UHF FOLIAGE PENETRATION AND SCATTERING MODEL FOR POLARIMETRIC AND INTERFEROMETRIC SAR APPLICATIONS

Sassan S. Saatchi
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, CA 91109
Email: Sassan.Saatchi@jpl.nasa.gov

Abstract

Today, the scientific community and the space organizations are becoming increasingly interested in the use of UHF radar sensors for global observation of forested ecosystems. This interest has challenged the radio science community to develop innovative and improved approaches to problems associated with the spaceborne UHF propagation and scattering of microwaves in forest applications. In this paper, we present an improved forest scattering model at UHF (P-band) frequency (432-438 MHz) for SAR (synthetic Aperture Radar) sensors in both polarimetric and interferometric configurations. The model is based on coherent scattering theory of a cluster of scatterers of cylinders and disks representing tree stems, branches, and leaves. Multiple scattering theory in the context of Distorted Born Approximation has been used to obtain the mean field propagation and scattering in forests. Additional statistics to model a heterogeneous forest canopy structure with different vertical and horizontal distributions of tree crowns have been incorporated in the model to extend its application and to include the real variations of forest structure. Simulations are performed for both polarimetric backscattering and interferometric coherence over forests with densely foliated canopy to examine the performance of the model and the UHF sensors in extreme cases of forest density. The model results are analyzed to assess the capability of UHF SAR sensors in estimating forest structural variables and the total above ground biomass in different ecosystems. Furthermore, the uncertainties in estimation of forest structure are quantified in terms of forest architecture, environmental variables, and sensor geometry and characteristics.

Keywords: UHF, SAR, Polarimetry, Interferometry, Wave Theory, Forest Structure, Biomass

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