Exact Geometrical Optics Scattering by a Right-Angle Metallic Wedge Illuminated by Three Plane Waves

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There exist a few known two-dimensional structures consisting of multiple penetrable and/or metallic wedges for which a solution to the scattering problem under single or multiple plane wave incidence is available (P.L.E. Uslenghi, *IEEE Trans. Antennas Propag.*, vol. 44, p. 129, Jan. 1996; P.L.E. Uslenghi, *IEEE Trans. Antennas Propag.*, vol. 45, p. 179, Jan. 1997; P.L.E. Uslenghi, *IEEE Trans. Antennas Propat.*, vol. 48, pp. 335-336, Feb. 2000; P.L.E. Uslenghi, *IEEE Antennas Wireless Propag. Lett.*, vol. 3, pp. 94-95, 2004; P.L.E. Uslenghi, *IEEE Antennas Wireless Propag. Lett.*, vol. 3, pp. 127-128, 2004). The only single wedge for which geometrical optics provides the exact solution under plane wave incidence is a right-angle wedge made of DNG metamaterial (P.L.E. Uslenghi, *IEEE Trans. Antennas Propag.*, vol. 54, pp. 2301-2304, Aug. 2006).

In this work, a right-angle perfectly conducting (PEC) wedge is considered. With reference to rectangular coordinates (x, y, z), the edge of the wedge coincides with the z-axis and in any plane z = constant the wedge occupies the third quadrant ($x \leq 0$; $y \leq 0$). Three plane waves are incident perpendicularly to the edge of the wedge from the first, second and fourth quadrants, respectively. The amplitudes, phases and directions of incidence of the three waves are chosen so that the total field (which consists of incident plus – were applicable – reflected contributions) satisfies the boundary conditions on the faces of the metallic wedge and is continuous across the optical boundaries. This closed-form, exact geometrical optics solution is derived for both E and H polarizations. In order to obtain an exact geometrical optics solution, it is necessary that the incident plane waves and their reflections on the metallic faces of the wedge combine in such a way that the total electric field at the edge of the wedge is zero, thus ensuring that the edge does not scatter.

The obtained solution is extended to oblique incidence on the edge of a right-angle wedge that is truncated perpendicularly to its edge by a metallic plane, utilizing a known general method (P.L.E. Uslenghi, *IEEE Trans. Antennas Propag.*, vol. 63, no. 5, pp. 2228-2236, May 2015).