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Isolation of backscattering resonances of a thin spherical shell using iterative time reversal

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The backscattering spectrum of thin spherical shells show resonance peaks due to several different physical processes including high frequency Lamb wave excitation and low frequency modal ringing [Kaduchak et al., J. Acoust. Soc. Am. 97, 2699-2708 (1995)]. These different processes can be isolated in both time and frequency by using simulated iterative time reversal. This is accomplished by windowing in the time domain and/or filtering in the frequency domain. Iterative time reversal techniques developed for buried target detection [Waters et al., J. Acoust. Soc. Am. 122, 3023 (2007)] are applied to the partial wave series solution for the backscattering of plane acoustic waves by a thin-walled spherical shell. Tank experiments are performed to verify theoretical results. Targets loaded with both water and sediment are considered. Understanding the relationship between the time reversal window's size/position and the dominant target scattering mechanisms is key to the development of time reversal as a detection and identification technique. [Work supported by The Office of Naval Research.]