Abstracts

Comparison of the transmission-line matrix and finite-difference time-domain methods for a problem containing a sharp metallic edge

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We compare Yee's finite-difference time-domain (FDTD) and symmetric condensed node transmission-line matrix (SCN-TLM) solutions for a cavity containing a metallic fin. Differential equation-based numerical methods are known to produce inaccurate results for this type of problem due to the rapid spatial variation of the field distribution in the vicinity of the singularity at the edge of the metal fin. This problem is relevant to the analysis of structures of practical interest such as microstrip and coplanar waveguides. Based on simulations, it is determined that for identical discretizations, SCN-TLM is more accurate than FDTD for this problem. We interpret this result as an indication that the symmetric condensed representation of fields (used within the SCN-TLM) lends itself to a more accurate algorithm than the distributed representation used by Yee. We estimate that the FDTD method requires 3.33 times more cells for a given three-dimensional problem than the transmission-line matrix (TLM) method (1.49 times more cells per linear dimension of the problem) in order to achieve the same accuracy. If we consider the requirements to update and store a single TLM or FDTD cell, we find the SCN-TLM algorithm is more efficient than the Yee FDTD algorithm in terms of both computational effort and memory requirements. Our conclusions regarding computational effort and memory requirements are limited to problems with homogeneous material properties.

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