Abstracts

Elimination of Vector Parasites in Finite Element Maxwell Solutions

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The vector parasite problem is studied in the context of finite element solutions of Maxwell's equations for driven boundary-value problems. An expanded weak form is introduced which combines the divergence equation with the conventional weak form of the double-curl equation. This new form is related to penalty methods where the penalty or weighting factor varies with the dielectric constant. The resulting algebraic system is identical to the Galerkin-Helmholts operator on homogeneous subregions. Normal and tangential boundary conditions arise in terms of the divergence and curl of the field on the boundary. Computational results show the occurrence of two distinct types of parasitic modes in driven problems and their elimination with the new formulation. Practical observations concerning the conditions which provoke spurious modes in these problems are reported. Spurious solutions also arise from improper or unphysical boundary conditions, and the importance of careful specification of boundary-value problems is illustrated. Most conceptual difficulties with boundary conditions per se are removed when hybrid methods are used to couple the interior finite element solution to the exterior problem, which focuses attention on the physics of the source distribution.

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