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Uniform Complex-Source Beam Diffraction by a PEC Wedge Surrounded by a Lossy Medium

Ludger Klinkenbusch(1), Giuliano Manara* (2), and Andrea Michel(2)
(1) Kiel University, Kiel, Germany; e-mail: klinkenbusch@tf.uni-kiel.de
(2) University of Pisa, Pisa, Italy, e-mail: giuliano.manara@unipi.it ; andrea.michel@unipi.it

The scattering of a Uniform Complex-Source Beam (UCSB) [1] from a perfectly electric conducting (PEC) wedge was presented in [2] by resorting to a ray analysis of the diffraction phenomenon. The solution was derived as an extension of the Uniform Geometrical Theory of Diffraction (UTD) [3]. There, the wedge was surrounded by free space. In particular, the accuracy of the extended UTD solution was validated through extensive comparisons with data obtained by a rigorous multipole expansion of the field.

The solution proposed in [2] is generalized here to analyze the case in which the PEC wedge is surrounded by a lossy medium. Specifically, it is worth observing that a UTD solution for the diffraction by a PEC wedge embedded in a lossy medium was presented in [4] for the case of inhomogeneous plane wave illumination. It is also important to note that when the medium surrounding the wedge is lossy, the wave number of the medium becomes complex. Consequently, also the wave vector associated with evanescent waves results to be complex. In this case it indeed consists of a real and an imaginary part which are no more orthogonal to each other. In particular, the real part of the wave vector is perpendicular to surfaces of equal phase, and it points in the direction of the maximum variation of the phase. On the other hand, the imaginary part of the wave-vector is perpendicular to surfaces of equal amplitude, and points in the direction of the maximum decrease of the amplitude.

Attention is also focused on 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 the latter, where it flows and how it is dissipated in the lossy medium surrounding the edge. Again, reference data obtained by a rigorous technique, namely the multipole expansion method, are compared with those provided by the UTD description of the UCSB diffraction. Of remarkable interest is the analysis of the energy flow in the neighborhood of the edge and across the shadow boundaries of both the incident and the reflected fields, as identified by the proposed ray technique.

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[2] L. Klinkenbusch and G. Manara, "Diffraction of a Complex-Source Beam by a PEC Wedge: Energy Flows of Exact and Asymptotic Solutions," Proc. 3rd URSI Atlantic/Asia Pacific Radio Science Conference (AT-AP RASC), Gran Canaria (Spain), May 29 - June 3, 2022.

[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, No. 11, pp. 1448-1461, 1974.

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