Effects of a Rapidly Varying Incident Field on the Diffraction from a PEC Wegde

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The analysis of diffraction of fields exhibiting a rapid spatial variation on the plane perpendicular to the direction of propagation has received much attention in the past years, as shown by the open literature. For instance, in the framework of ray techniques such as the Uniform Geometrical Theory of Diffraction (UTD), suitable slope diffraction coefficients have been proposed [1] – [3].

An extension of the Uniform Geometrical Theory of Diffraction (UTD) has been more recently proposed to analyze evanescent fields diffraction by a perfectly electrically conducting (PEC) wedge. More specifically, both the cases of inhomogeneous plane wave and Complex Source Beam (CSB) illumination have been investigated [4, 5], showing a very good agreement with the corresponding reference solutions. It has been shown that these uniform high-frequency solutions can be obtained by resorting to a standard UTD procedure for the asymptotic evaluation of the diffracted field. In particular, suitable and compact expressions for the diffracted contributions can be obtained by applying a uniform asymptotic evaluation of the diffraction integral by following the Pauli-Clemmow method [6, 7], and retaining all terms of order $K^{-1/2}$ in the asymptotic evaluation. A specific and accurate analysis must be performed to obtain uniform asymptotic expressions when the poles, accounting for the incident and reflected fields, cross the Steepest Descent Path (SDP) away from the saddle points.

The compact expressions obtained from the previously described procedure are analyzed in detail in this paper to highlight their relation to the slope diffraction coefficients previously proposed in the open literature. To the end of demonstrating the effectiveness of the mathematical analysis performed, several examples will be presented and compared with the corresponding reference solutions.

References

[1] R. G. Kouyoumjian, "The Geometrical Theory of Diffraction and Its Application," in *Numerical and Asymptotic Techniques in Electromagnetics*, ed. by R. Mittra, New York: Springer Verlag, 1975.
[2] R. G. Kouyoumjian, P. H. Pathak, and . D. Burnside, "A Uniform GTD for the Diffraction by Edges, Vertices, and Convex Surfaces," in *Theoretical Methods for Determining the Interaction of Electromagnetic Waves with Structures*, ed. by J. K. Skwirzynski, Amsterdam, The Netherlands,: Sijthoff and Noordhoff, 1981.
[3] P. H. Pathak, "Techniques for High-Frequency Problems," in *Antenna Handbook*, ed. by Y. T. Lo and S. W. Lee, New York: Springer Science+Business Media, 1988.
[4] R.G. Kouyoumjian, G. Manara, P. Nepa, and B.J.E. Taute, "The diffraction of an inhomogeneous plane wave by a wedge," *Radio Science*, vol. 31, Nov./Dec. 1996, pp. 1387-1397.
[5] G. Manara, and L. Klinkenbusch, "Extension of the UTD to the Diffraction of Complex-Source Beams," *XXII International Union of Radio Science & Scientific Symposium (GASS)*, Montreal, Canada, 19-26, 2017.
[6] P. C. Clemmow, "Some extension to the method of integration by steepest descents," *Quart. J. Mech Appl. Math*., Vol. 3, pp. 241 – 256, 1950.
[7] P. C. Clemmow, *The Plane Wave Spectrum Representation of Electromagnetic Fields*, New York, Pergamon, 1966, pp. 56 – 58.