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Invariants of the time reversal operator for an elastic target in a water waveguide

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Detection and characterization of a target in shallow water is an active field of research. In general, in a waveguide, the dispersion is such that the frequency signature of a target cannot be extracted from a single backscatterd signal unless the waveguide properties as well as the target's position are known (Mignerey et al., JASA 1992 and Yang et al., JASA 1994). We propose to apply the Decomposition of the Time-Reversal Operator method to recover the target's signature in an unknown waveguide. Using a modal theory, we show that provided the target is far from the boundaries of the guide the first singular value of the time reversal operator is proportional to its signature. Using the same approach, the second singular value is shown to be proportional to the second derivative of the angular dependant form function which is a relevant parameter for target identification. Ultrasonic laboratory experiments are presented that confirm these theoretical results.