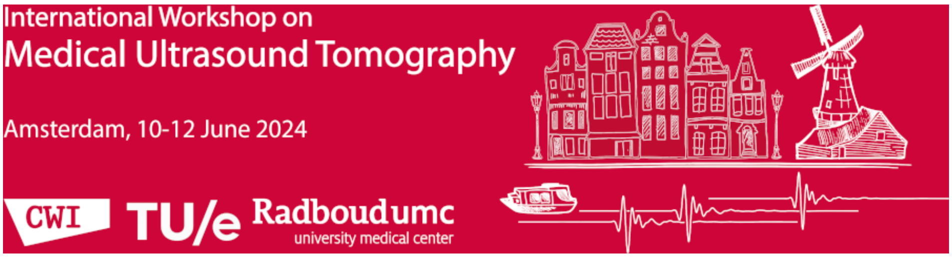

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Fourier Beamforming for Enhanced Resolution in Ultrasound Computed Tomography

Wednesday, June 12, 2024 10:20 AM (20 minutes)

Background:
Ultrasound Computed Tomography (USCT) based on circular arrays provides richer and more detailed information compared to traditional ultrasound imaging, which has attracted extensive attention. The delay-and-sum (DAS) method, along with its related weighted improvement strategies, stands as the mainstream signal beamforming approach in this domain. In the DAS method, the received echo signals are aptly delayed, followed by a summation of these time-aligned signals to enhance the signal at the imaging point. However, the DAS method assumes wave propagation along straight paths, resulting in limited resolution when addressing complex structures in media where multipath propagation exists.
Method:
Addressing these limitations, this study proposes a novel USCT algorithm for circular arrays based on Reverse Time Migration (RTM). This method aims to effectively handling wave propagation in heterogeneous tissue structures. After the Fourier transformation is applied to both the transmitted and received wavefields, by extrapolating the wavefield based on the two-dimensional acoustic wave equation in polar coordinates, our approach obtains the transmitted and received wave fields in the fourier domain at identical spatial locations with a reduced radius, followed by cross-correlation and summation along the frequency axis.
Results and Conclusion:
Experiments on resolution phantom data collected by a circular-array USCT system were conducted. The lateral and axial Full Width at Half Maximum (FWHM) values of the chosen points are calculated to verify the performance. Compared with the classical Coherence Factor-weighted DAS (CF-DAS) method, our approach can offer a 15% higher FWHM value than CF-DAS method. Therefore, our approach has the advantage of improving image resolution in USCT through more accurate wavefield reconstruction. Additionally, it is noteworthy that the results demonstrate that our method can effectively suppress the artifacts associated with multiple reflections. Moreover, leveraging parallel processing on GPUs, this algorithm shows promising potential for clinical applications.

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