Abstracts

A Hybrid Yee Algorithm/Scalar-Wave Equation Approach

P.H. Aoyagi, J.-F. Lee and R. Mittra. "A Hybrid Yee Algorithm/Scalar-Wave Equation Approach." 1993 Transactions on Microwave Theory and Techniques 41.8 (Sep. 1993 [T-MTT] (Special Issue on Modeling and Design of Coplanar Monolithic Microwave and Millimeter-Wave Integrated Circuits)): 1593-1600.

In this paper, two alternate formulations of the Yee algorithm, namely, the finite-difference time-domain (FDTD) vector-wave algorithm and the FDTD scalar-wave algorithm are examined and compared to determine their relative merits and computational efficiency. By using the central-difference divergence relation the conventional Yee algorithm is rewritten as a hybrid Yee/FDTD scalar-wave algorithm. It is found that this can reduce the computation time for many 3-D open geometries, in particular planar structures, by approximately two times as well as reduce the computer-memory requirements by approximately one-third. Moreover, it is demonstrated both mathematically and verified by numerical simulation of a coplanar strip transmission line that this hybrid algorithm is entirely equivalent to the Yee algorithm. In addition, an alternate but mathematically equivalent reformulation of the Enquist-Majda absorbing boundary condition based on the normal field component (relative to the absorbing boundary wall) is given to increase the efficiency of the hybrid algorithm in the modeling of open region problems. Numerical results generated by the hybrid Yee/scalar-wave algorithm for the Vivaldi antenna are given and compared with published experimental work.

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