

Computing modes of open periodic waveguides

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The propagation of electromagnetic waves in periodic media is usually described using Floquet-Bloch theory. This talk will concentrate on a stack of dielectric slabs which contain a small periodic grating. Such structures find applications in many integrated optics devices, such as semi-conductor lasers, waveguide couplers or leaky-wave antennas.

The modes are determined from the spectrum of the Helmholtz operator on an infinite strip with quasiperiodic boundary conditions, which can consist of guided modes, radiation modes and leaky modes. To motivate the periodic case a great deal of attention will be devoted to planar waveguides which share some of the important features of the periodic case.

To compute the eigenmodes and the associated propagation constants numerically, one usually truncates the domain that contains the grating and imposes certain radiation conditions on the artificial boundary. An alternative is to decompose the infinite strip into a rectangle, which contains the grating, and two semi-infinite domains. The guided and leaky modes can be computed by matching the Dirichlet-to-Neumann (DtN) operator on the interfaces of these three domains. While the exterior DtN map can be found analytically, the interior DtN map must be computed numerically. To that end, a symmetric boundary integral formulation will be used.

The discretized problem is a nonlinear eigenvalue problem, which is solved by numerical continuation. The talk concludes with numerical results for single- and double periodic structures.