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Efficient calculation for waveguides and for photonic crystal band structures using improved finite elements in 2D[1]
C.R. BOUCHER, C.I. AHHENG, L.R. RAM-MOHAN, WPI — We employ scalar, fifth-order Hermite interpolation polynomials to solve Maxwell's equations in two dimensions in the finite element method. We analyze homogeneous conducting waveguides, inhomogeneous waveguides, and photonic crystals. The Hermite interpolation functions provide greater accuracy than vector finite elements of equal polynomial order, while bypassing the issue of spurious modes observed when using Lagrange polynomials. The scalar Hermite elements offer a level of flexibility which is not seen with vector finite elements, as in multiphysics problems such as coupled Schrödinger-Maxwell problems. The use of Hermite elements is an attractive alternative to plane-wave methods for modeling photonic crystals, leading to sparse matrices due to local connectivity of the finite elements, greater flexibility in modeling, and lower computational costs.

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