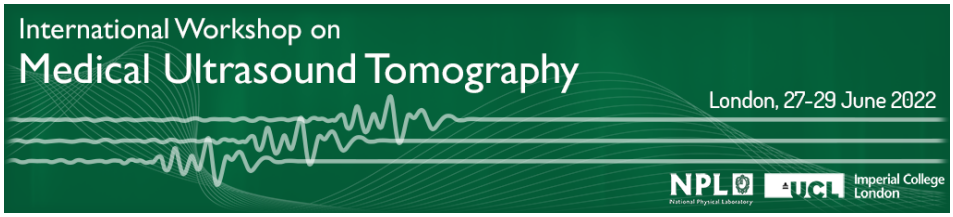

Contribution ID: **25** Type: **not specified**

Wave-based Ultrasound Transmission Tomography Using the Paraxial Approximation in 2D and 3D

Monday, June 27, 2022 4:40 PM (20 minutes)

3D Ultrasound Computed Tomography (3D USCT) is a promising technique for early breast cancer diagnosis. The 3D USCT III device built at Karlsruhe Institute of Technology allows reconstruction of quantitative tissue parameters like speed of sound and attenuation. We investigated the paraxial approximation of the Helmholtz equation as forward model for reconstruction of speed of sound and attenuation images for this full 3D device.
An example for the setup of the method in 2D is shown in Fig. 1 (A) as ring transducer with water as a background medium and an object placed inside the region of interest (ROI). The field propagation from an emitter to receivers is divided into three parts: (i) from the emitter to z = -ROI pixel line it is done with the Green's function; (ii) within the ROI the field is transmitted with the paraxial forward operator slice by slice; (iii) from the pixel line z = ROI the field is propagated with the paraxial approximation in one step to the receivers. Our backprojection method allows calculating the field from the receivers to the z = ROI line, which is the start line of the reconstruction.
We realized the forward solution, backprojection and reconstruction in 2D. The reconstructions were evaluated with data simulated using the k-Wave toolbox, resulting in the mean error of the speed of sound of 12.6 m/s for a pixel size of 0.3 mm. The ground truth phantom and the reconstructed speed of sound in 2D and can be seen in Fig. 1 (B,C) correspondingly.
In a next step, simulation and reconstruction were realized in 3D, based on the geometry of the USCT III device. Reconstruction was implemented by the L-BFGS algorithm. The reconstruction was initially evaluated using the paraxial approximation to simulate data. Reconstructed sound speed in 3D is presented in Fig. 1 (D,E) for coronal and transverse planes correspondingly. The average error of the reconstructed 3D speed of sound map is 0.3 m/s for a pixel size of 1.5 mm. The backprojection method in 3D based on neural networks is currently under development.
We present initial results of using the paraxial approximation for the reconstruction of the speed of sound maps in 3D.

Preferred Contribution Type

Presentation

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