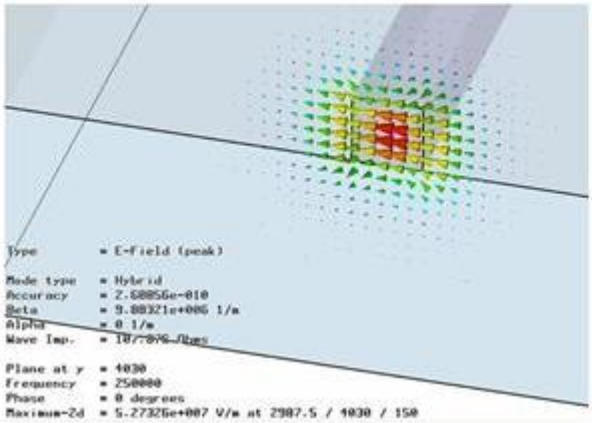
Excitation of waveguides in time domain simulations

Waveguides are an important concept for controlling the flow of electromagnetic fields allowing short and long distance transport of electromagnetic energy and signals. In the TET group one research focus are planar waveguides, which play an import role in integrated optics. To allow simulations of waveguides with Finite Difference Time Domain developed in our group, this project with programming focus aims at developing a theoretical framework and implementation for waveguide ports, that allow seamless excitation of guided forward-propagating pulses consisting of eigenmodes.



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Work packages

1. Read up on planar waveguides (especially slab&strip waveguides, types of modes, calculation of eigenmodes), the total/scattered wave coupling formalism, and basics of the FDTD method (e.g. http://alphard.ethz.ch/Hafner/Vorles/Numeric/IntroCE-Dgtd-Mar2012.pdf).
2. Introduce yourself to the midg code of the TET group, set up several geometries including slab and strip waveguides (with varying width and height) and test them with nearly-monochromatic excitation using a point source.
3. Use a total/scattered plane wave source for excitation of the considered structures.
4. Modify the total/scattered source to support a spatial profile of the (still nearly-monochromatic) incoming field within the plane. Start with a rectangular or Gaussian profile. Then excite with analytically calculated mode profiles of the considered structures.
5. Extension: Derive a formalism to allow time dependent field excitation, by Fourier expansion into eigenmodes.
6. Extension (two semesters): Use an external tool (e.g. COMSOL, JCM Wave, or other) for the calculation of eigenmodes for arbitrary waveguide geometries.

All steps including results should be well documented and discussed in the thesis. Integral part are regular convergence checks and their documentation.