Abstracts

A Unified Theory for Frequency-Domain Simulation and Sensitivity Analysis of Linear and Nonlinear Circuits

J.W. Bandler, Q.-J. Zhang and R.M. Biernacki. "A Unified Theory for Frequency-Domain Simulation and Sensitivity Analysis of Linear and Nonlinear Circuits." 1988 Transactions on Microwave Theory and Techniques 36.12 (Dec. 1988 [T-MTT] (1988 Symposium Issue)): 1661-1669.

In this paper, a unified theory for frequency-domain simulation and sensitivity analysis of linear and nonlinear circuits is presented. An elegant derivation expands the harmonic balance technique from non-linear simulation to nonlinear adjoint sensitivity analysis. This provides an efficient tool for the otherwise expensive but essential gradient calculations in design optimization. The hierarchical approach, widely used for circuit simulation, is generalized to sensitivity analysis and to computing responses in any subnetwork at any level of the hierarchy. Therefore, important aspects of frequency-domain circuit CAD such as simulation and sensitivity analysis, linear and nonlinear circuits, hierarchical and nonhierarchical approaches, voltage and current excitations, or open- and short-circuit terminations are unified in this general framework. Our theory provides a key for the coming generation of microwave CAD software. It will take advantage of the many existing and mature techniques such as the syntax-oriented hierarchical analysis, optimization, and yield driven design to handle nonlinear as well as linear circuits. Our novel sensitivity analysis approach has been verified by a MESFET mixer example exhibiting a 90 percent saving of CPU time over the prevailing perturbation method.

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