# DOUBLE SCATTER FROM TWO DIMENSIONAL RANDOM ROUGH SURFACES THAT EXHIBIT ENHANCED BACKSCATTER

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Full wave solutions for the single and double scatter radar cross sections from two dimensional random rough surfaces are obtained. The solutions are given as multi-dimensional integrals. The high frequency approximation is applied to these expressions to reduce the dimensions of the integrals. The incident waves are assumed to be plane waves. The large radius of curvature approximation is assumed in this work. The incident waves are assumed to be plane waves. The high frequency double scatter expressions are given as four dimensional integrals. The single scatter cross section is given in closed form. This work is an extension of the analysis of double scatter from one dimensional random rough surfaces.

The major contributions to the double and single scatter cross sections, in the high frequency limit, come from the neighborhood of the specular points of the rough surface. The heights at any two neighboring points on the two dimensional rough surface are expanded and written as functions of the heights and slopes of the mean point between them. The surface element scattering coefficients are evaluated at the specular points after integrating with respect to the slopes. The probability density functions of the slopes are assumed to be Gaussian. The high frequency approximation is used to reduce the double scatter cross section expressions from twelve to four dimensional integrals.

Similar to scattering from the one dimensional random rough surfaces, the major contributions to the double scatter cross sections come from the quasi parallel and the quasi anti-parallel double scatter paths. The final expressions for the total incoherent cross section is the sum of the single and the double scatter cross sections. Shadow functions are included in the expressions.

The numerical results, using the high frequency approximations, show sharp enhancement in the backscatter direction at normal and at oblique incident angles. This sharp enhancement is due to the contributions associated with the quasi anti-parallel double scatter paths. The level and width of the peak in the backscatter direction depend on the mean square height and slope of the two dimensional random rough surface. The numerical results are compared with experimental results. The results show no significant differences between the vertically and the horizontally polarized scattered waves. The integrand of the four dimensional integral of the double scatter expression is plotted versus the integration variables (the azimuth and elevation angles). These plots shed light to the significant range of the integration variables. Use of high frequency approximations make the computations more tractable. This work is in the preliminary phase for computing the double scatter cross sections of two dimensional random rough surfaces based on the full wave approach.