Broadband Time Reversal Scheme for Target Detection in Highly Cluttered Field

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In electromagnetic wave propagation, utilizing time reversal scheme, focus with superresolution has been experimentally demonstrated in highly cluttered environment [1, 2]. Based on such concept, a modified time reversal scheme based on the utilization of antenna array has also been developed to substantially enhance the target detection in highly cluttered environment. The spatial nullifying scheme results in a virtual elimination or substantial suppression of the scattering on the clutter while enabling automatic energy focusing on the target [3, 4]. In this paper, we present a time reversal scheme along using only a single antenna and a broad band illumination of a highly cluttered field for target detection.

Consider a single target in a cluttered field. A short pulse, corresponding to a broad spectral bandwidth, is broadcast from a single transmitter to the field. Echoes from the field with and without the target presence are recorded by a single receiver. The difference signal between the echoes with and without target is time reversed and mathematically rebroadcast to the field. The final received echo is used for an energy detector to assess the presence of the target. Figure 1 shows a 2-D FDTD simulation of a cluttered field along with a target. The scatters and the target are all identical square cross-sectioned metallic objects. AWGN is added to the receiver prior to the mathematical time reversal operation. Figure 2 shows the ROC curve for comparison between results of the broadband time reversal scheme the simple change detection.

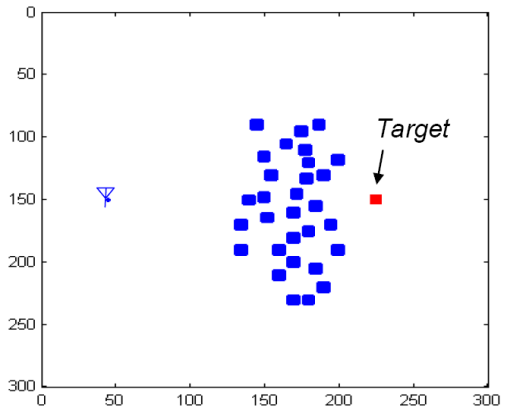

Figure 1: Cluttered field and target used in simulation.

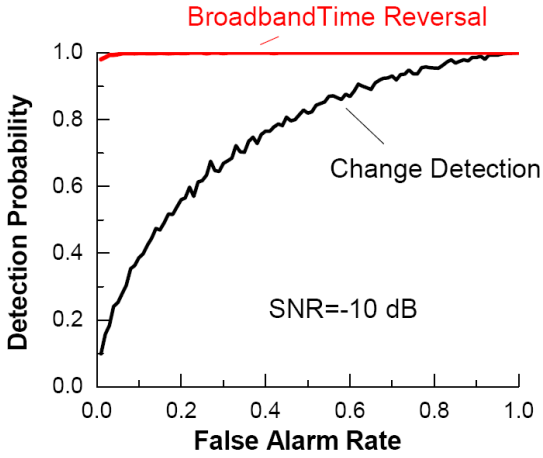

Figure 2: Calculated ROC curve using an energy detector.

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