Vegetated Terrain Clutter Modeling Using Digital Elevation and National Land Cover Datasets

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Abstract

The detection and characterization of targets in a complex environment with the presence of ubiquitous ground clutter is of critical military importance. In spite of laudable advances in radar technologies, the gaps in accurate and reliable clutter prediction models continue to be a challenging problem in the optimal radar system design and performance evaluation. The characteristics of ground clutter and RF propagation are strongly dependent on the type of land cover above the earth surface, which are significantly different from the open bare soil, sand, and water surfaces. Having a high fidelity and reliable clutter modeling tool is important for better understanding scattering phenomenology and developing, testing and validating new target detection and characterization algorithms. However, the design and evaluation of a radar system cannot be realized without testing, real or simulated, data.

In this paper, we develop an analytical vegetated terrain scattering model using the analytical rough surface scattering theory combined with the distorted Born approximation (DBA) for volume scattering. The layered medium model includes surface scattering, direct volume scattering and double bounce scattering. The model has a three-layer structure: the free-space layer above the top of canopy where air- and space-borne sensors are located; the vegetation layer, and the ground with rough boundary. The multiple scattering is ignored by assuming that the scatterers inside the vegetation are usually sparsely distributed. In addition, we combine information available from the National Elevation Dataset (NED) and the Land Cover Data (LCD) with the electromagnetic scattering model. The physical characteristics of the terrain of interest are determined from the NED and the LCD. The region that is common to both data sets is first determined. Then, we generate surface facets and differentiate the shadowed and illuminated facets. The surface of each illuminated facet can be described by an appropriate surface spectrum with roughness parameters, *rms* height and correlation length, extracted from the data sets to determine the local terrain features. The total scattered field from the resolution cell is computed by summing up the contribution from each illuminated cell. In this work, we also examine the impact of soil moisture content and vegetation water content (VWC) on terrain reflectivity.

URSI Topics: Commission B
URSI Topics: Commission F