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VirtualLab FUSION

FAST PHYSICAL OPTICS SOFTWARE

LightTrans' talks at SPIE Photonics West 2018

Laser system modeling with fast physical optics

Components and Packaging for Laser Systems IV • Part of SPIE LASE • 30 January 2018 • 1:40 - 2:00 PM

Frank Wyrowski, Site Zhang, Christian Hellmann

Nowadays, the development of modern laser systems tends to be more and more integrated and compact. A huge variety of components with specific purposes and in largely different dimension scales can be seen even in a single laser system. As a result, the difficulty in modeling and designing such a system increases dramatically. To model such systems, instead of attempting to use multiple disciplines in combination, we adhere to physical optics, which is governed by Maxwell's equations. Especially, by fast physical optics, we emphasize on highly efficient solutions to Maxwell's equations, based on 1) the paradigm shift of switching the main modeling domain from space to spatial frequency domain; 2) innovative Fourier transform concepts that minimize the field sampling parameters. With these techniques, components ranging from sub-wavelength gratings to prisms, and from structured waveguides to laser crystals, can all be included. In addition to optics itself, it is possible to take other physical aspects and their impact on the optical performance into consideration in a flexible manner, such as mechanical and thermal effects in laser packaging processes. We will present simulations of several typical modern laser systems based on fast physical optics modeling.

Fast propagation of electromagnetic fields through graded-index media

Physics and Simulation of Optoelectronic Devices XXVI • Part of SPIE OPTO • 30 January 2018 • 3:05 - 3:25 PM

Huiying Zhong, Site Zhang, Rui Shi, Christian Hellmann, Frank Wyrowski

The propagation of electromagnetic fields through inhomogeneous media is an essential requirement in the modeling and design of optoelectronic devices. In the most general case, this requires the application of finite-difference techniques in frequency or time domain, or other rigorous solutions of Maxwell's equations, which often results in a numerical effort too high for practical applications. However, if the inhomogeneity is represented by a smoothly varying refractive index, e.g. in a GRIN lens, fiber, or acousto-optic modulator, the propagation of the electromagnetic fields can be modeled by fast algorithms. They are based on recent major achievements in fast physical optics and make use of the identification of the diffractive and geometric zones of electromagnetic fields. Dependent on the situation, this can enable vectorial propagation through graded-index media in seconds, including even the crosstalk between polarization directions. The theory and the resulting algorithms include established beam propagation techniques as special cases, e.g. the popular paraxial split-step technique.

Non-paraxial diffractive and refractive laser beam shaping

Laser Resonators, Microresonators, and Beam Control XX • Part of SPIE LASE • 1 February 2018 • 2:25 - 2:45 PM

Roberto Knoth, Liangxin Yang, Christian Hellmann, Frank Wyrowski

There are several reasons that a paraxial assumption in laser beam shaping is not justified, including 1) the use of laser diodes, which deliver a non-paraxial beam in the fast axis, 2) the use of lasers or other sources for wide-angle illumination, and 3) the generation of small focal spots with controlled profile by high NA lens systems. In order to keep the systems compact, it is not always possible to apply the beam shaping component in a paraxial region of the setup. We discuss the implications of the modeling and the design of diffractive and refractive freeform surfaces in non-paraxial regions of the fields to shape the profile of a laser beam in its far field, its focus or any other region. The fast physical optics approach employed enables the inclusion of freeform surfaces and diffractive beam shaping elements in the modeling. The design of beam shaping elements follows an inverse physical optics approach. We will discuss the pros and cons of refractive and diffractive solutions together with examples.

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