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

Zachary Waters[a], Benjamin Dzikowicz[b], R. Glynn Holt[a] and Ronald Roy[a]
[a]Boston University, Dept. of Aerosp. and Mech. Eng., 110 Cummington St., Boston, MA 02215, USA
[b]Naval Surface Warfare Center, Panama City Division, Code HS-11, 100 Vernon Ave., Panama City, FL 32407, USA

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∼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).]