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# Transcranial Ultrasound Computed Tomography with Minimal Prior Knowledge Using Optimal Transport

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Transcranial ultrasound imaging using waveform-based inversion techniques is an emerging high resolution brain imaging modality, but often relies on incorporating considerable prior knowledge to avoid the significant cycle skipping effects introduced by the skull. In this work, we present a strategy employing both reverse time migration and optimal transport which is able to mitigate cycle skipping while using a starting model that assumes no prior knowledge of any tissue or bone structures within the medium. Numerical examples are shown *in silico* using a realistic brain phantom to demonstrate the effectiveness of this strategy.

This inversion workflow involves first approximating the major impedance contrasts within the medium using reflection data. These reflectors are mapped to an otherwise uniform sound speed model to approximate the two highest contrast portions of the domain, namely the skin and the skull. This strategy allows for these major structures to be incorporated within the starting model without requiring one to have explicit knowledge of these tissues *a priori*. Given that the spectral-element method is utilized for modeling the propagation of the ultrasound waves, the soft tissue-bone interfaces can be explicitly meshed within the spatial discretization to further enhance the quality of the starting model.

Once this initial model has been constructed, a full-waveform inversion approach is used in conjunction with a graph-space formulation of an optimal transport misfit functional. This misfit functional has been shown in the context of geophysical inverse problems to be excellent at dealing with heavily cycle skipped data. This approach allows for potentially significant mismatches in both phase and amplitude between the observed and simulated measurements to be accounted for.

## Preferred Contribution Type

Presentation

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