Abstracts

An all-purpose transmission-line model for interconnect simulation in SPICE

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A new all-purpose multiconductor transmission-line model is described for efficient and robust interconnect simulation using nonlinear circuit simulators such as SPICE. All types of interconnects, i.e., uniform, nonuniform, lossless, lossy/dispersive, can be handled by the proposed model. Furthermore, coupling of electromagnetic radiation to interconnects can be directly modeled without the need for developing a new subcircuit. Another advantage of the proposed model is that it enables sensitivity analysis with respect to both circuit and interconnect parameters, thus facilitating interconnect circuit optimization. Chebyshev expansions for the spatial variations of the interconnect voltages and currents are used to effect highly accurate numerical approximations of the Telegrapher's equations using as small a number of degrees of freedom as possible. A simple rule of thumb is provided for the selection of the order of the approximation given the frequency bandwidth of interest. Numerical examples are presented to demonstrate the validity of the proposed model and illustrate its application to a variety of interconnect-induced noise interactions in high-speed electronic systems.

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