

Post Beamforming Adaptive Second Order Volterra Filter (ASOVF) for Pulse-Echo Ultrasonic Imaging

Authors: Mamoun F. Al-Mistarihi

Abstract: We have previously introduced post-beamforming second order Volterra filter (SOVF) for decomposing the pulse echo ultrasonic radio-frequency (RF) signal into its linear and quadratic components. Using singular value decomposition (SVD), an optimal minimum-norm least squares algorithm for deriving the coefficients of the linear and quadratic kernels of the SOVF was developed and verified. However, the agent specificity of the standard SVD-based quadratic kernel is sometimes compromised by sensitivity to nonlinear echoes from tissue. In this paper, we present an adaptive second-order Volterra filter (ASOVF) designed to obtain the optimum filter coefficients minimizing the cost function 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. The least-squares approach of a second-order Volterra model and its adaptive filtering algorithm based on recursive least-squares are introduced.