A Dirichlet-to-Neumann approach for the exact computation of guided modes in photonic crystal waveguides

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This work deals with one dimensional infinite perturbation — namely line defects — in periodic media. In optics, such defects are created to construct an (open) waveguide that concentrates light. The existence and the computation of the eigenmodes is a crucial issue. This is related to a self-adjoint eigenvalue problem associated to a PDE in an unbounded domain (in the directions orthogonal to the line defect), which makes both the analysis and the computations more complex. Using a Dirichlet-to-Neumann (DtN) approach, we show that this problem is equivalent to one set on a small neighborhood of the defect. On contrary to existing methods (the Supercell method for instance), this one is exact but there is a price to be paid: the reduction of the problem leads to a nonlinear eigenvalue problem of a fixed point nature.