ABSTRACT

The Finite Difference Time Domain (FDTD) method offers a flexible and effective solution to a broad range of electromagnetics problems, but is also known to consume a large amount of computational time and memory. Two possible extensions to FDTD to reduce these costs are (1) Subgridding (SG) and (2) Alternating Direction Implicit (ADI). However, the most straightforward implementations of (1)-(2) known to cause additional problems. We here introduce novel algorithms to cope with these problems.

We introduce an Overlapping Subgridding scheme with Digital Filters (OSG-F) to take advantage of digital filter design methods and optimize the interpolation and decimation operations involved in the standard subgridding operation. Motivated by some difficulties present in the OSG-F, we introduce a Subgridding with Domain Overriding (SG-DO) scheme which overrides the overlapping (sub)grid regions using auxiliary (buffer) sub-domains containing perfectly matched layers (PML). This allows for a more explicit control on the reflection and transmission properties at subgridding interfaces. We demonstrate the performance of both methods by numerical examples.

We also show that previously observed asymmetry error in ADI-FDTD can be reduced down to the numerical noise level, if the excitation is applied inside the tri-diagonal matrix and the source is correctly discretized within each time step.