Extracting UTD Wedge Diffraction Coefficients from Electric Field Measurements

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The geometrical theory of diffraction (GTD) provides a powerful and computationally efficient framework for investigating real-world diffraction problems. Originally restricted to perfectly electrically conducting (PEC) wedges, the GTD and its uniform offspring have since been extended to wedges characterized by impedance surfaces (R. Tiberio *et al.*, IEEE Trans. AP, 37, 2, 212-218, 1989). Though the impedance wedge solution provides a sound theoretical model for describing the field diffracted by numerous real-world edges, the impedance wedge solution is only applicable in cases where the material properties of the diffracting edge are known. Generally speaking, the data on the frequency-dependent permittivity and conductivity is extremely limited. More so, use of these values assumes that the diffracting body may be modeled as a smooth, solid, homogeneous wedge. The composition and internal geometry of the actual diffracting body as well as its external roughness may significantly alter how the edge diffracts any incident fields.

To circumvent the challenges of a purely analytical approach, we investigate the feasibility of developing *semi-empirical* diffraction coefficients using measurements of the total field in the vicinity of the diffracting edge. Careful examination of the impedance wedge's uniform geometrical theory of diffraction (UTD) coefficient leads to a set of spatial basis functions for approximating the total field observed due to diffraction by an arbitrary wedge. In the simplest case, this basis set has just three terms: the total field solution for the corresponding PEC wedge, a correction term for the diffracted field near incident shadow boundary, and a final correction term that modifies both the reflected field and the diffracted field along the reflection shadow boundary. By fitting these basis functions to total field diffraction measurements, it is possible to accurately characterize the edge's diffraction coefficient using the latter two basis functions and a corresponing pair of normalized coefficients. The result is a simple yet accurate semi-empirical diffraction coefficient for the measured diffracting edge.

The presentation will demonstrate by example the procedure for extracting semi-empirical diffraction coefficients from measurements of the total field near a diffracting edge. Numerically derived field data obtained from a finite-difference time-domain (FDTD) simulation of radiation in the presence of a dielectric wedge is used as measurement data for extracting the wedge's semi-empirical diffraction coefficient. The resulting diffraction coefficient and its corresponding UTD total field solution are then compared to the FDTD solution both within and outside of the simulated measurement region. Furthermore, the challenges of extracting diffraction coefficients from actual measurement data will be discussed including the technique's sensitivity to field and position errors. Finally, preliminary results for the semi-empirical diffraction coefficient corresponding to an exterior, brick building corner will be presented.