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Propagation Prediction Over Random Rough Surface By Zeroth Order Induced Current Density

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Abstract
Electromagnetic wave propagation over random sea surfaces is a classical problem of interest for the Navy, and significant research has been done over the years. Here we make use of numerical and analytical methods to predict the propagation of microwaves over random rough surface. The numerical approach involves utilization of the direct solution (using Volterra integral equation of the second kind) to currents induced on a rough surface due to forward propagating waves to compute the scattered field. The mean scattered field is computed using the Monte-Carlo method. Since the exact solution (consisting of an infinite series) to induced current density is computationally intensive, there exists a need to predict the propagation using the closely accurate zeroth order induced current (first term of the series) for time-varying multiple realizations of a random rough surface in a computationally efficient manner. The wind-speed dependent, fully-developed, Piersen-Moskowitz sea spectrum has been considered in order to model a rough sea surface, although other partially-developed roughness spectra may also be utilized. An analytical solution based on the zeroth order current density obtained by deriving the mean scattered field as a function of the range and vertical height by directly using the Parabolic Equation (PE) approximation method and the resulting Green's function has been utilized for a comparative study. The analytical solution takes into account the diffused component of the scattered field.