Jordan University of Science and Technology

Quadratic Pulse Inversion Ultrasonic Imaging (QPI) Analysis and Design of Quadratic Kernel in the Frequency Domain to reduce tissue component introduced by motion

Authors: Mamoun F. Al-Mistarihi, and Emad S. Ebbini

Abstract: We have previously introduced an ultrasonic imaging approach that combines harmonic-sensitive pulse sequences with a post-beamforming quadratic kernel derived from SOVF. The approach was designed to produce images with high sensitivity to nonlinear oscillations (20 - 30 dB below the fundamental) from microbubble ultrasound contrast agents (UCA) while maintaining high levels of noise rejection. Although pulse inversion detection using the sum signal, can detect the nonlinear echoes from microbubbles and suppress the linear echoes from stationary tissue, echoes from moving tissue will not be suppressed completely and could mask echoes from microbubbles. In this paper, analysis and design of the quadratic kernel in the frequency domain for the case of linear scatterer motion is presented leading to reduction of tissue component introduced by motion and increase the specificity while optimizing the sensitivity to the ultrasound contrast agents (UCA). The approach is demonstrated experimentally using images from imaging flow phantom under a variety of exposure conditions and UCA concentration levels. Imaging results show a significant increase in harmonic sensitivity, reduction in noise levels and reduction of tissue component introduced by motion.