Abstracts

Global modeling of millimeter-wave circuits: electromagnetic simulation of amplifiers

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Global modeling of microwave and millimeter-wave circuits is important to simulate the electromagnetic (EM) coupling, device-EM wave interaction, and the EM radiation effects of the closely spaced active and passive components of monolithic microwave integrated circuits (MMIC's). In this paper, a global-modeling technique is presented to characterize the millimeter-wave integrated-circuit amplifiers. The characterization of amplifier circuits, including the input and output matching networks, are performed using a full-wave analysis coupled with physical modeling of the semiconductor devices. The entire amplifier is simulated with the finite-difference time-domain (FDTD) algorithm, which also solves for the EM fields inside the transistor. The intensive computer-memory requirement and the large simulation time are reduced by applying a hybridization approach. The small signal as well as the large signal propagation through the amplifier circuit are demonstrated. The scattering parameters are extracted for the amplifier circuit at small and large signals for different frequencies. The global technique is able to model the nonlinearity and the harmonic distortion of the amplifier circuit. The third and fifth harmonic components in the output spectrum at large signal are predicted for different frequencies.

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