Abstracts

A three-dimensional unconditionally stable ADI-FDTD method in the cylindrical coordinate system

Chenghao Yuan and Zhizhang Chen. "A three-dimensional unconditionally stable ADI-FDTD method in the cylindrical coordinate system." 2002 Transactions on Microwave Theory and Techniques 50.10 (Oct. 2002 [T-MTT]): 2401-2405.

An unconditionally stable finite-difference time-domain (FDTD) method in a cylindrical coordinate system is presented in this paper. The alternating-direction-implicit (ADI) method is applied, leading to a cylindrical ADI-FDTD scheme where the time step is no longer restricted by the stability condition, but by the modeling accuracy. In contrast to the conventional ADI method, in which the alternation is applied in each coordinate direction, the ADI scheme here performs alternations in mixed coordinates so that only two alternations in solution matching are required at each time step in the three-dimensional formulation. Different from its counterpart in the Cartesian coordinate system, the cylindrical ADI-FDTD includes an additional special treatment along the vertical axis of the cylindrical coordinates to overcome singularity. A theoretical proof of the unconditional stability is shown and numerical results are presented to demonstrate the effectiveness of the cylindrical algorithm in solving electromagnetic-field problems.

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