Abstracts

Evaluation of perfectly matched layer mesh terminations in finite-element bioelectromagnetic scattering computations

J. Tang, S.D. Geimer and K.D. Paulsen. "Evaluation of perfectly matched layer mesh terminations in finite-element bioelectromagnetic scattering computations." 1999 Transactions on Microwave Theory and Techniques 47.4 (Apr. 1999 [T-MTT]): 410-415.

There has been considerable interest in and development of perfectly matched layer (PML) mesh terminations for electromagnetic scattering problems. For the most part, PML performance has been characterized on benchmarks which involve scattering from perfectly conducting objects. In this paper, we evaluate a recent PML implementation for node-based finite-element formulations using a prototype problem which is relevant to bioelectromagnetic computations. Variables under consideration include the layer material properties, layer thickness, and layer distance from the biological body. The results demonstrate that distance from the body is the strongest determinant of solution accuracy with increasing errors occurring with increasing frequency at a fixed distance, although average solution variations of less than 10% are observed in most cases where layers are located at a distance of at least 1.5 times the smallest body dimension. In addition, the PML need only consist of two to three layers in order to reduce solution variations resulting from layer thickness, and this thickness requirement is largely independent of layer distance from the body. This is in contrast to results from perfectly conducting scatterers where six to eight or more layers have been recommended. Further, the computed solutions are not a strong function of the layer material property and this parameter can easily be determined from a simple analytical decay formula without compromising PML performance. These findings are encouraging from a computational economy perspective and they suggest that the PML concept is an excellent choice for finite-element mesh truncation in bioelectromagnetic computations.

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