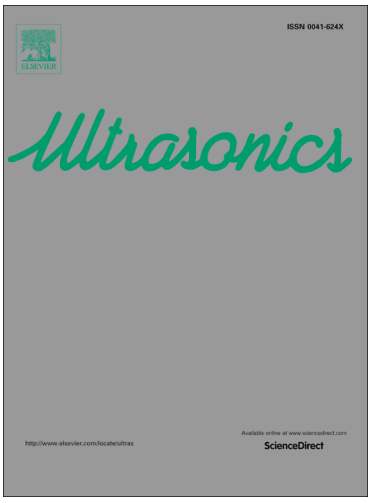

A Robust Method for Ultrasound Beamforming in the Presence of Off-Axis Clutter and Sound Speed Variation

Kazuyuki Dei, Brett Byram

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Kazuyuki Dei and Brett Byram

Department of Biomedical Engineering, Vanderbilt University, Nashville, TN, USA

Abstract

Previously, we introduced a model-based beamforming algorithm to suppress ultrasound imaging artifacts caused by clutter sources, such as reverberation and off-axis scattering. We refer to this method as aperture domain model image reconstruction (ADMIRE). In this study, we evaluated the algorithm's limitations and ability to suppress off-axis energy using Field II-based simulations, experimental phantoms and *in vivo* data acquired by a Verasonics ultrasound system with a curvilinear transducer (C5-2). We compared image quality derived from a standard delay-and-sum (DAS) beamformer, DAS with coherence factor (CF) weighting, ADMIRE and ADMIRE plus CF weighting. Simulations, phantoms and *in vivo* scan results demonstrate that ADMIRE substantially suppresses off-axis energy, while preserving the spatial resolution of standard DAS beamforming. We also observed that ADMIRE with CF weighting further improves some aspects of image quality. We identified limitations of ADMIRE when suppressing off-axis clutter in the presence of strong scattering, and we suggest a solution. Finally, because ADMIRE is a model-based beamformer, we used simulated phantoms to test the performance of ADMIRE under model-mismatch caused by gross sound speed deviation. The impact of sound speed errors largely mimics DAS beamforming, but ADMIRE never does worse than DAS itself in resolution or contrast. As expected the CF weighting used as a post processing technique provides a boost in contrast but decreases CNR and speckle SNR. The results indicate that ADMIRE is robust in terms of model-mismatch caused by sound speed variation, especially when the actual sound speed is slower than the assumed sound speed. As an

*Address Correspondance to: Kazuyuki Dei, Department of Biomedical Engineering, Vanderbilt University, Nashville, TN 37235, USA. Email: kazuyuki.dei@vanderbilt.edu