Abstracts

Rigorous coupled-wave-theory analysis of dipole scattering from a three-dimensional, inhomogeneous, spherical dielectric, and permeable system

J.M. Jarem. "Rigorous coupled-wave-theory analysis of dipole scattering from a three-dimensional, inhomogeneous, spherical dielectric, and permeable system." 1997 Transactions on Microwave Theory and Techniques 45.8 (Aug. 1997, Part I [T-MTT]): 1193-1203.

This paper presents a rigorous coupled-wave-theory analysis (RCWT) of the electromagnetic (EM) radiation, which occurs when a centered electric dipole excites power and energy in a general three-dimensional (3-D) inhomogeneous spherical system. The formulation of this paper consists of a multilayer state-variable (SV) analysis of Maxwell's equations in spherical coordinates (the SV analysis used transverse-to-/spl gamma/ spherical EM field components), as well as a presentation of the EM fields which exist in the interior and exterior regions (which bound the inhomogeneous spherical system). A detailed description of the matrix processing which is involved with finding the final EM fields of the overall system is given. Three numerical examples of the RCWT method are studied. The first example presents EM scattering when a centered dipole radiates through a uniform material shell. In this example, numerical results of the RCWT algorithm are compared with numerical results as obtained by a Bessel-function matching algorithm, and excellent agreement was found between the two methods. The second example presents centered dipole radiation when the spherical system is a dielectric shell, which is inhomogeneous in the (/spl theta/, /spl rho/) directions, and the third example presents centered dipole radiation when the spherical system is inhomogeneous in the (/spl gamma/,/spl theta/,/spl rho/) directions. Several examples and plots of the power diffracted into higher order modes by the inhomogeneity profiles are given. As the thickness of the inhomogeneous dielectric shell is increased, it is observed that, through diffraction, power is increasingly depleted from lower order modes into higher modes, The depletion of power from lower to higher order spherical modes with increasing shell thickness is noted to be very similar to the variation of diffraction-order power efficiency, which is observed when the layer thickness of a planar transmission diffraction grating is increased.

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