Simulations of Kerr based non linear optical components with the Complex Jacobi iteration

Peter Vandersteegen, Peter Bienstman, Roel Baets
Department of information technology, UGent - IMEC, St Pietersnieuwstraat 41, B-9000 Ghent,
Peter.Vandersteegen@intec.UGent.be

Adrien Dewandre, Marc Haelterman
Faculté des Sciences Appliquées, Service de Physique Générale, ULB,
CP165/81, avenue F.D. Roosevelt 50, B-1050 Bruxelles

We present several non-linear structures simulated with the non-linear complex Jacobi iteration. This method numerically integrates the fields of the Helmholtz equation for points located on a grid. Because the fields are calculated on each grid point this results in a very flexible method. This iterative method refines each iteration step the calculated fields until a desired error has been achieved.

The first structure under discussion is a one dimensional study of a cavity surrounded by two Bragg gratings, fig. 1(a). These two Bragg gratings create a photonic band gap. The introduced cavity creates a resonance wavelength in the middle of this band gap. All light with this resonance wavelength will be transmitted by this structure. Introducing a non-linear material in the cavity will shift the resonance peak to higher wavelengths. A comparison with non-linear eigenmode expansion confirms the accuracy of our simulation tool. We have also shown that the numerical dispersion introduced by a discrete mesh can be controlled if the discretization step $\Delta x < \frac{\lambda}{20}$.

![Diagram of cavity and grating](image)

(a) Cavity encapsulated by 2 Bragg gratings
(b) Vertical grating coupler

Fig. 1. Non linear wavelength scale structures

We will also present preliminary simulation results from a 2 dimensional vertical coupler. Light coupled vertically in the coupler is symmetrically injected in a left and right waveguide. Injection efficiency in one waveguide reaches a maximum for a certain wavelength. Adding non-linearity in the grating material will hopefully result in a shift of this maximum.

Parts of this work has been performed in the context of the Belgian IAP Photon network.


[2] Peter Vandersteegen, Peter Bienstman and Roel Bates, 'Using the Complex Jacobi method to simulate Kerr non-linear photonic components', Optical and Quantum Electronics (to be published)
ICTON 2006
8th International Conference on Transparent Optical Networks

cou-located with:

ESPC 5th European Symposium on Photonic Crystals
WAOR 5th Workshop on All-Optical Routing
GOWN 3rd Global Optical & Wireless Networking Seminar
RONEXT 2nd COST 270 Workshop on Reliability Issues in Next Generation Optical Networks
PICAW 2nd Photonic Integrated Components & Applications Workshop
NAON COST 283 Nanophotonics for All-Optical Networking Workshop
GRAAL COST 283 Annual Conference on Graphs and Algorithms in Communication Networks
COST P11 Training School: Modelling and Simulation Techniques for Linear, Nonlinear and Active Photonic Crystals

and special sessions:

MPM – Microresonators and Photonic Molecules: trapping, harnessing and releasing light
Industrial

Volume 4
contains: Conference & COST P11 Training School Posters
Nottingham, United Kingdom, June 18 – 22, 2006