Abstracts

Finite Element Computation of Electromagnetic Fields

S.T. Clegg, K.A. Murphy, W.T. Joines, G. Rine and T.V. Samulski. "Finite Element Computation of Electromagnetic Fields." 1994 Transactions on Microwave Theory and Techniques 42.10 (Oct. 1994 [T-MTT]): 1984-1991.

A three dimensional finite element solution scheme is developed for numerically computing electromagnetically induced power depositions. The solution method is applicable to those problems for which it can be reasonably assumed that the magnetic permeability is homogeneous. The method employs an incident field/scattered field approach where the incident field is precalculated and used as the forcing function for the computation of the scattered field. A physically logical condition is used for the numerical boundary conditions to overcome the fact that electromagnetic problems are generally unbounded (i.e., the boundary condition is applied at infinity) but numerical models must have a boundary condition applied to some finite location. At that numerical boundary, an outgoing spherical wave is simulated. Finally, an alternate to a direct solution scheme is described. This alternate method, a preconditioned conjugate gradient solver, provides both a storage and CPU time advantage over direct solution methods. For example, a one-thousand fold decrease in CPU time was achieved for simple test cases. Unlike most iterative methods, the preconditioned conjugate gradient technique used has the important property of guaranteed convergence. Solutions obtained from this finite element method are compared to analytic solutions demonstrating that the solution method is second-order accurate.

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