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Scattering Computed Tomography visualizing density distributions by back-propagation

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Ultrasound computed tomography (UCT) has various imaging modes; sound speed profile, attenuation profile and gradient of acoustic impedance. In these imaging modes, ultrasound scattering tomography gives high resolution images highly relating to anatomical structure. In order to visualize density distribution as new efficient information in diagnoses, we use echo scattering signals and information of sound speed profile obtained by UCT.

(2) Material and Methods

Calculation area defined in a wave-propagation simulator, K-wave, was inside of the 256-element ring array transducer with the diameter of 100 mm, and the grid size was 0.125 mm. A pulse wave was transmitted at the frequency of 2 MHz. Point scatterers, which only affected the distributions of density and not those of sound speed, were placed with distance in a heterogeneous medium modeled from a clinical MRI image. The simulation had following 2 steps: (1)A pulse wave was transmitted into the medium from an element and received at all elements. (2)Time-reversed scattering signals were calculated and transmitted into the medium.

(4) Discussion and Conclusion

When we back-propagate the scattering signals from all elements, we could hardly visualize density distributions. This is because the amplitude of penetration waves are much higher than that of scattering signals. To separate the influence of the penetration and scattering waves, we visualized 2 different images using our proposal method.

*Detail information relate to our patent and are not disclosed in this abstract; details will be discussed in the workshop.

(3) Results

Since the sound speed distribution can't be obtained exactly in reality, the ambiguity was applied to it using the low-pass filter. In usual scattering visualizing method using synthetic aperture with sound speed correction (Fig. (a)), the distribution of sound speed and density are superimposed and these are not distinguishable. In our method, we achieved to distinguish them; density distributions were visualized in Fig. (b), and the error of sound speed distributions due to the ambiguity were visualized in Fig. (c).

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