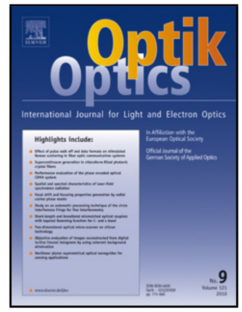

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PII: S0030-4026(17)30700-3
DOI: http://dx.doi.org/doi:10.1016/j.ijleo.2017.06.035
Reference: IJLEO 59298

To appear in:

Received date: 12-3-2017
Accepted date: 7-6-2017

Short Note

Hybrid composed method associating conformal transformation with matrix formulation for computing eigenvalues and eigenvectors in bended optical waveguides

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Abstract

A fast hybrid composed and numerical method for the calculation of eigenvalues (effective indices) and eigenvectors (optical modes) of a slab waveguide presenting a radius of curvature is presented in this letter. This compound method combines a conformal transformation of the complex plane plus a multilayer matrix formalism addressing directly the modified index profile obtained by the conformal transformation; the matrix formalism is then applied in second step so as to discretize and slice the profile in a virtual multilayer structure. This method being conveniently operable on a personal computer in a short amount of time and is easy to implement. Its results are then compared to values afforded with the commercial vectorial software COMSOL 3D so as to discuss their accuracy.

Keywords: Integrated optics, hybrid composed method, mathematic conformal transformation with multilayer formalism methods.

Accurate knowledge of how light behave within a waveguide with a given radius of curvature becomes more and more important because of the development of integrated photonics [1-3], which include ring micro-resonators, phasars, and other devices fitted with a radius of curvature. Sometimes, it can be original and interesting to modify, adapt, enhance or merge various methods of resolution [4,5]. This work presents a hybrid numerical calculation method (HNM) to determine the eigenvalues (effective indices) and eigenvectors related to the optical field within a curved waveguide. This method is a hybrid method which uses at first an apt conformal transformation (CT) of the complex plane plus secondly a matrix multilayer formalism (MMF) developed at the origin for real materials. As a *'o'* composition law, we can write HNM ≡(MMF *o* CT). The aim of the conformal transformation is to convert a curved geometry into a virtual straight geometry structure; such a conversion entails a significant effect on the index profile of the structure and modifies its pattern. Various kinds of mathematic conformal transformations can be considered [6], and used in physics, optoelectronics and hyper-frequency such as: inversion, rotation, homographic or more particular transformations like the Schwarz-Christoffel or Joukovsky ones; the specific one used in this work will be detailed later. In our case, it will be a shortcut and a mathematical trick that makes it possible to dispense with the 'true' Jacobian method and the equation of propagation in polar coordinates. Then, as regards the modified index profile, we use the matrix multilayer formalism first developed by