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Separable Implementation Of The Second Order Volterra Filter (SOVF) In Xilinx Virtex-E FPGA

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Abstract: Post-beamforming second order Volterra filter (SOVF) was previously introduced 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. The "Separable" implementation algorithm of a SOVF based on the eigenvalue decomposition (EVD) of the quadratic kernel was introduced and verified. In this paper, the "Separable" version of a Second Order Volterra filter is implemented in Xilinx Virtex-E FPGA. Parallel operation, efficient use of instructions per task, and data streaming capability of FPGA are identified. This implementation should allow for real-time implementation of quadratic filtering on commercial ultrasound scanners.