

Comsol Optical Wave Simulation

John D. Joannopoulos, Steven G. Johnson, Joshua N. Winn, Robert D. Meade

Optics Modeling and Visualization with Comsol Multiphysics Hee C. Lim, 2018-08 This manuscript is a step-by-step graphical instructions for COMSOL Multiphysics with Ray Optics Module and Wave Optics module modeling and computational physics simulation. All the example models investigated and visualized with the help of Finite Element Analysis are referenced from the standard USA undergraduate text on Optics by E. Hecht. The simulations include the use of geometrical ray tracings for point source, hemispherical, and conic rays as well as full electromagnetic waves source employing the Maxwell's wave equations for Gaussian waves input. Both 2D and 3D computational physics approach will be discussed with the introduction of the trick-of-the-trades meshings, and modeling skill besides setup options that are skillfully hidden in the simulation software from plain sight. The geometrical model covers 2D and 3D electromagnetic waves propagation in user defined refractive index domain; Laws of Refraction for 2D converging and diverging lens; Laws of Reflection for specular mirrors, 3D Prism, 3D Prism mirror equivalent system; Polarizations for 3D linear polarizers, 3D circular polarizer, 3D linear wave retarder such as half wave plate, quarter wave plate; the Theory of Superposition for the 2D Young's double slits Wavefront-splitting interference experiment, 3D thin film uniform thickness Amplitude-splitting interference experiment, 2D Michelson interferometer Mirrored-interference setup with the 1D interference fringes line graph; Fermat's principle for 2D single slits diffraction, 3D circular aperture diffraction experiment, 3D rectangular slit diffraction experiment, 3D diffraction gratings experiment with Fresnel near field and Fraunhofer far field diffraction pattern, diffraction pattern: Sinc() function observation discussions, the Limitation of ray tracing physics vs. full electromagnetic waves simulations in the physics of optics, the Babinet's principle of transparent openings or opaque obstacles diffraction slit; and finally the Modern optics of 2D and 3D LASER cavity multiphysics models with the application of multiple release time of rays for Stimulated Emission lasing. One of the most important and crucial component of the computational physics subject, the user customizable library of material properties that governs the realisticality of the final modeled results, is highlighted in the appendix section.

Optical Waveguides and Devices Modeling and Visualization Using COMSOL Multiphysics Volume 2 Hee Lim, 2018-10-20 This pictorial manuscript is a step-by-step graphical illustrations for waveguides and devices modeling and computational physics simulation using COMSOL Multiphysics with Ray Optics, Wave Optics and AC/DC Electrostatics modules. All the

example models investigated and visualized with the help of Finite Element Analysis are referenced from the standard USA undergraduate text on Optical Guided Waves and Devices by Richard Syms and John Cozens. The simulations include the use of geometrical ray tracings for point source and full electromagnetic waves source employing the Maxwell's wave equations for plane wave input. Both 2D and 3D simulation results will help in visualize the electromagnetic field propagating inside the waveguides and devices. Readers without fundamental handle on optics modeling are suggested to read the Optics Modeling and Visualization with COMSOL Multiphysics: A step by step graphical instruction manuscripts for detailed discussion. These models may be expanded to post-graduate research and industrial photonics waveguides and devices development. There are 46 chapters of different 2D and 3D optical waveguides & devices structures modeled and simulated in Volume 1 and 2. Volume 1 models include 3D single mode optical fiber, planar waveguide, channel waveguide, longitudinal and transverse phase modulator, surface plasmon, optical square waveguide, tapered waveguide, FTIR beamsplitter in ray tracing and electromagnetic wave solvers, full prism coupler, halved prism coupler, plano convex overlay lens, overlay Luneburg lens, geodesic lens with control setup for resulted electric field comparison, corrugated gratings, transmission and reflection gratings, chirped grating lens, beam expander grating, grating coupler, chirped grating coupler, buried channel waveguide. Volume 2 models continue with the ridge channel waveguide, strip loaded channel waveguide, GaAs GaAlAs planar waveguide, GaAs GaAlAs heterostructure waveguide, radiation leaks at fiber bend, radiation leaks at waveguide bend, c-axis Calcite polarizer waveguide, integrated optic normal reflector, horn channel waveguide, Y-junction waveguide, optical phase modulator, cut off modulator, electro optic Mach-Zehnder interferometer waveguide, parallel coupling waveguide, electro optic directional coupler, single polished fiber directional coupler, double polished fiber directional coupler, tunable-coupling strength of polished double fiber coupler, cross sectional coaxial fiber coupler, 2D directional coupler with tapered coupling, corrugated reflection gratings, optical fiber grating on half polished fiber coupler, and track-changing reflector with grating assisted-coupling fiber.

Optical Waveguides and Devices Modeling and Visualization Using COMSOL Multiphysics Volume 1 Hee Lim, 2018-10-19 This pictorial manuscript is a step-by-step graphical illustrations for waveguides and devices modeling and computational physics simulation using COMSOL Multiphysics with Ray Optics, Wave Optics and AC/DC Electrostatics modules. All the example models investigated and visualized with the help of Finite Element Analysis are referenced from the standard USA undergraduate text on Optical Guided Waves and Devices by Richard Syms and John Cozens. The simulations include the use of geometrical ray tracings for point source and full electromagnetic waves source employing the Maxwell's wave equations for plane wave input. Both 2D and 3D simulation results will help in visualize the electromagnetic field propagating inside the waveguides and devices. Readers without fundamental handle on optics modeling are suggested to read the Optics Modeling and Visualization with COMSOL Multiphysics: A step by step graphical instruction manuscripts for

detailed discussion. These models may be expanded to post-graduate research and industrial photonics waveguides and devices development. There are 46 chapters of different 2D and 3D optical waveguides & devices structures modeled and simulated in Volume 1 and 2. Volume 1 models include 3D single mode optical fiber, planar waveguide, channel waveguide, longitudinal and transverse phase modulator, surface plasmon, optical square waveguide, tapered waveguide, FTIR beamsplitter in ray tracing and electromagnetic wave solvers, full prism coupler, halved prism coupler, plano convex overlay lens, overlay Luneburg lens, geodesic lens with control setup for resulted electric field comparison, corrugated gratings, transmission and reflection gratings, chirped grating lens, beam expander grating, grating coupler, chirped grating coupler, buried channel waveguide. Volume 2 models continue with the ridge channel waveguide, strip loaded channel waveguide, GaAs GaAlAs planar waveguide, GaAs GaAlAs heterostructure waveguide, radiation leaks at fiber bend, radiation leaks at waveguide bend, c-axis Calcite polarizer waveguide, integrated optic normal reflector, horn channel waveguide, Y-Junction waveguide, optical phase modulator, cut off modulator, electro optic Mach-Zehnder interferometer waveguide, parallel coupling waveguide, electro optic directional coupler, single polished fiber directional coupler, double polished fiber directional coupler, tunable-coupling strength of polished double fiber coupler, cross sectional coaxial fiber coupler, 2D directional coupler with tapered coupling, corrugated reflection gratings, optical fiber grating on half polished fiber coupler, and track-changing reflector with grating assisted-coupling fiber.

The Finite Element Method in Electromagnetics Jian-Ming Jin, 2015-02-18 A new edition of the leading textbook on the finite element method, incorporating major advancements and further applications in the field of electromagnetics The finite element method (FEM) is a powerful simulation technique used to solve boundary-value problems in a variety of engineering circumstances. It has been widely used for analysis of electromagnetic fields in antennas, radar scattering, RF and microwave engineering, high-speed/high-frequency circuits, wireless communication, electromagnetic compatibility, photonics, remote sensing, biomedical engineering, and space exploration. The Finite Element Method in Electromagnetics, Third Edition explains the method's processes and techniques in careful, meticulous prose and covers not only essential finite element method theory, but also its latest developments and applications—giving engineers a methodical way to quickly master this very powerful numerical technique for solving practical, often complicated, electromagnetic problems. Featuring over thirty percent new material, the third edition of this essential and comprehensive text now includes: A wider range of applications, including antennas, phased arrays, electric machines, high-frequency circuits, and crystal photonics The finite element analysis of wave propagation, scattering, and radiation in periodic structures The time-domain finite element method for analysis of wideband antennas and transient electromagnetic phenomena Novel domain decomposition techniques for parallel computation and efficient simulation of large-scale problems, such as phased-array antennas and photonic crystals Along with a great many examples, The Finite Element Method in Electromagnetics is an ideal book for engineering students

as well as for professionals in the field.

Multiphysics Simulation Ercan M. Dede, Jaewook Lee, Tsuyoshi Nomura, 2014-05-28 This book highlights a unique combination of numerical tools and strategies for handling the challenges of multiphysics simulation, with a specific focus on electromechanical systems as the target application. Features: introduces the concept of design via simulation, along with the role of multiphysics simulation in today's engineering environment; discusses the importance of structural optimization techniques in the design and development of electromechanical systems; provides an overview of the physics commonly involved with electromechanical systems for applications such as electronics, magnetic components, RF components, actuators, and motors; reviews the governing equations for the simulation of related multiphysics problems; outlines relevant (topology and parametric size) optimization methods for electromechanical systems; describes in detail several multiphysics simulation and optimization example studies in both two and three dimensions, with sample numerical code.

Multiphysics Modeling Using COMSOL 5 and MATLAB Roger W. Pryor, 2021-12-03 COMSOL 5 and MATLAB are valuable software modeling tools for engineers and scientists. This updated edition includes five new models and explores a wide range of models in coordinate systems from 0D to 3D, introducing the numerical analysis techniques employed in COMSOL 5.6 and MATLAB software. The text presents electromagnetic, electronic, optical, thermal physics, and biomedical models as examples. It presents the fundamental concepts in the models and the step-by-step instructions needed to build each model. The companion files include all the built models for each step-by-step example presented in the text and the related animations, as specified. The book is designed to introduce modeling to an experienced engineer or can also be used for upper level undergraduate or graduate courses. FEATURES: Focuses on COMSOL 5.x and MATLAB models that demonstrate the use of concepts for later application in engineering, science, medicine, and biophysics for the development of devices and systems Includes companion files with executable copies of each model and related animations Includes detailed discussions of possible modeling errors and results Uses a step-by-step modeling methodology linked to the Fundamental Laws of Physics. The companion files are also available online by emailing the publisher with proof of purchase at info@merclearning.com.

Multiphysics Modeling With Finite Element Methods William B J Zimmerman, 2006-10-25 Finite element methods for approximating partial differential equations that arise in science and engineering analysis find widespread application. Numerical analysis tools make the solutions of coupled physics, mechanics, chemistry, and even biology accessible to the novice modeler. Nevertheless, modelers must be aware of the limitations and difficulties in developing numerical models that faithfully represent the system they are modeling. This textbook introduces the intellectual framework for modeling with Comsol Multiphysics, a package which has unique features in representing multiply linked domains with complex geometry, highly coupled and nonlinear equation systems, and arbitrarily complicated boundary, auxiliary, and initial conditions. But

with this modeling power comes great opportunities and great perils. Progressively, in the first part of the book the novice modeler develops an understanding of how to build up complicated models piecemeal and test them modularly. The second part of the book introduces advanced analysis techniques. The final part of the book deals with case studies in a broad range of application areas including nonlinear pattern formation, thin film dynamics and heterogeneous catalysis, composite and effective media for heat, mass, conductivity, and dispersion, population balances, tomography, multiphase flow, electrokinetic, microfluidic networks, plasma dynamics, and corrosion chemistry. As a revision of *Process Modeling and Simulation with Finite Element Methods*, this book uses the very latest features of Comsol Multiphysics. There are new case studies on multiphase flow with phase change, plasma dynamics, electromagnetohydrodynamics, microfluidic mixing, and corrosion. In addition, major improvements to the level set method for multiphase flow to ensure phase conservation is introduced.

Multiphysics Modeling Using COMSOL? Roger Pryor, 2011 *Multiphysics Modeling Using COMSOL?* rapidly introduces the senior level undergraduate, graduate or professional scientist or engineer to the art and science of computerized modeling for physical systems and devices. It offers a step-by-step modeling methodology through examples that are linked to the Fundamental Laws of Physics through a First Principles Analysis approach. The text explores a breadth of multiphysics models in coordinate systems that range from 1D to 3D and introduces the readers to the numerical analysis modeling techniques employed in the COMSOL? Multiphysics? software. After readers have built and run the examples, they will have a much firmer understanding of the concepts, skills, and benefits acquired from the use of computerized modeling techniques to solve their current technological problems and to explore new areas of application for their particular technological areas of interest.

High Voltage Engineering and Applications Ayman El-Hag, 2020-04-09 This book is a collection of recent publications from researchers all over the globe in the broad area of high-voltage engineering. The presented research papers cover both experimental and simulation studies, with a focus on topics related to insulation monitoring using state-of-the-art sensors and advanced machine learning algorithms. Special attention was given in the Special Issue to partial discharge monitoring as one of the most important techniques in insulation condition assessment. Moreover, this Special Issue contains several articles which focus on different modeling techniques that help researchers to better evaluate the condition of insulation systems. Different power system assets are addressed in this book, including transformers, outdoor insulators, underground cables, and gas-insulated substations.

Optical Properties of Thin Solid Films O. S. Heavens, 1991-01-01 Authoritative reference treats the formation, structure, optical properties, and uses of thin solid films, emphasizing causes of their unusual qualities. 162 figures. 19 tables. 1955 edition.

Surface Acoustic Wave Devices in Telecommunications Ken-Ya Hashimoto,2000-06-21 Surface acoustic wave (SAW) devices are widely used in mobile communications, a rapidly evolving market. This book gives an overview on the latest SAW technologies with an emphasis on the design and simulation of devices, such as resonator-based devices employing the SH-type leaky SAW.

Gradient-Index Optics C. Gomez-Reino,M.V. Perez,C. Bao,2012-12-06 This book provides a comprehensive and thorough treatment on fundamentals and applications of light propagation through inhomogeneous media. The authors present a description of the phenomena, components and technology used in GRIN Optics, and analyze various applications.

Microwave Circuit Modeling Using Electromagnetic Field Simulation Daniel G. Swanson,Wolfgang J. R. Hoefer,2003 Annotation This practical how to book is an ideal introduction to electromagnetic field-solvers. Where most books in this area are strictly theoretical, this unique resource provides engineers with helpful advice on selecting the right tools for their RF (radio frequency) and high-speed digital circuit design work

Fundamental Optical Design Michael J. Kidger,2002 This book provides all the essential and best elements of Kidger's many courses taught worldwide on lens and optical design. It is written in a direct style that is compact, logical, and to the point--a tutorial in the best sense of the word. I read my copy late last year and read it straight through, cover to cover. In fact, I read it no less than three times. Its elegant expositions, valuable insights, and up-front espousal of pre-design theory make it an outstanding work. It's in the same league with Conrady and Kingslake. Warren Smith.

Theory and Computation of Electromagnetic Fields Jian-Ming Jin,2015-08-10 Reviews the fundamental concepts behind the theory and computation of electromagnetic fields The book is divided in two parts. The first part covers both fundamental theories (such as vector analysis, Maxwell's equations, boundary condition, and transmission line theory) and advanced topics (such as wave transformation, addition theorems, and fields in layered media) in order to benefit students at all levels. The second part of the book covers the major computational methods for numerical analysis of electromagnetic fields for engineering applications. These methods include the three fundamental approaches for numerical analysis of electromagnetic fields: the finite difference method (the finite difference time-domain method in particular), the finite element method, and the integral equation-based moment method. The second part also examines fast algorithms for solving integral equations and hybrid techniques that combine different numerical methods to seek more efficient solutions of complicated electromagnetic problems. *Theory and Computation of Electromagnetic Fields, Second Edition*: Provides the foundation necessary for graduate students to learn and understand more advanced topics Discusses electromagnetic analysis in rectangular, cylindrical and spherical coordinates Covers computational electromagnetics in both frequency and time domains Includes new and updated homework problems and examples *Theory and Computation of Electromagnetic Fields, Second Edition* is written for advanced undergraduate and graduate level electrical engineering students. This book

can also be used as a reference for professional engineers interested in learning about analysis and computation skills.

Photonic Crystals John D. Joannopoulos, Steven G. Johnson, Joshua N. Winn, Robert D. Meade, 2011-10-30 Since it was first published in 1995, Photonic Crystals has remained the definitive text for both undergraduates and researchers on photonic band-gap materials and their use in controlling the propagation of light. This newly expanded and revised edition covers the latest developments in the field, providing the most up-to-date, concise, and comprehensive book available on these novel materials and their applications. Starting from Maxwell's equations and Fourier analysis, the authors develop the theoretical tools of photonics using principles of linear algebra and symmetry, emphasizing analogies with traditional solid-state physics and quantum theory. They then investigate the unique phenomena that take place within photonic crystals at defect sites and surfaces, from one to three dimensions. This new edition includes entirely new chapters describing important hybrid structures that use band gaps or periodicity only in some directions: periodic waveguides, photonic-crystal slabs, and photonic-crystal fibers. The authors demonstrate how the capabilities of photonic crystals to localize light can be put to work in devices such as filters and splitters. A new appendix provides an overview of computational methods for electromagnetism. Existing chapters have been considerably updated and expanded to include many new three-dimensional photonic crystals, an extensive tutorial on device design using temporal coupled-mode theory, discussions of diffraction and refraction at crystal interfaces, and more. Richly illustrated and accessibly written, Photonic Crystals is an indispensable resource for students and researchers. Extensively revised and expanded Features improved graphics throughout Includes new chapters on photonic-crystal fibers and combined index-and band-gap-guiding Provides an introduction to coupled-mode theory as a powerful tool for device design Covers many new topics, including omnidirectional reflection, anomalous refraction and diffraction, computational photonics, and much more.

The Physics of Semiconductor Devices R. K. Sharma, D.S. Rawal, 2019-01-31 This book disseminates the current knowledge of semiconductor physics and its applications across the scientific community. It is based on a biennial workshop that provides the participating research groups with a stimulating platform for interaction and collaboration with colleagues from the same scientific community. The book discusses the latest developments in the field of III-nitrides; materials & devices, compound semiconductors, VLSI technology, optoelectronics, sensors, photovoltaics, crystal growth, epitaxy and characterization, graphene and other 2D materials and organic semiconductors.

Integrated Ring Resonators Dominik G. Rabus, 2007-04-26 The optical filter is resonator based. The required passband shape of ring resonator-filters can be custom designed by the use of configurations of various ring coupled resonators. This book describes the current state-of-the-art on these devices. It provides an in-depth knowledge of the simulation, fabrication and characterization of ring resonators for use as example filters, lasers, sensors.

Proceedings of the 2nd International Conference on Electronic Engineering and Renewable Energy Systems

Bekkey Hajji, Adel Mellit, Giuseppe Marco Tina, Abdelhamid Rabhi, Jerome Launay, Salah Eddine Naimi, 2020-08-14 This book includes papers presented at the Second International Conference on Electronic Engineering and Renewable Energy (ICEERE 2020), which focus on the application of artificial intelligence techniques, emerging technology and the Internet of things in electrical and renewable energy systems, including hybrid systems, micro-grids, networking, smart health applications, smart grid, mechatronics and electric vehicles. It particularly focuses on new renewable energy technologies for agricultural and rural areas to promote the development of the Euro-Mediterranean region. Given its scope, the book is of interest to graduate students, researchers and practicing engineers working in the fields of electronic engineering and renewable energy.

Specialty Optical Fibers Handbook Alexis Mendez, T. F. Morse, 2011-10-10 This book is a comprehensive contributed volume that aims to describe and explain the design, fabrication, operating characteristics, and specific applications of the most popular and useful types of specialty optical fibers. These specialty fibers include any kind of optical fiber that has been architecturally manipulated to diverge from a conventional structure. For instance, metal-coated fibers can be utilized for bandwidth improvement, and hollow core fibers offer more controllable dispersion for sensitive medical procedures. Applications for these specialty fibers abound in the biomedical, sensors, and industrial fields, as well as in more traditional communications capacities. This book will act as a specialty fiber guided tour, hosted by the top names in the discipline. The globally renowned editors, Drs. Mendez and Morse, have extensive experience in research, academia, and industry.*Completely covers biomedical and industrial sensor technology with emphasis on real world applications
*Comparative studies of pros and cons of all fiber types with relation to test and measurement, mechanical properties and strength, and reliability*Easy to access essential facts and details at the beginning of each chapter

Comsol Optical Wave Simulation Book Review: Unveiling the Magic of Language

In an electronic digital era where connections and knowledge reign supreme, the enchanting power of language has become more apparent than ever. Its ability to stir emotions, provoke thought, and instigate transformation is truly remarkable. This extraordinary book, aptly titled "**Comsol Optical Wave Simulation**," compiled by a highly acclaimed author, immerses readers in a captivating exploration of the significance of language and its profound effect on our existence. Throughout this critique, we shall delve into the book's central themes, evaluate its unique writing style, and assess its overall influence on its readership.

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