Abstracts

Efficient circuit simulation of nonuniform transmission lines

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This paper extends the transmission-line simulation method presented previously by Kuznetsov and Schutt-Aint (see IEEE Trans. Circuits Syst. I, vol. 43, p. 111-121, Feb. 1996) to nonuniform lines. The method is applicable to multiconductor lossy frequency-dependent transmission lines characterized by sampled frequency-domain responses. The resulting model can be directly incorporated into a circuit simulator. The implementation includes AC, DC, and transient analyses. The method is reliable, accurate, and as efficient as the simple replacement of interconnects by lumped resistors. The method is based on approximation, and its accuracy and efficiency result from the simplicity of characteristic responses. To apply the method to nonuniform lines, two novel nonuniform line models are introduced. An open-loop model completely separates forward and backward waves and results in the simplest aperiodic responses, but does not guarantee their stability. An open-loop distributed-reflection model explicitly includes the internal distributed reflections, and provides the simplest stable characterization. It is shown that for nonuniform lines, the generalized method of characteristics no longer separates forward and backward waves. Numerical example of a parabolically tapered frequency-dependent four-conductor line is given.

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