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Spatio-temporal deconvolution of pulsed ultrasonic fields received by a transducer of linear aperture : a simulation study

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Abstract : In ultrasonic field measurements, the signal delivered by the receiving transducer is affected by the receiver spatio temporal transmission properties. The pressure is spatially averaged over its finite-size aperture. Furthermore, frequency variations of its transfer function may distort the output signal. The efficiency of the deconvolution of these effects is shown by means of numerical simulations. The pulsed pressure field radiated by a wideband 10.3mm-radius planar transducer, with a central frequency fc = 2.25 MHz (?c: corresponding ultrasonic wavelength in water) is considered. The receiver is a linear aperture 25 ?m- thick PVDF membrane hydrophone. The study shows that the quality of the reconstructed signal depends strongly upon the signal-to-noise ratio (SNR), the aperture dimensions and the distance from the source. For an aperture of length L = 2.6 mm ??3.9?c, placed on axis at z = 3 mm, correlation coefficients between the reconstructed pressure and the original one, rppˆ , of 0.999, 0.988 and 0.655 have been obtained, for SNRs of 60, 40 and 20 dB respectively. For a greater aperture (L = 4.6=mm ??6.9?c) and SNR = 40 dB, no satisfactory results could be obtained at this distance (rppˆ = 0.912). At a greater axial distance (z = 20 mm), better deconvolution results could be achieved (rppˆ = 0.928).

Keywords : PVDF hydrophones, SNR, Wiener filtre, aperture, spatio -temporal