Conditions For Exact Geometrical Optics Scattering By Penetrable Wedge Structures

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The scattering of a plane electromagnetic wave by structures containing wedge regions made of penetrable materials is considered. The purpose of this study is to develop some general rules that, if satisfied, may permit the determination of an exact solution to the scattering problem solely by means of geometrical optics.

The investigation is limited to the two-dimensional case in which all edges of the wedge regions are parallel to one another and the primary wave is incident perpendicularly to the edges. The exact solution for incidence oblique to the edges can be derived from the normal incidence case only if the structure contains only PEC, PMC and isorefractive materials (see e.g. Bowman, Senior and Uslenghi, Electromagnetic and Acoustic Scattering by Simple Shapes, 1969,1987 for PEC; Uslenghi, URSI Intl. Symp. on Electromagnetic Theory pp. 432-433, Thessaloniki, Greece, 1998 for isorefractive cylinders of arbitrary cross-section).

It is well known that even the simple problem of scattering by a dielectric wedge poses serious difficulties requiring the use of function-theoretic methods and, in fact, has not yet been solved in a satisfactory manner. However, this author has been able to obtain exact, geometrical optics solutions for several wedge structures made of different materials, under one or more restrictions on the geometry of the scattering structure, the direction and/or polarization of the incident field, the incidence by more than one plane wave, and the nature of the materials involved (such as isorefractive, isoimpedance, or DNG media). The present work explores the common features for these exact geometrical optics solutions, and proposes some general rules for the discovery of additional exact solutions.