Abstracts

Time-Domain Simulation of n Coupled Transmission Lines

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In this paper, a general SPICE model for n coupled transmission lines is presented. The model consists of two identical transformation networks and n single-transmission-line models. The transformation networks are realized with linear time-invariant voltage-controlled voltage sources (VCVS's) and current-controlled current sources (CCCS's) only. A simplified model designed to simulate connections on multilayer printed circuit boards is also presented. In this case, the coupling model is adequately described by a capacitance matrix C and an inductance matrix L that are Toeplitz, symmetric, and tridiagonal. The particular structure of C and L makes the computation of the parameters of the transformation network extremely easy and efficient because only simple function evaluations (cosines) are required. Furthermore, the transformation network depends only on the number of coupled lines and not on the parameters of those lines. Therefore, a library of such models needs to be determined only once, and only the characteristic impedances and time delays for the single lines have to be recomputed. The simulation results have been compared against expermental results, and the difference between the two is less than 1 percent.

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