Application of the Brown Model to Estimate the Scattering Coefficient of Layered Rough Surfaces

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The "Brown model" describes the near nadiral impulse response of a rough surface as a convolution of the flat surface impulse response, the height pdf of the rough surface, and the radar point target response. The primary use of this model has been in altimetry applications, in particular for sea surfaces. However, recent studies have shown that the Brown model if appropriately modified can also provide reasonable estimates of the pulse return waveform for polar ice sheets. This is due to the fact that the surface roughness can be approximated as uniform over the entire target area illuminated by the radar. Using the Brown model, the backscattering coefficient of an ice sheet surface can be determined from the surface impulse response. Furthermore, when the beamwidth of the radar antenna is sufficiently large, the scattering coefficient as a function of the incidence angle can be obtained to determine additional surface property information.

In this presentation, we describe a procedure for retrieving angular properties of the surface scattering coefficient using the Brown model. The main focus is on application of this procedure to the bottom interface of two-layer ice sheet by including the effect of the presence of the upper layer structure as a reflection coefficient of the top boundary and a change in the effective angle of incidence on the bottom surface as a result of refraction through the upper layer. The impulse response model for this particular scenario is formulated. Monte Carlo simulations predicting the pulse return waveform from layered media are used to demonstrate the validity of this approach.