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Minimum-variance beamforming for ultrasound computer tomography imaging

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The breast cancer has become the most common type of cancer among women throughout the world.The traditional delay-and-sum (DAS) beamforming has been widely used in USCT imaging. In this paper, minimum-variance (MV) beamforming method is applied to improve the image quality for USCT. The USCT image is expected to have less noises and artifacts, and higher resolution and contrast.

(2) Material and Methods

A 1024-element ring array with the center frequency 2.5MHz was used to scan the breast phantom 052A (CIRSINC, USA) . The diameter of ring array was 200 mm, and the sampling frequency was 12.5 MHz. Phantom 052A immersed in water were put in the center of the transducer. The conventional DAS beamforming is non-adaptive and blind beamformer whose weights are predetermined. In the MV beamformer, the weights are computed to optimally minimize the output power by maintaining a unity gain in the desired direction and reducing the interference from other directions.

(3) Results

One element emits the ultrasound impulse signal, while all the elements act as the receiver to capture the raw data. The reconstruction algorithm for reflectivity image is the synthetic aperture focusing technique (SAFT). For each focal point, the weighting factors were calculated in each emissions using the MV method. Fig.2 shows the B-mode images of breast phantom using traditional DAS and MV method. It can be found that MV can reduce the artifact around array boundary while the phantom are more clearly presented comparing with DAS.

(4) Discussion and Conclusion

The MV beamformer have been applied to improve spatial resolution and suppress clutters in USCT. The proposed method was evaluated by experimental results. The results showed that the reconstructed images of the breast phantom by the MV beamformer enhanced the image quality compared to DAS. The main disadvantage of MV beamforming method is the excessive computational complexity. In the future, the proposed methods will be testified with in-vivo data.

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