Effects of antenna radiation pattern on validations of alternative scattering theories for distributed scatterers

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The usual parameter employed in theoretical evaluations of scattering from rough surfaces is a normalized scattering cross section per unit area (" sigma zero") which generally does not correspond to a directly measurable quantity. Actual measurement results, whether in the bistatic or monostatic mode of operation, can be significantly modified by the receiving and transmitting antenna radiation patterns so that the inference of the theoretically computed normalized cross section from measured data is rather indirect. Usually (as, e.g., in estimates of radar clutter) the effects of the antenna radiation pattern are taken into account by an incoherent summation of the amplitudes of the returns over the illuminated area. In cases where the scattering is dominated by coherent effects this approach can lead to significant errors. Using a recently developed formulation of coherent backscattering from distributed targets (Wasyl Wasylkiwskyj "A new formulation for coherent backscattering from distributed targets", 2007 IEEE Antennas and Propagation International Symposium, June 14, 2007) this paper undertakes a comparative evaluation of the monostatic coherent antenna response using several well known approximate models for rough surface scattering: the small amplitude perturbation theory, the small slope approximation, a physical optics model as well as a two sale model. Taking explicit account of antenna characteristics, the receiver response is computed using a coherent surface scattering matrix and the results compared with predictions based on standard incoherent summation approaches. These results suggest several alternative normalizations of the radar cross section that could be of value in a comparative evaluations of alternative rough surface scattering theories.