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Reconstruction of temporal invariants of the time-reversal operator for communication in shallow water

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Time-reversal techniques allow focusing in waveguides with application for detection or telecommunication(Kupperman et al, J. Acoust. Soc. Am. 103 (1): 25-40,(1998)). It has been shown that the DORT method (French acronym for Decomposition of the Time Reversal Operator) can be used to achieve detection and selective focusing on pointlike scatterers in a waveguide (Mordant et al, J.Acoust.Soc.Am. 105, 2634-2642,(1999)). However, the decomposition is done in frequency domain providing eigenvectors V(ω) of undetermined phase. In order to achieve temporal focusing, it is necessary to built 'temporal eigenvectors' V(t) as an appropriate combination of the eigenvectors V(ω). Due to dispersion, the reconstruction of the temporal eigenvectors is difficult in waveguides. One solution was proposed by Mordant et al, using the symmetry of the array response matrix and assuming continuous frequency dependence of the invariants. However this method does not work if eigenvalues crossings occur. Furthermore, it cannot be applied to distinct arrays of transmitters and receivers. We propose a simple method to reconstruct the temporal invariants by using the back propagation of eigenvector in free space. Application to data from a laboratory experiment and from the DOREV 2005 shallow water experiment are presented.