Abstracts

FD-TD Modeling of Digital Signal Propagation in 3-D Circuits with Passive and Active Loads

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Most existing computer-aided circuit design tools are limited when digital clock speeds exceed several hundred MHz. These tools may not deal effectively with the physics of UHF and microwave electromagnetic wave energy transport along metal surfaces such as ground planes or in the air away from metal paths that are common at or above this frequency range. In this paper, we discuss full-wave modeling of electronic circuits in three dimensions using the finite-difference time-domain (FD-TD) solution of Maxwell's equations. Parameters such as stripline complex line impedance, propagation constant, capacitance per unit length and inductance per unit length can be easily computed as a function of frequency. We also discuss FD-TD Maxwell's equations computational modeling of lumped-circuit loads and sources in 3-D, including resistors and resistive voltage sources, capacitors, inductors, diodes, and transistors. We believe that this approach will be useful in simulating the large-signal behavior of very high-speed nonlinear analog and digital devices in the context of the full-wave time-dependent electromagnetic field.

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