RADAR CROSS SECTION FOR COMPOSITE GAUSSIAN OR PEARSON-MOSKOVITZ TYPE RANDOM ROUGH SURFACES BASED ON THE TWO SCALE UNIFIED FULL WAVE APPROACH

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A composite two scale model of rough surfaces is considered using superpositions of Gaussion or Pearson-Moskovitz type surface height spectral density functions. The full wave backscatter cross sections of the random rough surfaces are expressed as weighted sums of two cross sections. The first, associated with the larger scale component of the rough surface is reduced by a factor related to the smaller surface height characteristic function. The second, associated with the smaller scale component of the rough surface, accounts for slope modulation by the larger scale surface. Unlike the conventional hybrid perturbation/physical optics solutions, the unified full wave approach used here is not restricted by the small scale Releigh parameter $\beta = 4k_o^2 \langle h_s^2 \rangle << 1$, (where $k_0$is the free space wave number and $\langle h_s^2 \rangle$ is the mean square height of the small scale surface) nor are two cross sections added in an ad hoc manner.

The total composite surface height spectral density function is decomposed in a smooth, continuous manner, into larger and smaller scale surface height spectral density functions. Thus the distinction between the smaller and larger scale spectral density function is not characterized by a discrete spacial wave number where spectral splitting is assumed to occur. Furthermore the Pearson-Moskowitz spectral density function is not truncated abruptly in order to make the mean square slope of the larger scale surface finite.

The ratio of the mean square height of the smaller scale surface and the mean square height of the total surface $r = \langle h_s^2 \rangle / \langle h^2 \rangle$ can be varied from zero to unity. Thus, in the limit$r = 0$, the total composite surface is regarded as a large scale surface (associated with the physical optics solution) or in the limit $r = 1$as a small scale surface (associated with the small slope, original full wave solution). In order to ascertain the stationarity of the solutions for the entire range $0 \leq r \leq 1$ of the variational parameter, the norm of the error over the backscatter angles is plotted as a function of the variational parameter r. It is shown that the unified full wave solutions for the polarization dependent scatter cross sections are stationary over a very wide range of the variational parameter $r = \langle h_s^2 \rangle / \langle h^2 \rangle$. For rough soil surfaces over slowly undulating fields for example, the decomposition of the composite rough surface into larger and smaller scale surfaces may not be very difficult to ascertain. However in the general case of scattering from composite rough surface this is not obvious apriori. The examination of stationarity over the variational parameters r in the two-scale full wave solutions, provides a very useful guide in determining the appropriate specutral splitting of composite rough surfaces.

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2. B - Fields and Waves

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4. C - Contributed Paper

5. No special instructions