Abstracts

Hybrid electromagnetic modeling of noise interactions in packaged electronics based on the partial-element equivalent-circuit formulation

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The partial-element equivalent-circuit (PEEC) method is used to develop a flexible, hierarchical electromagnetic modeling and simulation environment for the analysis of noise generation and signal degradation mechanisms in packaged electronic components and systems. The circuit-oriented approach used by the method for the development of the numerical approximation of the electric-field integral equation leads to SPICE-compatible, yet fully dynamic, discrete approximation of the electromagnetic problem. Contrary to other full-wave formulations, the proposed method has the important attribute of lending itself to a very systematic and physical model complexity reduction on the basis of the electrical size of the various portions of the system. Thus, a hybrid electromagnetic modeling and simulation environment is established for the analysis of complex structures which exhibit large variation in electrical size over their volume, using a combination of lumped-circuit elements, transmission lines, as well as three-dimensional (3-D) distributed electromagnetic models. These models may or may not account for retardation, depending on the electrical size of the part of the structure that is being modeled. These special attributes of the proposed electromagnetic-simulation environment are demonstrated through several examples from its application to the modeling of noise interactions in generic interconnect and package geometries.

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