# ABSTRACT

Improved theories of scattering from rough surfaces are of interest in many areas, including the design of remote sensing systems. The small slope approximation (SSA) is a recent theory that bridges the standard optical and perturbation method limits; however studies with this theory for the three-dimensional, penetrable surface scattering case have begun to be reported only recently. The SSA theory takes the form of a series for scattered fields in terms of surface "quasi-slope": the first term has a form similar to that of physical optics, while the second SSA term has a complicated form involving a quadruple integral and the third SSA term (partial fourth order) computation involves a six-fold integral.

In this thesis a computational code is developed to compute the normalized radar cross section from the SSA series for surfaces with Gaussian and exponential correlation functions. A new approach to evaluate the first higher-order SSA term for surfaces with an isotropic Gaussian correlation functions is also presented. In this method, a coordinate shifting technique is used to align near-singular kernel regions with the integration domain, allowing an analytical form to be obtained for SSA kernel Fourier harmonic terms. Results computed by the new method are compared with those computed by the previous approach, in order to demonstrate the obtained improvement in accuracy and efficiency. Furthermore, results from the SSA are compared with those from the Advanced Integral Equation Model (AIEM), the Reduced third-order Local Curvature Approximation (RLCA3), and predictions from numerical simulations based on the Method of Moments for dielectric surfaces and 3-D scattering problems. The surfaces considered are realizations of a Gaussian random process, with either Gaussian or exponential correlation functions. A discussion of the results obtained is provided, along with a summary of the computational issues inherent in each model. Final recommendations for further use of these models in remote sensing applications are also provided.