Electreomagnetic Scattering by a Truncated Concave Parabolic Cylinder

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The metallic structure under consideration consists of concave metallic parabolic cylinder truncated by a metal plane in a direction perpendicular to the focal axis of the cylinder. The primary field is a plane electromagnetic wave propagating in a direction parallel to the symmetry plane of the parabolic cylinder with an arbitrary polarization and at an oblique angle with respect to the focal axis of the cylinder. The analysis is conducted in the phasor domain.

The method of solution is a specific application of a general technique (P.L.E. Uslenghi, IEEE Trans. Antennas Propag., vol. 63, no. 5, pp. 2228-2236, May 2015). The technique consists in extending to oblique incidence the known solution of the two-dimensional problem for incidence normal to the focal axis of the parabolic cylinder (P.L.E. Uslenghi, IEEE Antennas Wireless Propag. Lett., vol. 11, pp. 419-422, 2011). The two-dimensional solution consists of a linear combination of a plane wave and of the product of a plane wave times a Fresnel integral. The analysis is conducted separately for E- and H-polarization of the incident plane wave (the general result for arbitrary polarization is easily obtained by superposition).

Particular attention is paid to the surface current densities on the concave parabolic cylinder and on the truncating plane, and on their behavior at the intersection of the parabolic cylinder surface with the truncating metal plane.

It should be noted that this boundary-value problem could be formulated also in terms of an infinite series of parabolic-cylinder functions, leading of course to the same final results. However, the formulation presented herein in terms of plane waves and Fresnel integrals is much more compact and more easily evaluated numerically. The solution obtained in this work is a new canonical solution of an electromagnetic boundary-value problem, and may also be of use in the validation of computer solvers.