A computer-assisted proof for photonic band gaps

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We investigate photonic crystals, modeled by a spectral problem for Maxwell's equations with periodic electric permittivity. Here, we specialize to a two-dimensional situation and to polarized waves. By Floquet-Bloch theory, the spectrum has band-gap structure, and the bands are characterized by families of eigenvalue problems on a periodicity cell, depending on a parameter k varying in the Brillouin zone K. We propose a computer-assisted method for proving the presence of band gaps: For k in a finite grid in K, we obtain eigenvalue enclosures by variational methods supported by finite element computations, and then capture all $k \in K$ by a perturbation argument.

The talk is based on joint work with Vu Hoang and Christian Wieners.