Incremental Fringe Formulation for Complex Point Sources Diffraction by Edges in Planar Metallic Objects

Stefano M. Canta[(1)]*, Danilo Erricolo[(1)] and Alberto Toccafondi[(2)]

(1) Department of Electrical and Computer Engineering
University of Illinois at Chicago
851 South Morgan Street, Chicago, Illinois 60607, USA

(2) Department of Information Engineering
University of Siena
Via Roma, 56, 53100, Siena, Italy

cantastefano@gmail.com, erricolo@ece.uic.edu, albertot@dii.unisi.it

It is well known that the Complex Point Sources (CPS) representation of a field is more general and may model common spherical point sources as well as Gaussian Beams (Heyman, E. and Felsen, L. B, "Gaussian beam and pulsed-beam dynamics: complex-source and complex-spectrum formulations within and beyond paraxial asymptotics", *J. Opt. Soc. Am. A*, Vol. 18, No. 7, July 2001). Moreover, when adequately combined in arrays, CPS also provide an efficient representation of the field radiated by any kind of apertures, such as horn or parabolic reflectors. Recently, an extension of the Incremental Theory of Diffraction (ITD) formulation for the scattering by wedges illuminated by CPS has been introduced (Polemi, A., Carluccio, G., Albani, M., Toccafondi, A., and Maci, S., "Incremental theory of diffraction for complex point source illumination", *Radio Science*, 42:RS6S23 1-13, 2007). This formulation may provide an effective tool to accurately model the diffraction by complex structures, when illuminated by a CPS. However, in some practical antenna design cases it is useful to resort to a Physical Optics description of the field radiated by apertures or reflectors also when they are illuminated by CPS. In order to augment the accuracy of the PO radiated field predictions, an incremental fringe formulation of the field diffracted by edges in planar perfect electric conductor (PEC) objects when illuminated by Complex Point Sources (CPS) is presented in this paper. The formulation is obtained by first identifying spurious incremental end-point contributions that arise at the truncation of the CPS-PO induced currents over a canonical lit surface (Michaeli, A., "Elimination of Infinities in Equivalent Edge Currents-I : Fringe Current Components", *IEEE Transactions on Antennas and Propagation*, AP-34, July 1986). Subsequently, the contributions due to the PO endpoints are subtracted from the ITD field contributions (Polemi *et al.*, *Radio Science*, 2007) in order to obtain the incremental fringe coefficients. The determination of the incremental fringe coefficients for Complex Points Sources is carried out by analytical continuation of the relevant geometrical quantities that appear in the formulation for real sources. Finally, the fringe field to be added to the PO representation is obtained by adiabatically distributing and integrating the incremental fringe contributions along the edge discontinuities of the actual surfaces. It is found that this formulation produces a more accurate prediction of the field due to apertures or reflectors in presence of CPS illumination, for which PO is commonly and extensively used. Theoretical and numerical results will be shown during the oral presentation.