# Probability Density Functions of Bistatic Rough Surface Scattered Fields Using the Small Slope Approximation

Hongkun Li* and Joel T. Johnson
The Ohio State University, Columbus, OH, USA

The probability density functions (pdfs) of fields backscattered from rough surfaces have been examined in several previous studies. Scattered fields typically exhibit complex Gaussian statistics (i.e. Rayleigh amplitudes) when the radar's spatial resolution is insufficient to resolve any long wave "tilt" or "topography" effects. For systems with higher spatial resolution, the scattered field can have a non-Gaussian pdf and can depart from Rayleigh statistics due to the modulation of the field amplitude by tilt or shadowing effects.

In this work, pdfs for bistatic scattered fields from rough surfaces are studied in a Monte Carlo process using the 2nd order Small Slope Approximation (SSA2) to solve for bistatic scattered fields from deterministic surface realizations. The surface is modeled as an ensemble of tilted rough facets. A single surface realization consists of a rough facet containing "small scale" roughness that is tilted by a second "large scale" roughness process. Realizations in the Monte Carlo process are generated by varying both the "small" and "large" scale roughness on each trial. This process models for example the variations in surface returns that occur for a radar system capable of resolving larger scale surface topography. The resulting pdfs are parametrized by the bistatic scattering geometry, surface permittivity, small scale roughness properties, and the rms slopes of the Gaussian "tilting" process.

Results will be shown to investigate the behaviors of the resulting pdfs as a function of the geometric and roughness parameters. In particular, differences between backscattered and bistatic pdfs will be explored as a function of the bistatic angle between transmitter and receiver. Attempts to fit the resulting pdf's in terms of standard forms, for example the K distribution, will also be provided. Attempts to develop new pdf functional forms that capture the physics of the "tilted" SSA2 method will also be discussed.