Model Order Reduction of Nonlinear Systems in Circuit Simulation

Michael Striebel
Chemnitz University of Technology, D-09126 Chemnitz, Germany
michael.striebel@mathematik.tu-chemnitz.de

Simulation plays a major role in computer aided design of integrated circuits. Mathematical models describe the dynamical processes and interactions of electrical devices. Verification of a circuit's behaviour by means of solving these model equations in time and frequency domain is a mandatory task in the design process. The structures' sizes are decreasing, the packing density gets higher and so do the driving frequencies. This requires to use refined models. The very high dimensional nonlinear problems that emerge in this way may be solvable with the help of computer algebra in an unreasonable amount of time only. Clearly, this conflicts with the short time-to-market demands in industry. Model-Order-Reduction presents a way out of this dilemma.

Despite the linear case where great progress is being recorded, methodologies for nonlinear problems are only beginning to develop. It is not possible to apply techniques from linear model order reduction to nonlinear problems as the computational work for solving the arising order-reduced models might increase.

We review techniques for nonlinear model order reduction, in particular the technique based on piecewise linearisation [1] and the missing point estimation based on proper orthogonal decomposition [2, 3]. We show benefits, discuss limitations of the respective techniques and point out possible improvements.

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References

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