3D Electromagnetic Scattering of a Complex-Source Beam by a PEC Wedge

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An extension of the Uniform Geometrical Theory of Diffraction (UTD) is proposed to analyze three-dimensional electromagnetic Complex-Source Beam (CSB) diffraction by a perfectly electrically conducting (PEC) wedge. The corresponding two-dimensional case has been already analyzed by the same authors in [1]. Again, the solution is derived in the framework of high-frequency ray methods and is written in terms of incident, reflected and diffracted contributions, so that it can be directly applied to calculate the scattering from more complex geometries with edges. It is worth noting that the three-dimensional electromagnetic scattering from a PEC wedge illuminated by evanescent waves has been already analyzed in [2], when the incident field is associated with an inhomogeneous plane wave.

The proposed UTD solution is obtained by introducing higher-order terms in the asymptotic evaluation of the diffracted field. This also guarantees an improved accuracy when the observation point lies close to the diffracting edge. In particular, the accuracy of the solution is demonstrated through extensive comparisons with a rigorous solution obtained by a multipole expansion of the scattered field. In this regard, a new rigorous solution has been recently presented for 3D scattering by a wedge illuminated by a uniform CSB, which consists of both a diverging and converging part and which is analytic everywhere [3].

A simple UTD type solution can be obtained by a direct analytic continuation of the corresponding UTD formulation for sources in real space [4], by allowing angles and distances to assume complex values. It is observed that the proper discontinuities in the diffracted field are provided by the standard UTD transition functions, when they are extended to complex arguments. These discontinuities exactly compensate for those exhibited by the incident and reflected field, when crossing the incident and reflection shadow boundary, respectively. Relevant issues in the proposed solution consist in the interpretation of the involved physical phenomena in real space. These latter aspects constitute important objectives of the paper.

References

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