Abstracts

On causality and dynamic stability of perfectly matched layers for FDTD simulations

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We investigate the spectral properties of the Cartesian, cylindrical, and spherical perfect matched layer (PML) absorbing boundary conditions. In the case of the anisotropic-medium PML formulation, we analyze the analytical properties of the constitutive PML tensors on the complex /spl omega/-plane. In the case of the complex-space PML formulation (complex coordinate stretching formulation), we analyze the analytical properties of field solutions directly. We determine the conditions under which the PMLs satisfy (or do not satisfy) causality requirements in the sense of the real-axis Fourier inversion contour. In the case of the noncausal PML, we point out the implications on the dynamic stability of time-domain equations and finite-difference time-domain (FDTD) simulations. The conclusions have impact both on the design of PMLs for practical FDTD simulations and on the use of PML's as a physical basis for engineered artificial absorbers on nonplanar (concave or convex) surfaces. Numerical results illustrate the discussion.

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