Advantages of rectangular and uniform-triangular discretization on the scattering analysis of very small sharp-edged objects with the Magnetic Field Integral Equation

Eduard Ubeda* (1) and Juan M. Rius (1)
(1) Universitat Politècnica de Catalunya (UPC), Dept. of Signal Theory and Communications (TSC), Barcelona, Spain

Although the Magnetic field Integral Equation shows a very stable condition number as the frequency decreases, all the triangular Magnetic Field formulations in Method of Moments adopting triangular-facetted meshings with low-order basis functions -RWG, nxRWG or monopolar RWG- show in general huge inaccuracies when managing objects at extremely low frequencies. This error is in our experience most noticeable in the far-field computation of sharp-edged objects, although it is also observable in other smooth objects at much lower frequencies. Indeed, the analysis of sharp-edged objects with triangular-facetted discretizations produces in general remarkable errors for electrical dimensions of about one thousand of the wavelength, which stands for a bound several orders of magnitude higher than the low-frequency breakdown of the EFIE formulation. In this paper, we show that this anomaly in the MoM-MFIE performance in the very low frequency regime is related to the degree of distortion of the meshing in triangular facets. Indeed, this error vanishes only for those very specific sharp-edged geometries discretized with perfectly uniform meshings; that is, equilateral triangular facets. Surprisingly, we have discovered that the use of the MoM-MFIE discretization with rectangular facets, in practice restricted to the analysis of prisms and cubes, is also free of errors. This opens the possibility of extending the success of the MoM-MFIE formulation to other closed objects resulting from the combination of regions that can be meshed either with square facets or with equilateral triangular facets, for which mixed triangular-rectangular basis functions must then be used.