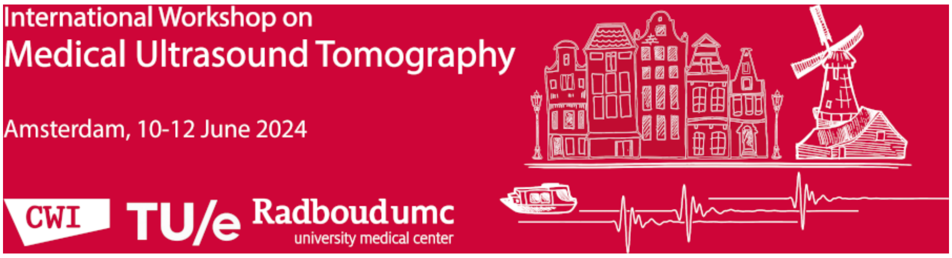

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Coordinate-based implicit neural representation for full waveform inversion in ultrasound computed tomography

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Background:
Sound speed imaging is an important characteristic of ultrasound computed tomography (USCT). Full waveform inversion (FWI) is regarded as the most promising algorithm for high-resolution sound speed imaging. However, FWI may encounter the phenomenon of cycle-skipping, which means falling into local optimal solutions. Implicit neural representation (INR) is a popular technique that has been developed recently. The technique has demonstrated impressive results in tasks such as super-resolution and image generation. This study explores the application of INR to the field of sound speed imaging.
Method:
We present a multilayer perceptron (MLP) network that receives the coordinates of image pixels as inputs and predicts the sound speed values at the corresponding positions. This network is employed to create a sound speed image. The generated sound speed image is subsequently used in the forward process to simulate signals, followed by the backward process in which the sound speed is iteratively refined through the adjustment of the MLP network parameters.
Results:
We conduct a simulation experiment using a numerical model of a breast to verify the effectiveness of the algorithm. The simulation experiments are performed with a circular array of 64 transmitters and 256 receivers at a toneburst wave with 350 kHz center frequency. The baseline method is based on the least-square FWI. The root mean square error of the results of the proposed method was 5.9 and 1993.3 for the baseline.
Conclusion:
The results demonstrate that the INR network is able to act as an implicit regularizer for the FWI algorithm, thus preventing it from falling into a locally optimal solution. Therefore, it is believed that the proposed method offers a feasible alternative to the current sound speed imaging in USCT.

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