Extension of the SSA+ for Two-dimensional Surfaces

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For a number of years our goal has been to develop bistatic scattering cross section expressions for scattering from randomly-rough surfaces. The catch has been to obtain an expression requiring relatively modest computation but giving reasonably accurate results. We finally succeeded a few years ago for a range of problems. At recent meetings we presented results for our rough surface scattering model which is based on the nonlocal small slope approximation (NLSSA) introduced by A.G. Voronovich. The attraction of the NLSSA is implied by its name—it incorporates nonlocal interactions. The challenge was to approximate the NLSSA in such a way as to retain some of these nonlocal interactions. A number of approximations were made to the original NLSSA expressions resulting in a model we call the SSA+. The SSA+ expression for the cross section is a sum of the lowest-order small slope approximation equation and a term we consider as a correction to the SSA which is used only at low grazing angles of scatter where the effects of small nonlocal surface interactions are important. We have presented results for one-dimensional (1-D) surfaces satisfying the Dirichlet boundary condition [S.L. Broschat, *IEEE Antennas and Propagat. Soc. Int. Symposium*, 2004] and for 1-D dielectric-dielectric interfaces [Y. Wang and S.L. Broschat, *IEEE Antennas and Propagat. Soc. Int. Symposium*, 2005]. The results compared well with Monte Carlo integral equation results.

In this paper, we extend the SSA+ to two-dimensional surfaces for the Dirichlet boundary condition. As for the 1-D surface problem, the SSA+ bistatic scattering cross section can be written as the sum of the lowest-order SSA and a correction term comprised of two integrals. Numerical results for the SSA+ are presented for both a Gaussian roughness spectrum and a modified power law spectrum. These are compared with results obtained using the SSA and the Kirchhoff approximation.