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Extended Physical Optics Approximation for Electromagnetic Wave Scattering from Penetrable Objects

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High frequency electromagnetic wave scattering from penetrable objects has been one of the challenging analytical topics. While many analytical methods have been proposed for applying non-penetrable cases[1], the applicability to penetrable objects is not clear and more works have to be done for the evaluation. In this paper, a physical optics (PO) type of approximation has been tested for high frequency diffraction by penetrable objects.

PO method is rather classical and simple, but a powerful tool for analyzing high frequency electromagnetic wave scattering and radiation problems[2, 3]. While the exact definition of PO is not clear, the scattering field is often given by a radiation integral from the secondary source which is approximated by a primary field on the surface of the scattering body [4].

In the previous investigations for the electromagnetic wave scattering by conducting objects [5, 6, 7], the scattering field is formulated through a field equivalent theorem from equivalent electric and magnetic currents on the conducting surface. When the equivalent sources are approximated from the geometrical optics (GO) reflected field for the illuminated side and the negative incident field for the shadowed side, the resulting radiation field is found to be the same one obtained from the conventional PO method which is calculated by twice of the incident magnetic field.

Our formulation is now extended for the scattering calculation from penetrable bodies, which may have a comparable approximation accuracy with those for non-penetrable bodies. Numerical results for the diffraction by lossless and lossy dielectric wedges will be given and compared with other methods to show the validity.

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