Laboratory investigations of the detection and characterization of buried targets by iterative, single-channel time reversal

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Due to the dynamic nature of the shallow water environment, targets are often buried beneath the seafloor, hindering their detection and identification by acoustic methods. Using iterative time reversal with a single channel transducer [Waters et al., J. Acoust. Soc. Am. 122, 3023 (2007)], the monostatic return from a buried resonant target is enhanced, yielding convergence to a narrowband waveform characteristic of the dominant mode in the target’s scattering response. Scaled laboratory experiments are performed with a broadband (Q\textsuperscript{2}) transducer operating in the 0.5-2 MHz frequency range. Solid and evacuated metallic spheres used as targets are buried beneath a layer of simulated sediment. Images generated by scanning the transducer laterally in two dimensions over an area of sediment containing multiple targets show enhancement of different modes in a single target’s scattering response and test the selectivity between targets of differing type. Experiments with the transducer positioned at normal and non-normal incidence, quantify the enhancement in the signal-to-noise ratio of target returns as a function of window size and position. [Work supported by The Office of Naval Research and the Center for Subsurface Sensing and Imaging Systems (NSF ERC Award No. EEC-9986821).]