Asymptotic Near-to-Far-Zone Transformation for Conformal Antennas Embedded in an Elliptic Cylinder

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Conformal antennas are important to the aerospace community because of their low cost, aerodynamic characteristics and their versatility for electronic scanning implementation. Numerical methods such as the Finite Element-Boundary Integral (FE-BI) method and a combination of the Finite Difference Time Domain (FD-TD) and the Method of Moments (MoM) have been used to obtain estimations of radiation and scattering performance of microwave antennas on planar, circular, elliptical and prolate spheroid surfaces. Typically, these methods have used an infinite structure (e.g. cylinder) approximation, or used reciprocity to accomplish the near-to-far-zone transformation, or ignored the need for such a transformation all-together. In cases where a Green's function–that enforced cylinder boundary conditions–was used, calculations of the far-zone field in the paraxial region were inaccurate. Several authors (particularly from The Ohio State University) have been working in obtaining integral solutions that overcome the problems in the paraxial and shadow zone using GTD and UTD techniques.

In this present paper, the asymptotic dyadic Green's function will be used to truncate the finite element mesh. The near-zone fields, specifically across the aperture of an embedded antenna within an elliptic cylinder, will be used to find the far-zone fields. A different asymptotic approximation for the Green's function will be used to accomplish the near-to-far-zone transformation. This method is valid for cylinders having a rather large radius of curvature and so results will be compared with planar results. The near-to-far-zone transformation for planar apertures does not require the same asymptotic approximation as does the curved case.