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Diffraction of a Complex-Source Beam by a PEC Wedge: Energy Flows of Exact and Asymptotic Solutions

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The scattering of a Uniform Complex-Source Beam (UCSB) [1] from a perfectly electric conducting (PEC) wedge has been presented in [2] by resorting to a ray picture of the diffraction phenomenon. The asymptotic solution has been derived in the framework of the Uniform Geometrical Theory of Diffraction (UTD) [3]. Moreover, the accuracy of the proposed extended UTD solution has been verified through extensive comparisons with data obtained by a rigorous multipole expansion of the field.

The problem analyzed in [2] is revisited here, with specific attention to the analysis of the energy distribution around the edge of the wedge. In particular, it is investigated how the energy conveyed by the incident UCSB to the wedge interacts with this latter and flows in the free-space surrounding the edge (see Fig. 1). Again, data obtained by a rigorous method, namely the multipole analysis, are compared with those provided by the UTD description of the UCSB diffraction. Of particular interest is the analysis of energy flow in the neighborhood of the shadow boundaries of both the incident and the reflected fields, as identified by the reference ray technique.

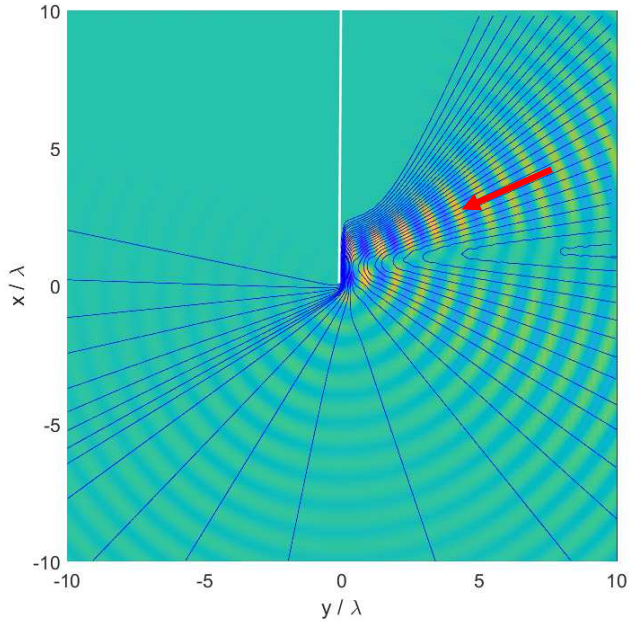

Figure 1. Stream lines of the real part of the complex Poynting vector $\frac{1}{2}\vec{E}\times\vec{H}^*$ and color-coded electric field for a UCSB incident on a PEC half plane (TM_z case; exact multipole solution; Waist at $R=2\lambda, \varphi_R=45°$; Rayleigh length $b=2\lambda; \varphi_b=-20°$).

[1] L. Klinkenbusch and H. Brüns, "Scattering and diffraction of scalar and electromagnetic waves using spherical multipole analysis and uniform complex-source beams," in: K. Kobayashi and P.D. Smith (ets.), "Advances in Mathematical Methods for Electromagnetics," Scitech Publishing (IET Book), 2020.

[2] S. Terranova, G. Manara, and L. Klinkenbusch, "A Physical Insight into Complex-Source Beam Diffraction by a Wedge," Proc. 2nd URSI Atlantic Radio Science Conference (AT-RASC), Gran Canaria (Spain) May 28 - June 1, 2018.

[3] R. G. Kouyoumjian and P. H. Pathak, "A uniform geometrical theory of diffraction for an edge in a perfectly conducting surface," Proceedings of the IEEE, Vol. 62, 1974, no. 11, 1448‑1461.