Estimation and Empirically Verification of Radar Cross Section of a Dielectric Lossy Cylinder above Rough Surface

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Accurate and reliable methods for modeling the global carbon cycle and consequently the climate change are highly desirable in the scientific community. Remote sensing/detection of trees' structures in a forest enable ecologists to better understand the dynamics of a forest ecosystem and thus improve existing models to further our understanding of the global carbon cycle. Interferometric Synthetic Aperture Radar (InSAR) has been shown to be a good remote sensing modality to detect such temporal changes in forests. Specifically, InSAR is capable of detecting/estimating a forest's mean tree height, biomass, canopy density and other parameters through known allometric equivalencies.

To enhance the accuracy of existing coherent models, we propose to use a computationally tractable approach for including near-field interaction between the underlying undulating ground and the tree trunk. This proposed iterative method is based on the utilization of the reciprocity theorem and it requires only computation of scattered fields and induced currents in discrete scatterers, in the absence of other particles. The number of iterations required for an accurate estimation is a function of the proximity of the scatterers.

In order to verify the accuracy of the theoretical formulation, an extensive set of measurements using polarimetric radar is performed. The scenario under test consists of a lossy cylinder above a rough surface made on top of a sand box. The undulating rough surface is formed by pressing a statistically known rough surface generated using three dimensional printer. In the measurement setup, the uncorrelated samples recorded after rotating the sand box are combined with the uncorrelated samples obtained from the frequency bands for more precise measurement results. The measurements have been performed for several lossy cylinders above rough surface.