

Exact Scattering by Metal Cylinders Truncated by a Metal Plane

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The behavior of electromagnetic fields near the junctions of metallic structures is important in a variety of applications, from computers to indoor propagation to ground vehicles, ships, airplanes and satellites. In this work, such behavior is analyzed for several metallic cylinders that are truncated by a metal plane oriented perpendicularly to the cylinders' generators. Exact solutions are obtained by separation of variables for plane-wave incidence on circular, elliptic and parabolic cylinders, wedges, half-planes, and strips. Particular attention is paid to the surface current densities on the cylinders and on the truncating plane. The analysis is performed in the frequency domain with a time-dependence factor $\exp(+j\omega t)$ that is omitted throughout.

The procedure for solving the boundary-value problems consists of three steps. First, the field generated by a plane wave of either polarization that is incident perpendicularly to the cylinder generators is determined when the cylinder is of infinite length (two-dimensional problem). Second, the field generated when the primary plane wave is obliquely incident on the infinite cylinder is obtained from the two-dimensional solution of step one by following a well-known method (see chapter 1 in: J.J. Bowman, T.B.A. Senior and P.L.E. Uslenghi, *Electromagnetic and Acoustic Scattering by Simple Shapes*. Amsterdam: North-Holland Publishing Co., 1969. Reprinted by Hemisphere Publishing Corp., New York, 1987). Third, the field reflected by the truncating metal plane is added to the field of step two to produce the solution of the problem.

The method utilized herein may be extended to cases when the two-dimensional solution is only approximately known, thereby generating an approximate solution to the problem at hand. The extension may be valid for low-frequency solutions that are expressed as convergent series, but usually not for high-frequency solutions that are expressed as asymptotic series. Finally, the method can be extended to penetrable cylinders only if TE and TM fields remain decoupled under oblique incidence, as is the case for isorefractive cylinders.