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ACTIVE AND PASSIVE REMOTE SENSING OF ICE(U)  
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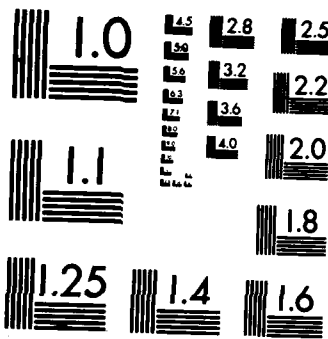
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ACTIVE AND PASSIVE REMOTE SENSING OF ICE

Department of the Navy  
Office of Naval Research  
Contract N00014-83-K-0258

SEMI-ANNUAL REPORT

covering the period

February 1, 1986 - July 31, 1986

prepared by

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July 1986

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corresponding to a covariance matrix with four zero elements. Theoretical predictions are matched with experimental data for vegetation fields.

The study of the strong fluctuation theory for a bounded layer of random discrete scatterers are extended to include high-order co-polarized and cross-polarized second moments. The backscattering cross sections per unit area are calculated by including the mutual coherence of the fields due to the coincidental ray paths and that due to the opposite ray paths which are corresponding to the ladder and cross terms in the Feynman diagrammatic representation. It is proved that the contributions from ladder and cross terms for co-polarized backscattering cross sections are the same, while the contributions for the cross-polarized ones are of the same order. The bistatic scattering coefficients in the second-order approximation for both the ladder and cross terms are also obtained. The enhancement in the backscattering direction can be attributed to the contributions from the cross terms.

We have derived the dyadic Green's function for a two-layer anisotropic medium. The Born approximation is used to calculate the scattered fields. With a specified correlation function for the randomness of the dielectric constant, the backscattering cross sections are evaluated. The analytic expressions for backscattering coefficients are shown to include depolarization effects in the single-scattering approximation. It is also shown that the backscattering cross section (per unit area) of horizontal polarization can be greater than that of vertical polarization even in the case of half-space. The bistatic scattering coefficients are first calculated and then integrated over the upper hemisphere to be subtracted from unity, in order to obtain the emissivity. The principle of reciprocity is then invoked to calculate the brightness temperatures. It is shown that both the absorptive and randomly fluctuating properties of the anisotropic medium affect the behavior of the resulting brightness temperatures both in theory and in actual controlled field measurements. The active and passive results are favorably matched with the experimental data obtained from the first-year and the multiyear sea ice as well as from the corn stalks with detailed ground-truth information.

Electromagnetic wave propagation and scattering in an anisotropic random medium has been examined with Dyson equation for the mean field which is solved by bilocal and nonlinear approximations and with Bethe-Salpeter equation for the correlation of field

was derived and solved by ladder approximation. The effective propagation constants are calculated for the four characteristic waves associated with the coherent vector fields propagating in an anisotropic random medium layer, which are the ordinary and extraordinary waves with upward and downward propagating vectors. The z-component of the effective propagation constant of the upward propagating wave is different from the negative of that of the downward propagating wave, not only for the extraordinary wave but also for the ordinary wave. This is due to the tilting of the optic axis which destroys the azimuthal symmetry.

Since both snow and ice exhibit volume scattering effects, we model the snow-covered ice fields by a three-layer random medium model with an isotropic layer to simulate snow, an anisotropic layer to simulate ice, and the bottom one being ground or water. The snow and ice are characterized by different dielectric constants and correlation functions. The theoretical results are illustrated for thick first-year sea ice covered by dry snow at Point Barrow and for artificial thin first-year sea ice covered by wet snow at CRREL. The radar backscattering cross sections are seen to increase with snow cover for snow-covered sea ice, because snow gives more scattering than ice. The results are also used to interpret experimental data obtained from field measurements.

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