A Dyadic Green's Function Representation of Fields Near A Convex Impedance Surface

Paul E. Hussar and Edward M. Smith-Rowland
Alion Science and Technology
185 Admiral Cochrane Drive
Annapolis, MD 21401
Phussar@alionscience.com: 410-573-7703; fax – 410-573-7634
Esmith-rowland@alionscience.com 410-573-7227; fax – 410-573-7634

ABSTRACT

Asymptotic methods have been widely used to evaluate inter-antenna electromagnetic compatibility (EMC) between aircraft-mounted antennas in cases where the aircraft exterior surfaces can be considered to exhibit perfect conductivity. In other cases, the asymptotic methods have proven less attractive owing, to a significant degree, to the unavailability of a Green's function suitable for representing creeping-ray fields on or near surfaces which are not perfect conductors. Such a Green's function is supplied here for the case of a simple impedance boundary condition..

Recently, an approximate asymptotic solution for the fields in the boundary layer of a smooth convex impedance surface was obtained (P.. E. Hussar and E. M. Smith-Rowland, *J. Electro. Waves and Appl.,* 16, pp. 185-208, 2002) by applying a substitution process to a canonical solution for fields in the vicinity of an impedance circular cylinder excited by an axial surface magnetic dipole. This new solution subscribes to the familiar creeping-ray modal format for fields in the far shadow region of a smooth convex surface, and avoids the restriction on surface-impedance values encountered in the earlier solution of Bouche (D. Bouche, *Ann. Telecomm.*, 47, 400-412, 1992). It is important to note, however, that the new solution consists merely of a set of **E** and **H** components that satisfy the Maxwell Equations to order $k^{-2/3}$, and is not associated with any particular source excitation. Here it is shown that the substitution method can be extended to provide a solution that both satisfies the Maxwell Equations to order $k^{-2/3}$ and corresponds to an excitation by an infinitesimal surface magnetic dipole of arbitrarily specified orientation. First, an additional set of field components (**E**,**H**) that satisfy the Maxwell Equations to order $k^{-2/3}$ are obtained by applying the substitution process to a canonical solution for fields in the vicinity of an impedance circular cylinder excited by an azimuthal surface magnetic dipole. Construction of the new set (**E**,**H**) is facilitated by the observation of a close relationship between the solution for azimuthal-source excitation and the solution for axial-source excitation under duality transformation. It is then demonstrated that the two convex-surface solutions, derived, respectively, from axial-source and azimuthal-source cylinder-canonical solutions, can be combined into a coordinate-free expression representing the boundary-layer fields excited in the vicinity of a convex impedance surface by an infinitesimal directed source of arbitrarily specified orientation. The coordinate-tree expression is shown to give the correct result under reduction to cylindrical surface geometry.

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