Time Integration Algorithms for the Xyce^{TM} Parallel Electronic Simulator

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The modified nodal formulation of a circuit network description leads to a set of differential/algebraic equations, upon invoking Kirchhoff current and voltage laws. Dynamic or time derivative terms enter the system of equations via such elements as capacitors and inductors, e.g. current is the derivative of a charge expression. As part of the High Performance Electrical Modeling and Simulation effort (an ASCI project) at Sandia National Laboratories, the Xyce^{TM} Parallel Electronic Simulator is being developed and will provide a circuit modeling tool for Sandia designers working in a massively parallel distributed computing environment. The code is being written in C++ using object oriented design. This paper is directed at matters that enter into the making of an effective numerical computational core for time integration of the resulting system of *stiff* differential and algebraic equations. Because of the typical simulation environment and solution behavior, we believe that high order methods are not generally appropriate. Hence the time integration package includes methods of first and second order only. This package, a C++ structure with object oriented numerics, is being constructed as a *stand-alone* code for easy and effective use in other application environments as well. We shall discuss methods, implementation matters, and other issues arising in this work.
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