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Complexity Reduction of UltrasoundSub-Ultra-Harmonic Modeling by an Input Modified Volterra Approach

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Abstract : Contrast of echographic images has been highly improved by the injection of microbubbles, due to their nonlinearbehavior. However, this contrast enhancement is limited by the nonlinear acoustic propagation in tissue. To overcome this drawback, sub and ultra-harmonic contrast imaging can be used, since only microbubbles can generate these components. Nonlinear modeling is aprimordial step in the analysis of microbubble signals for sub and ultra-harmonic imaging. Nonlinear models like Volterra model hasbeen applied in harmonic imaging to model harmonics optimally. However, it can model harmonics only. For sub and ultra-harmonicmodeling, a multiple input single output (MISO) Volterra has been proposed. The aim of this study is to propose a simpler alternativefor the modeling of sub and ultra-harmonics. We propose a modified single input single output (SMISO) Volterra model based on inputdemodulation. The model is tested using simulated and experimental signals. Results showed that sub and ultra-harmonics aremodeled. The number of kernels is reduced to its half using SMISO wolterra model is ?15.8 dB and it is ?60.7 dB for experimental signals. The computational time is reduced by a factor of 4 and 5 in simulated and experimental cases respectively. SMISO model cammake easier the sub and ultra-harmonics modeling.

Keywords : modeling, sub-ultra-harmonics, SMISO Volterra, demodulation, microbubble.