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Application of Inverse Methods for Spatial Deconvolution of Pulsed Ultrasound Fields Radiated in Solids

W. Djerir, T. Boutkedjirt, A.B. Bouda, A. Satour

Abstract: When measuring the ultrasound field, the signal provided by the receiving transducer is affected by its spatial properties. Particularly, the displacement normal to its surface is spatially averaged because of the receiver finite size. In this study, we show using a numerical simulation, the effectiveness of the spatial deconvolution of these effects for a rectangular transducer. For that, three methods allowing the inversion of the aperture effect are tested 1) Wiener's method; 2) the power spectral equalization (PSE) method, and 3) the maximum a posteriori (MAP) method. The obtained results show that the three methods are able to reconstruct the ultrasound field from the spatially averaged values and the quality of the reconstruction depends strongly upon the signal to noise ratio (SNR) and the spatial frequencies of the ultrasound field investigated.

Keywords : Deconvolution, Spatial filter, Wiener filter, Power spectral equalization method, Maximum a posteriori method.