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Calculations of Light Field Distributions Within and Beyond Wavelength-Scale Apertures GLEN GILLEN, Air Force Research Lab, Materials and Manufacturing Directorate, Anteon Corp., SHEKHAR GUHA, Air Force Research Lab, Materials and Manufacturing Directorate — We describe a computationally efficient method for calculation of electromagnetic fields within and beyond a diffracting aperture using Hertz vector diffraction theory. Commonly used diffraction models (Fresnel, Kirchhoff, Rayleigh-Sommerfeld, paraxial approximations) typically diverge or fail to accurately represent physical electromagnetic fields for points of interest in or near the aperture plane. These models also neglect to include the perturbation of the light field due to the aperture itself. Calculations using Hertz vector diffraction theory include the perturbation effects of the aperture, and the resulting fields satisfy Maxwell's equations for all space for aperture size larger than approximately half the wavelength of light. Calculated light field distributions using this method agree with experimental measurements previously conducted by the microwave community. By using line integral methods around the rim of the aperture instead of a two-dimensional integration over the aperture area, the computational times can be reduced by a factor of approximately 15 to 20. We will present basic equations for calculations using this method as well as two-dimensional beam profiles for diffraction of light by circular, elliptical, rectangular, and square apertures. Results will include the dependence of the beam distribution upon the incident laser polarization.

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