Modeling open nanophotonic systems using the Fourier modal method: Generalization to 3D Cartesian coordinates - DTU Orbit (26/04/2019)

Recently, an open geometry Fourier modal method based on a new combination of an open boundary condition and a non-uniform $k$-space discretization was introduced for rotationally symmetric structures providing a more efficient approach for modeling nanowires and micropillar cavities [J. Opt. Soc. Am. A33, 1298 (2016)]. Here, we generalize the approach to three-dimensional (3D) Cartesian coordinates allowing for the modeling of rectangular geometries in open space. The open boundary condition is a consequence of having an infinite computational domain described using basis functions that expand the whole space. The strength of the method lies in discretizing the Fourier integrals using a non-uniform circular “dartboard” sampling of the Fourier $k$ space. We show that our sampling technique leads to a more accurate description of the continuum of the radiation modes that leak out from the structure. We also compare our approach to conventional discretization with direct and inverse factorization rules commonly used in established Fourier modal methods. We apply our method to a variety of optical waveguide structures and demonstrate that the method leads to a significantly improved convergence enabling more accurate and efficient modeling of open 3D nanophotonic structures.

General information
Publication status: Published
Organisations: Department of Photonics Engineering, Quantum and Laser Photonics
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Pages: 1632-1641
Publication date: 2017
Peer-reviewed: Yes

Publication information
Journal: Journal of the Optical Society of America A
Volume: 34
Issue number: 9
ISSN (Print): 0740-3232
Ratings:
BFI (2017): BFI-level 2
Scopus rating (2017): CiteScore 1.76
Web of Science (2017): Impact factor 1.566
Web of Science (2017): Indexed yes
Original language: English
Keywords: Fourier modal method, Computational electromagnetic methods, Micro-optics, Waveguides, Mathematical methods in physics, Numerical approximation and analysis
Electronic versions:
Manuscript_arxiv.pdf
DOIs:
10.1364/JOSAA.34.001632
Source: FindIt
Source-ID: 2358377928
Research output: Contribution to journal › Journal article – Annual report year: 2017 › Research › peer-review