**Microwave Imaging of Objects Hidden by Non-penetrating Obstacles Using Time Reversal Imaging Technique**

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In recent years, researchers have done extensive studies on “Through Wall Imaging(TWI)”, which reconstructs the image based on the backscattered waves passing through the dielectric wall. However, in some cases,the objects are completely obscured by non-penetrating obstacles such as “hard wall ”and the signals cannot pass through the wall as it is in TWI case.Therefore, conventional techniques are not applicable to “Hard Wall Imaging(HWI)”. In this paper, a new imaging technique is proposed based on time-reversal(TR) imaging technique and diffraction theory to resolve this problem.

In our research, the target is assumed to be point scatter obscured by a conducting wall with two diffraction edges, which blocks all the transmission between antennas and targets. Since the target is located in the diffracted-field only region, only diffracted waves from conducting edge are received by the antennas. The conventional steering vector for free space imaging is not working well in this scenario so the diffraction coefficient has to be introduced to formulate a steering vector in HWI. The geometric diffraction theory(GTD) and uniform diffraction theory(UTD)are compared in the formulation of steering vector and the effect of polarization on diffraction boundary is also studied.

After having obtained steering vector, TR imaging function applied to reconstruct the image from the received signals and steering vector.However, it was found that the coherence of array elements is not significant due to diffraction at the same edge points and the angle dependent diffraction coefficient results in a biased image around the edge point.Moreover, the product between received signal and steering vector results in undesirable terms and consequent ghost image. For these reasons, the backward signals due to two edges have to be measured separately and the images due to two edges are superimposed after normalization. As the image resolution is only attributed to the frequency correlation of pulse, the superimposed image will be two semi-rings with the center of diffraction edge point and the intersection region is exactly the location of target. In this way, both single antenna and array antenna can give the image with similar resolution using TR imaging function. Nevertheless, the TR-DORT(Decomposition of Time-Reversal Operator) imaging, which includes the measurement of multistatic matrix and subspace signal processing, requires the array antenna to apply eigen-decomposition and extract the dominant response from the target. It is expected that DORT method is more immune to the clutters and gives a cleaner image than conventional TR imaging.Futhermore, in this paper, apart from the formulations, FDTD simulation is employed to verify the validity of the new imaging techniques.