XVI. ELECTROMAGNETIC WAVE THEORY AND REMOTE SENSING

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1. ELECTROMAGNETIC WAVES

Joint Services Electronics Program (Contract DAAG29-78-C-0020)

Jin Au Kong

Electromagnetic waves are studied with applications to microwave remote sensing, geophysical subsurface probing, microstrip antenna problems, and optical beam diffraction by periodic structures. Acoustic waves are also being studied with application to geophysical exploration. Refereed journal articles and conference papers published in the past year are listed in the references. Second-order coupled-mode equations have been used to study the diffraction of optical beams by a periodically modulated layer.[1] The use of acoustic and electromagnetic waves in geophysical exploration has been studied.[2-5] Extensive work has been accomplished on theoretical modeling and data interpretation for active and passive microwave remote sensing.[6-17] Microstrip antenna problems, relating to the study of radiation fields, resonance phenomena, electric capacitance, and input impedance, have been carried out with rigorous analytical approaches.[18-25] Multiple-scattering effects of acoustic and electromagnetic waves by random distribution of discrete scatterers are being studied using coherent potential and quantum-mechanical formalism.[26-27]

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27. L. Tsang and J.A. Kong, "Multiple Scattering of Electromagnetic Waves by Random Distributions of Discrete Scatterers," submitted for publication.

2. REMOTE SENSING WITH ELECTROMAGNETIC WAVES

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Active remote sensing with dipole antennas and line sources has been studied for both monochromatic and pulse excitations.[1-3] Extensive work has been accomplished on theoretical modeling and data interpretation for active and passive microwave remote sensing with radars and radiometers.[4-19] Multiple scattering effects of electromagnetic waves by a random distribution of discrete scatterers are being investigated for application to remote sensing of earth.[20]

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3. ACTIVE AND PASSIVE MICROWAVE REMOTE SENSING

National Aeronautics and Space Administration (Contract NAS5-24139)

Jin Au Kong

In the active and passive microwave remote sensing of low-loss and scattering-dominant areas, the effects of volume scattering are very important in the backscatter and brightness temperature measurements. The scattering effect can be accounted for by considering the scattering to be due to either discrete scattering centers imbedded in a homogeneous medium (discrete-scatterer approach) or by considering inhomogeneities in a medium (random-medium approach). We have used both the discrete-scatterer approach and the random-medium approach with the radiative transfer theory to study the effect of volume scattering.[1-10] We also used the Born approximation to develop theoretical models for the active remote sensing of layered random media.[11-13] The results have been applied to interpret the data obtained from vegetation and snow-ice fields. The radiative transfer theory was justified from a more rigorous wave theoretical approach, and the modified radiative transfer theory which includes the coherent effect is being derived.[14-16] Energy conservation and asymptotic solution for the reflectivity of a very rough surface have been studied.[17-18]

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4. PREDICTION OF BACKSCATTER AND EMISSIVITY OF SNOW AT MILLIMETER WAVELENGTHS

U.S. Air Force — Eglin (Contract F08635-78-C-0115)

Jin Au Kong

In the microwave remote sensing of snow, volume scattering effects play a dominant role in the backscatter and brightness temperature measurements. Radiative transfer theory has been used to develop theoretical models applicable to the active and passive remote sensing of scattering-dominant layered media.[1-9] The Born approximation has been applied to the active remote sensing of layered random media.[10-12] These theoretical results have been used extensively to interpret the data collected from snow fields. The validity of the radiative transfer theory has been justified by a more rigorous wave theoretical approach.[13] Energy conservation for reflectivity and transmissivity at a very rough surface has been investigated.[14]

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5. ACOUSTIC-WAVE PROPAGATION STUDIES

Schlumberger Doll Research Center

Jin Au Kong, Leung Tsang

Asymptotic solutions for the first compressional head wave arrival in a fluid-filled borehole have been investigated.[1] Transient solutions due to line and point sources in a slab medium have been obtained with the double deformation technique.[2-3] Numerical evaluation of the transient acoustic waveform due to a point source in a fluid-filled borehole has also been studied.[4] The study of microstrip disk resonance and capacitance is being rigorously carried out.[5-10] The problems are treated as mixed boundary value problems and are being investigated through various mathematical approaches. The validity of the radiative transfer theory has been justified by a rigorous wave theoretical approach.[11] Multiple scattering effects of acoustic and electromagnetic waves by random distribution of discrete scatterers are being studied using coherent potential and quantum mechanical formalism.[12-13]

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