Estimation of Penetration of Forest, Canopies by Interferometric SAR Measurements

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In contrast to traditional Synthetic Aperture Radar (SAR), an Interferometric SAR (I NSAIL) yields two additional measurements: the phase difference and the correlation between the two interferometric channels. The phase difference has been used to estimate topographic height. For homogeneous surfaces, the correlation depends 011 the system signal-to-noise (SNR) ratio, the interferometer parameters, and the local slope. In the presence of volume scattering, such as that encountered in vegetation canopies, the correlation between the two channels is also dependent on the degree of penetration of the radiation into the scattering medium. In this paper, we propose a method for removing system and slope effects in order to obtain the decorrelation due to penetration alone. The sensitivities and accuracy of the proposed method are determined by Monte Carlo experiments, and we show that the proposed technique has sufficient sensitivity to provide penetration measurements for airborne SAR systems.

Next, we provide a theoretical model to estimate the degree of penetration in a way which is independent of the details of the scattering medium. We also present a model for the correlation from non-homogeneous layers. We assess the sensitivity of the proposed inversion technique to these inhomogeneous situations. Finally, we present a comparison of the interferometric results against in situ data obtained by an airborne laser profilometer which provides a direct measurement of tree height and an estimate of the vegetation density profile in the forested areas around Mt. Adams, WA.

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