The Effects of Wall Moisture Profiles on Matched Illumination Waveforms

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Improvements in through-the-wall radar imaging (TWRI) rely on understanding the phenomenology of the interaction between the radar signal and the wall structure. Propagation of the pulse through the wall adversely affects the resulting target return signatures through attenuation and time dispersion. One technique of improving TWRI performance is through optimal waveform design. The matched illumination concept has been shown to improve target detection and discrimination for TWRI by optimally shaping the transmission waveform to maximize the signal-to-interference and noise ratio of the radar's transmitter-receiver pair [H. Estephan et.al, *IEEE Trans. on Geoscience and Remote Sensing*, Vol. 48, No. 7, pp. 2930-2941, 2010].

However, research utilizing matched illumination has focused on homogeneous wall structures. The electrical properties of the wall structure are a significant TWRI design consideration as the target return signature is highly dependent on the physical composition of the wall structure. The moisture level within a solid wall is of significant interest because it can change quickly due to precipitation and other environmental conditions. The homogeneous wall model is insufficient to accurately design optimal waveforms for a solid wall with non-uniform moisture profile. A heterogeneous wall model is required.

In this presentation, we present the impact of moisture profiles within wall structures on the characteristics of the matched illumination waveform. A parametric study is undertaken through simulation of typically encountered wall types featuring various moisture configurations. Understanding the impact of solid wall moisture profiles on the associated matched illumination waveform will lead to better target classification and discrimination using through-the-wall radar.