Reconstruction of Pulsed Ultrasonic Fields Received by a hydrophone of rectangular aperture by application of inverse methods.

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Abstract : In order to carry out reliable measurements of pulsed ultrasonic fields, the use of a piezoelectric hydrophone as receiver is recommended. However, due the finite size of the receiver aperture the measured acoustic pressure is affected by spatial averaging. The output signal may also be distorted because of the frequency variations of its transfer function. The aim of this work is to deconvolve the spatio-temporal effects of the receiving chain (hydrophone, cable, oscilloscope...) in order to reconstruct the pulsed ultrasonic field with higher spatial and temporal resolution. This constitutes an inverse problem, which has been encountered in various domains of physics. The possibility of deconvolving the spatial effects has been shown for harmonic ultrasonic fields. The present contribution is a generalization of the study to pulsed ultrasonic fields. For that, three methods allowing the inversion of the aperture effect are tested 1) Wiener's method 2), the power spectral equalization method (PSE), and 3) the maximum a posteriori method (MAP). The obtained results show that the three methods are able to reconstruct the ultrasonic field from the spatially averaged values and the quality of the reconstruction depends strongly upon the SNR, the hydrophone dimensions and the axial distance to the source.