Singular Higher Order Models of Surface Integral Problems

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This paper considers the problem of electromagnetic scattering by arbitrarily shaped objects with sharp edges. To effectively solve surface integral equations via the Method of Moments (MoM) one must use higher order models for both the geometry and the equivalent surface currents. Since higher order regular vector bases generally perform poorly near the edge of a wedge, in the edge regions we employ higher-order singular divergence-conforming bases directly defined in the parent space of curved triangular and quadrilateral elements. The figure illustrates the improved modeling of the longitudinal current distribution near the edges of a square metal cylinder with sides of electrical length $ka = 1$ for TM plane wave illumination. The method used to construct such bases is simple and general, and can be used for any order (R.D. Graglia and G. Lombardi, IEEE **TAP**–52, 2004, to appear). These bases incorporate the edge condition and are able to approximate the unknown surface current in the neighborhood of the edge of a wedge for any order of the singularity coefficient ν that is supposed given and known *a priori*. For metal wedges of aperture angle α, one has $\nu = (2\pi - \alpha)$. Our divergence conforming singular functions are compatible with standard p-th order vector functions in adjacent elements (R.D. Graglia *et al.*, IEEE **TAP**–45, 329–342, 1997), and guarantee normal continuity along the edges of the elements allowing for the discontinuity of tangential components, adequate modeling of the divergence, and removal of spurious solutions. Evaluation of the MoM matrix elements when both the Green's function and the basis function are singular is effectively performed by using a new integration technique (D.R. Wilton and M. A. Khayat, URSI EM Theory Int. Symp., Pisa, Italy, 2004). Several results for the scattering by circular and square plates will be presented and discussed.