MULTIPATH RADAR PROPAGATION MODELING: ASSESSMENT OF THE MILLER-BROWN APPROXIMATION

D. E. Freund*, N. E. Woods, H.-C. Ku, and R. S. Awadallah
Johns Hopkins University Applied Physics Laboratory
11100 Johns Hopkins Road
Laurel, MD. 20723

In order to reliably predict over the horizon radar coverage within an ocean environment, one must accurately account for the effects of ocean roughness on radar propagation. The method often referred to as the Miller-Brown approximation is currently one of the most widely used techniques for computing the coherent field reflected by a rough surface and it is often incorporated into sophisticated numerical propagation models such as the Fourier split step algorithm of the parabolic wave equation. Nevertheless, the accuracy and region of validity of the Miller-Brown approximation has never been systematically and rigorously assessed for realistic scenarios of interest to shipboard radars. We present here a first step toward this assessment by using an exact numerical method of moments (MoM) solution to compute the propagation factor, η, for a rough ocean surface and then compare the exact MoM results with the corresponding predictions for η obtained using the Miller-Brown approximation. The particular MoM technique used here combines an accelerated spectral (steepest decent path) method and a multigrid iterative approach and will be referred to simply as the multigrid iterative approach (MGIA).

All calculations were performed at *S* band (f = 3 GHz) using a horizontally polarized line source (cylindrical wave) for the incident field. A Monte-Carlo approach was used for the MGIA calculations in which the ensemble average of the propagation factor is computed for 50 rough sea surface realizations. Specifically, for each of three different wind speeds, 50 1-D realizations of rough sea surfaces were generated using the 1-D Bjerkaas-Riedel surface-wave spectrum. A temperature and salinity-dependent Debye relaxation model was used to assign all surfaces dielectric properties that are in accord with seawater. Comparisons between η_{MGIA} and η_{MB} are presented as a function of elevation angle at fixed ranges of 1km and 5km from the source.