XVI. ELECTRODYNAMICS OF MEDIA

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1. ELECTROMAGNETIC WAVES

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We have the following objectives in our studies of electromagnetic waves: examination of subsurface probing and communication with a dipole antenna, study of remote sensing of the earth, and investigation of integrated optics and fiber optics as applied to optical communication systems. Papers on research supported in 1977 by the Joint Services Electronics Program which have been published, accepted for publication, submitted for publication, or presented at meetings are listed in references.[1-14] The advantages of using horizontal magnetic dipole antennas were explored in detail for both isotropic- and anisotropic-layered earth.[1] We compared field calculations and experimental results for a horizontal electric dipole submerged in lake water.[2] In remote sensing we studied thermal microwave emission from random media[3-5] and from media containing spherical scatterers.[6-8] Backscattering coefficients for active sensing have also been investigated.[9-10] In applied optics we investigated electro-optical modulators and developed theories for spatially modulated periodic media.[11-14]

References

1. D. Cheng, J. A. Kong, and L. Tsang, "Geophysical Subsurface Probing of a Two-Layered Uniaxial Medium with a Horizontal Magnetic Dipole," IEEE Transactions on Antennas and Propagation, Vol. AP-25, No. 6, pp. 766-769, November 1977.
2. J. A. Kong, L. C. Shen, and L. Tsang, "Field of an Antenna Submerged in a Dissipative Dielectric Medium," IEEE Transactions on Antennas and Propagation, Vol. AP-25, No. 6, pp. 887-889, November 1977.
3. L. Tsang and J. A. Kong, "Thermal Microwave Emission from a Random Inhomogeneous Layer over a Homogeneous Medium Using the Method of Invariant Imbedding," Radio Sci. 12, 185-194 (1977).
4. E. G. Njoku and J. A. Kong, "Theory for Passive Microwave Remote Sensing of Near-Surface Soil Moisture," J. Geophys. Res. 82, 3108-3118 (1977).
5. E. Njoku and J. A. Kong, "Passive Microwave Remote Sensing of Near-Surface Soil Moisture," URSI/USNC Symposium, June 24, 1977.

6. L. Tsang and J. A. Kong, "Theory for Thermal Microwave Emission from a Bounded Medium Containing Spherical Scatterers," J. Appl. Phys. 48, 3593-3599 (1977).

7. L. Tsang, J. A. Kong, E. Njoku, D. H. Staelin, and J. W. Waters, "Theory for Microwave Remote Sensing of Cloud and Rainfall," IEEE Transactions on Antennas and Propagation, Vol. AP-25, No. 5, pp. 650-657, September 1977.

8. J. A. Kong and L. Tsang, "Microwave Thermal Emission from a Bounded Medium Containing Spherical Scatterers," URSI/USNC Symposium, June 24, 1977.

9. L. Tsang and J. A. Kong, "Backscattering from a Half-Space Random Medium with the Radiative Transfer Approach," URSI/USNC Symposium, June 24, 1977.

10. L. Tsang and J. A. Kong, "Radiative Transfer Theory for Active Remote Sensing of Half-Space Random Media," Radio Sci., accepted for publication.

11. J. A. Kong, "Second-Order Coupled Mode Equations for Spatially Periodic Media," J. Opt. Soc. Am. 67, 825-829 (1977).

12. R. S. Chu, J. A. Kong, and T. Tamir, "The Diffraction of Gaussian Beams by Periodic Layers," URSI/USNC Symposium, June 24, 1977.

13. R. S. Chu and J. A. Kong, "Modal Theory of Spatially Periodic Media," IEEE Transactions on Microwave Theory and Techniques, Vol. MTT-25, No. 1, pp. 18-24, January 1977.

14. R. S. Chu, J. A. Kong, and T. Tamir, "The Diffraction of Gaussian Beams by a Layer of Periodic Medium," J. Opt. Soc. Am. 67, 1555-1561 (1977).

2. PASSIVE REMOTE SENSING OF THE EARTH WITH MICROWAVES

California Institute of Technology (Contract 953524)

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In passive remote sensing of the earth we have studied microwave thermal emission from a layered random medium.[1,2] The model of a medium containing spherical scatterers has also been developed.[3,4] These theoretical models have been applied to the solid earth, as well as to clouds and rainfall.[5]

References

1. E. G. Njoku and J. A. Kong, "Theory for Passive Microwave Remote Sensing of Near-Surface Soil Moisture," J. Geophys. Res. 82, 3108-3118 (1977).

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3. L. Tsang and J. A. Kong, "Theory for Thermal Microwave Emission from a Bounded Medium Containing Spherical Scatterers," J. Appl. Phys. 48, 3593-3599 (1977).

4. J. A. Kong and L. Tsang, "Microwave Thermal Emission from a Bounded Medium Containing Spherical Scatterers," URSI/USNC Symposium, June 24, 1977.

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3. REMOTE SENSING WITH ELECTROMAGNETIC WAVES

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Active sensing with dipole antennas has been studied with a horizontal magnetic dipole[1] and with a horizontal electric dipole.[2] Passive remote sensing of near-surface soil moistures and ice-covered land or water by using a model of a layered medium has been investigated.[3-5] The theory for thermal microwave emission from a bounded medium containing spherical scatterers has also been developed.[6,7] With a random medium model, active remote sensing techniques have been investigated.[8,9]

References

1. D. Cheng, J. A. Kong, and L. Tsang, "Geophysical Subsurface Probing of a Two-Layered Uniaxial Medium with a Horizontal Magnetic Dipole," IEEE Transactions on Antennas and Propagation, Vol. AP-25, No. 6, pp. 766-769, November 1977.
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4. E. Njoku and J. A. Kong, "Passive Microwave Remote Sensing of Near-Surface Soil Moisture," URSI/USNC Symposium, June 24, 1977.
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9. L. Tsang and J. A. Kong, "Radiative Transfer Theory for Active Remote Sensing of Half-Space Random Media," Radio Sci., accepted for publication, 1977.

4. ACTIVE AND PASSIVE MICROWAVE REMOTE SENSING

National Aeronautics and Space Administration (Contract NAS5-24139)

Jin Au Kong

With a random medium model, backscattering coefficients for active microwave remote sensing have been studied.[1,2] The spherical scatterer model[3] has been used to

interpret passive remote sensing data with diurnal changes. Rough surface effects are now being integrated into our theoretical models.

References

1. L. Tsang and J. A. Kong, "Backscattering from a Half-Space Random Medium with the Radiative Transfer Approach," URSI/USNC Symposium, June 24, 1977.

2. L. Tsang and J. A. Kong, "Radiative Transfer Theory for Active Remote Sensing of Half-Space Random Media," Radio Sci., accepted for publication, 1977.

3. L. Tsang and J. A. Kong, "Theory for Thermal Microwave Emission from a Bounded Medium Containing Spherical Scatterers," J. Appl. Phys. 48, 3593-3599 (1977).