Abstracts

State-of-the-Art Harmonic-Balance Simulation of Forced Nonlinear Microwave Circuits by the Piecewise Technique

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The paper discusses the theoretical foundations and the numerical performance of an advanced nonlinear circuit simulator based on the piecewise harmonic-balance (HB) technique. The program incorporates updated versions of several novel algorithmic concepts developed in the last few years. This results in computational capabilities well ahead of the state of the art of HB techniques as outlined even in recent review work. The exact computation of the Jacobian matrix for Newton-iteration based HB simulation, and the related conversion-matrix technique for fast mixer analysis, are formulated in the most general form available to date. Convergence problems at high drive levels are solved by a parametric formulation of the device models coupled with an advanced norm-reducing iteration. A physics-based approximation allows the HB equations to be effectively decoupled in many practical cases, thus bringing large-size jobs such as pulsed-RF analysis well within the reach of ordinary workstations. The exact Jacobian is used in conjunction with an exact formula for the gradient of the objective function, to implement an efficient broadband nonlinear circuit optimization capability. Finally, a number of examples are presented, in order to give the reader a feeling of the numerical performance that the program can provide at the workstation level.

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