High Order Impedance Boundary Condition for MoM Scattering

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Impedance boundary condition (IBC) are widely used in computational electromagnetics to model thin coatings on perfectly conducting (PEC) objects. The IBC is used to reduce drastically the number of unknowns in method of moments models and to obtain a better conditioned linear system that can be more efficiently iteratively solved.

Usually, the impedance of the coating is assumed to be the same for all incidence angles and polarizations (standard IBC). This assumption is valid for coatings with high refractive index or significant losses. For coatings with smaller refractive index or lower losses, the accuracy of the IBC can be greatly improved by approximating the impedance as a ratio of polynomials ([1] D.J. Hoppe, Y. Rahmat-Samii, Taylor and Francis, 1995). This results in a high order IBC involving partial derivative of the tangent electric field and of the electric current:

$$\mathbf{E_t} + b_1 \nabla_\Gamma div \mathbf{E_t} - b_2 \mathbf{rot}_\Gamma rot_\Gamma \mathbf{E_t} = a_0 \mathbf{J} + a_1 \nabla_\Gamma div \mathbf{J} - a_2 \mathbf{rot}_\Gamma rot_\Gamma \mathbf{J}$$

In [1], the high order IBC is discretized with spline basis functions. Here, the currents $\mathbf{J}$ and $\mathbf{M} = \mathbf{E} \times \mathbf{n}$ are discretized with the lower order HDiv functions that can be used to model objects both smooth or with sharp edges. The discretization of high order IBC with low order HDiv basis functions is not straightforward (B. Stupfel, IEEE Trans. on Ant. and Prop., Vol. 53, No. 11, 2005).

Validations will be presented that show the increased accuracy of high order IBC over standard IBC while the computational effort remains similar.

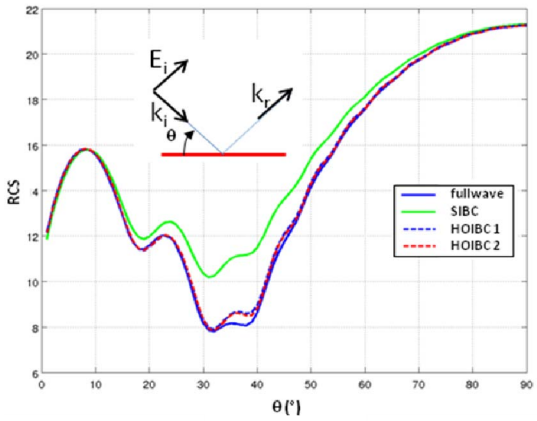

Fig. 1: Bistatic RCS of a coated plate, vertical polarization.

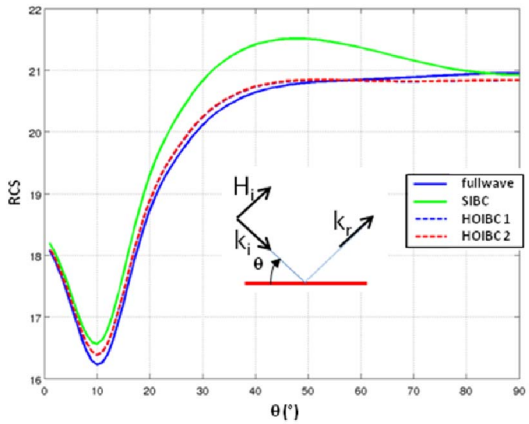

Fig. 2: Bistatic RCS of a coated plate, horizontal polarization.