A Collection of Iterative Algorithms for VLSI–Device Simulation

The discretization of the semiconductor equations leads to a nonlinear system of equations, which is commonly solved by a (damped) Newton scheme or by Gummel's algorithm, a block iterative Gauss–Seidel method. In both cases linear systems of equations have to be solved repeatedly.
Shrinking device dimensions allow an adequate description only by fully three-dimensional simulation. For those very high scale problems iterative algorithms for the solution of the linear systems of equations appear to be the only methods of choice. For the solution of the nonsymmetric linear systems of equations projection-type (conjugate gradient-like) methods have proved to be most suitable. We have compared both the theoretical and the numerical properties of some important algorithms. We show, how the recurrence relations introduced by preconditioners, which guarantee a fast and reliable convergence of the linear solvers, can be vectorized and/or parallelized efficiently. Results on vector– and massively parallel computers are presented.

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