Finite Difference Analysis of 3D Anisotropic Photonic Crystals

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We have extended the analysis of 2D photonic-crystal (PC) band diagrams using the Yee-mesh-based finite difference (FD) formulation [1] to 3D structures. The formulation starts from the two Maxwell curl equations and leads to a matrix eigenvalue equation. The FD formulation is relatively simple and we have demonstrated its efficiency and accuracy in [1]. It is easy to include the material diagonal anisotropy in the FD derivation. We have established a 3D analysis model with such anisotropy flexibility. We have performed such detailed study as examining the numerical convergence behavior with the number of grid points and the effect of treating the dielectric discontinuity with averaging schemes. We have compared our numerical results with published ones based on other methods, such as the plane-expansion method and the transfer matrix method based methods, for different structures, including the simple case as dielectric spheres in air for which the dielectric distribution function has analytical Fourier transform formulae and other more complex ones.

[1] C. P. Yu and H. C. Chang, *Optics Express*, 1**2**, 1397 (2004).