A vectorial solver for the reflection of semi-confined waves at slab waveguide discontinuities for non-perpendicular incidence

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The non-normal incidence of thin-film guided, in-plane unguided optical waves on straight, possibly composite slab waveguide facets is considered. The quasi-analytical, vectorial solutions permit to inspect polarization properties of reflected and refracted guided waves, radiative losses, and full field details near the facet.

Non-normal light incidence on a slab waveguide discontinuity

The effects of a straight transition between regions with different layering, or of a core facet, on thin-film guided, in-plane unguided light forms the basis for a series of classical integrated optical components. While scalar TE / TM Helmholtz equations apply for perpendicular incidence, for non-normal incidence one is led to a vectorial problem \textsuperscript{[1]} that is formally identical to that for the modes of 3-D channel waveguides. Here, however, it needs to be solved as a parametrized, inhomogeneous system on a 2-D computational window with transparent-influx boundary conditions.

Vectorial, quasi-analytical solutions by quadridirectional eigenmode propagation (QUEP)

As a step beyond the scalar approximation \textsuperscript{[1]} and an older bidirectional approach \textsuperscript{[2]}, we report on a dedicated vectorial solver for — in principle — arbitrary rectangular cross section geometries, based on simultaneous expansions into slab modes along two orthogonal coordinate axes (QUEP, \textsuperscript{[3]}). A review of general aspects (solver specifics, power balance, reciprocity, characteristic angles), will be followed by a discussion of solutions for different configurations, including the example below.

References

\textsuperscript{[1]} F. \textsuperscript{\cite{Civitci}}\textsuperscript{, M. Hammer, and H. J. W. M. Hoekstra. Optics and Quantum Electronics, 46(3):477–490, 2014.}