AN INVESTIGATION ON FDTD SOLUTIONS WITH NON-ABSORBING BOUNDARIES

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For FDTD solutions of scattering structures in unbounded domains, an investigation has been carried out on the necessary radiative field conditions at the outer lattice boundary. Also of interest was a simple yet suitable treatment at the truncation point of enclosed waveguiding structures that are semi-infinite in extent. The intention was to replace the much more complex absorbing boundary conditions or perfectly matched layers in typical use, understanding the likely trade-off of coding efficiency with loss of some accuracy.

Instead of applying an absorbing boundary condition, the coupled curl equations are truncated and appropriate field values substituted for the edge grid points. These field values are based on the local field values from the prior time step. This technique is thus frequency and angle independent, and the boundaries do not need to be far removed from the sources or scatterers. In one dimensional transmission line models, a perfect match is obtained at the termination. Scattering and waveguiding structures have been tested in two dimensions. Plane wave reflections of two percent are typical, though a portion of this can be attributed to numerical dispersion. These tests were performed with a collocated, Cartesian grid, and several classes of edge treatments are developed.

Even if the limits of accuracy cannot be pushed much further beyond a few orders using this technique, it nevertheless provides insight into the radiation requirements at the boundaries, since Maxwell's equations are dealt with directly. The local radiating behavior of the coupled curl equations is analyzed and discussed.

As it stands, these straight forward edge treatments provide a quick turn-around from start to finish, which reduces code development and computation time tremendously. Such a solution is especially helpful for training the electromagnetics engineer on computational methods. Indeed, since the physical insights are directly accessible without advanced field theory, the resulting pedagogical advantage is very desirable, as discussed in (J. R. Natzke, *URSI Digest*, June 2004).