ABSTRACT

It is known that electromagnetic signals can penetrate into non-metallic barriers such as building walls and soil. A portable Synthetic Aperture Radar (SAR) unit capable of transmitting and receiving such signals is desirable in various non-intrusive (proximity or remote) sensing applications. Theoretical and experimental issues associated with Ultra-Wide-Band (UWB) SAR imaging through complex media are studied. The complex media of interest include building walls, underground and foliage. It may be inconvenient and impractical for a hand-held unit to collect data at uniformly spaced positions. A back-projection algorithm is developed for the case where spatial sampling is not uniform. In addition, a spherical wavefront (as opposed to a uniformly planar wavefront) is assumed in the algorithm to account for the proximity of a radar unit relative to a target scene.

Imaging results from simulated point target data and measurements of various real targets are obtained. Defocusing and other image defects associated with imaging through complex media using the free space (or dielectric full space) assumption are addressed. Refocusing techniques based on a dielectric wall model and a dielectric half-space model are formulated and imaging results are compared with those generated using the free space assumption.