Ogive Modeling with Conformal Standard and Higher-Order FDTD

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The finite difference time domain (FDTD) stair-casing is the essential bottle neck to modeling irregularly shaped objects that do not conform to the Cartesian-based Yee grid. Many techniques are put-forward to handle this drawback in conventional second-order in time and space FDTD. Integral based higher-order FDTD, the FV24 (Finite Volumes second-order in time and fourth-order in space), is particularly suited to modeling and simulations of large scatterers and problem spaces, typically in the tens of wavelengths range. The FV24 also maintains excellent phase coherency when compared to conventional FDTD at much coarser grid densities.

Recent advances in plane-wave sourcing, near to far-field transformation and absorbing boundary optimizations for both the FDTD and FV24 are implemented; a) The dispersion-optimized and leakage-free total-field/scattered-field (TFSF) technique, b) near to far-field transformation required to calculate the radar cross-section (RCS) was implemented using arithmetic mean, geometric mean and mixed-surface interpolations, and c) optimized CPML absorbing boundary conditions that take into effect grid density, close proximity to scatterers and scatterer dimensions are used.

This work presents the conformal modeling of an electrically large three-dimensional PEC Ogive. The RCS computations are compared using FDTD vs. FV24 and stair-casing vs. conformal modeling. Results are also compared with the results from commercial FDTD and integral equation solvers. Computational resources required for simulations in terms of memory and time required, for FDTD and FV24 are compared for different grid resolutions.

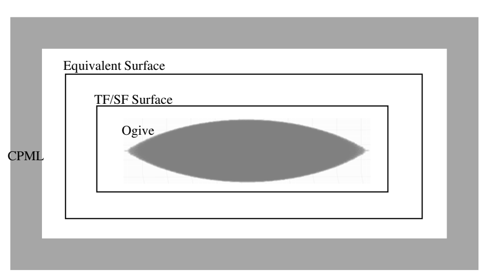

Figure 1: A 2D view of the ogive surrounded by TFSF, near to far-field transformation surface and outer absorbing boundary conditions.