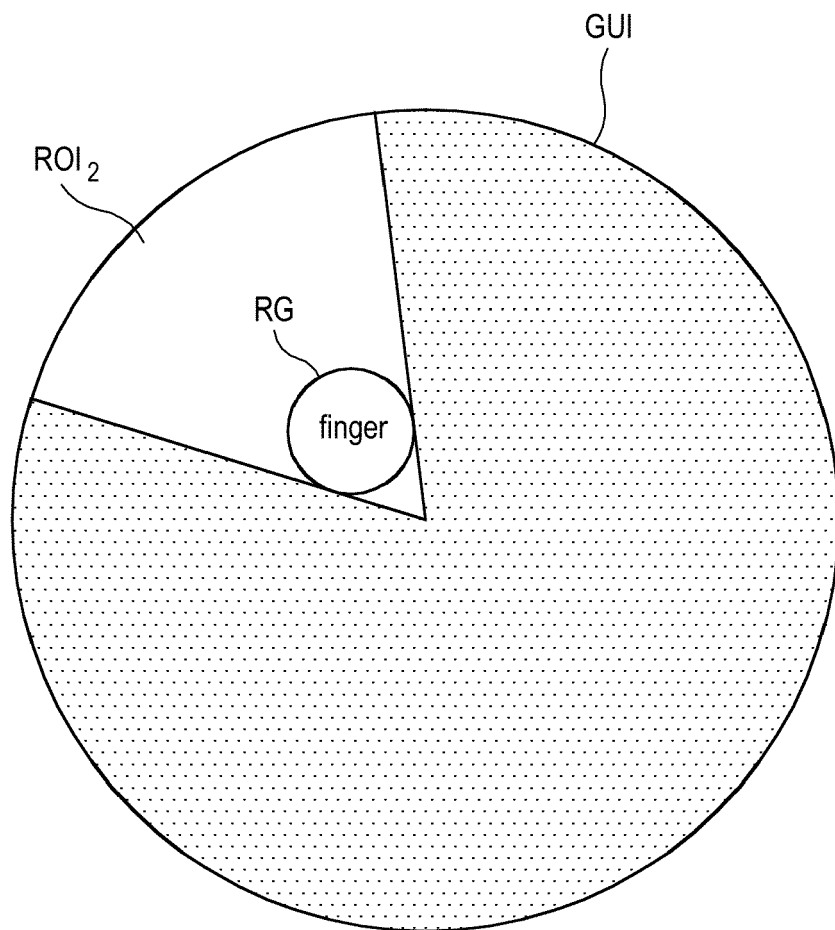
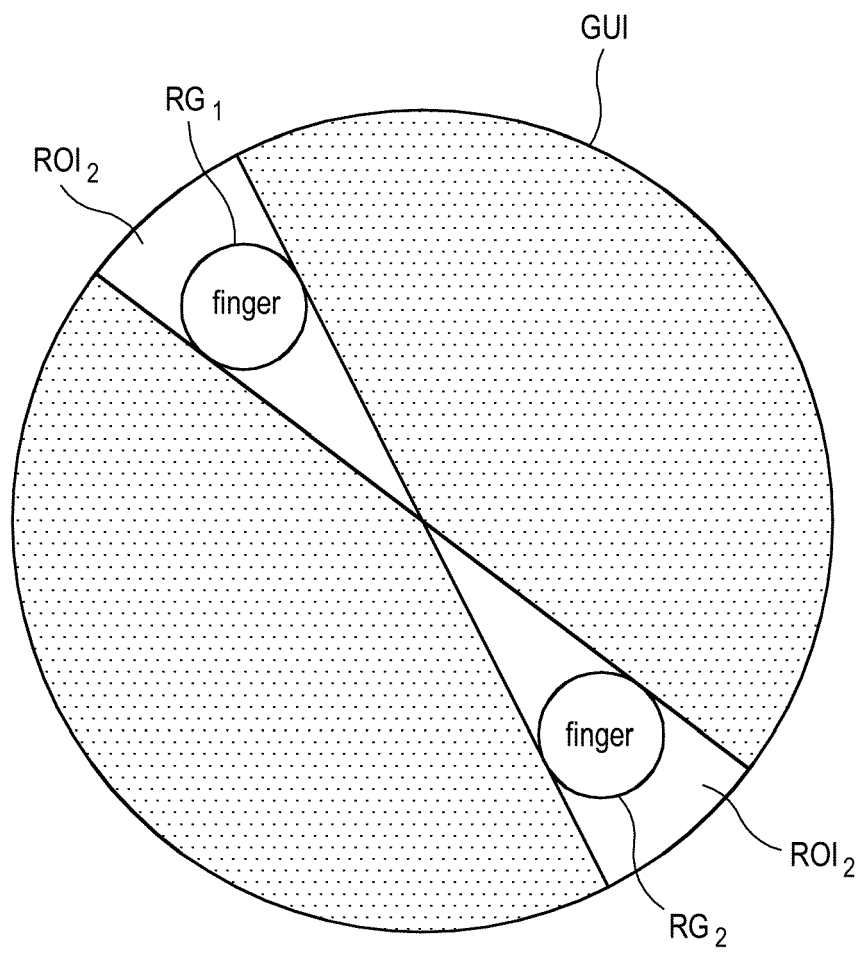


FIG. 20





EUROPEAN SEARCH REPORT

Application Number
EP 12 19 9541

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 25 April 2013	Examiner Daoukou, Eleni
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	

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EPO FORM 1503 03.82 (P04C01)



EUROPEAN SEARCH REPORT

Application Number
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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	US 2008/167557 A1 (KOZAI SHIGENORI [JP]) 10 July 2008 (2008-07-10) * paragraphs [0126], [0128]; figures 37,38 * -----	5,6,12, 13	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
Place of search		Date of completion of the search	Examiner
The Hague		25 April 2013	Daoukou, Eleni
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
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1
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25-04-2013

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专利名称(译)	在超声系统中提供用户界面		
公开(公告)号	EP2609868A1	公开(公告)日	2013-07-03
申请号	EP2012199541	申请日	2012-12-27
[标]申请(专利权)人(译)	三星麦迪森株式会社		
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发明人	KIM, HYOUNG JIN		
IPC分类号	A61B8/06 A61B8/08 A61B8/00		
CPC分类号	A61B8/06 A61B8/463 A61B8/465 A61B8/469 A61B8/488 G01S7/52063 G01S7/52071 G01S7/52073 G01S15/8984 G10K11/341 A61B8/08 A61B8/13 G01S7/52095 G01S15/8988 G06K9/46		
代理机构(译)	LORENZ , MARKUS		
优先权	1020110144476 2011-12-28 KR		
其他公开文献	EP2609868B1		
外部链接	Espacenet		

摘要(译)

提供了用于提供用于在矢量多普勒图像上执行滤波处理的用户界面的实施例。在一个实施例中，作为非限制性示例，超声系统包括：处理单元，被配置为基于与目标对象相对应的超声数据来形成目标对象的矢量信息，并形成用于对矢量多普勒执行滤波处理的用户界面。基于矢量信息的图像。

FIG. 20

