SOME ADVANCES IN THE ADI–FDTD METHOD

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The unconditionally stable Alternating Direction Implicit Finite Difference Time Domain (ADI–FDTD) method (T. Namiki, *IEEE Trans. on Microw. Theory and Techn.*, **47**, 2003–2007, 1999) (F. Zheng, *et al.*, *IEEE Microw. Guided Wave Lett.*, **9**, 441–443, 1999) is a powerful alternative to the traditional FDTD method. It can be obtained starting from the Crank–Nicolson fully implicit–in–space scheme, by adding a Δt^2 perturbation term to it, which permits its factorization into a two–substep tridiagonally implicit–in–space scheme. The resulting algorithm advances a single step in roughly 1.5 times the CPU time employed by the classical FDTD, but since the time increment does not need to fulfil the Courant stability criterion, it can be conveniently increased in many practical problems, with which the ADI–FDTD method can achieve significant reductions in CPU time compared to the FDTD method.

In the first part of this work we briefly summarize some new extensions of this method: inclusion of material dispersion, subgridding techniques, hybridizing with other time domain techniques, accurate source implementation, etc.

One drawback of the method is the errors that appear, especially in low frequency problems, and which are not present in the Crank–Nicolson scheme. Using the analytical expression of the truncation error, it has been shown (S. G. García, *et al.*, *IEEE Antennas and Wireless Propagation Letters*, **1**, 31–34, 2002) that the time increment cannot be increased arbitrarily taking into account only numerical dispersion criteria (number of samples per period); it is also limited by the fact that it must accurately *resolve* the spatial variations of the fields as well.

In the second part of this work we further discuss the origin of these errors, analyzing the consistency and convergence of the scheme. Finally, we focus our attention on possible solutions and alternatives to reduce the aforementioned errors.