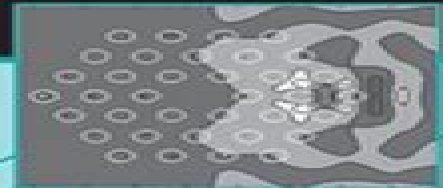
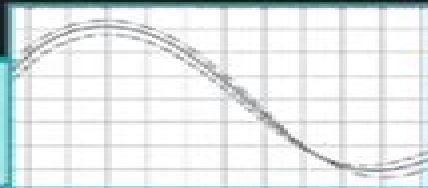
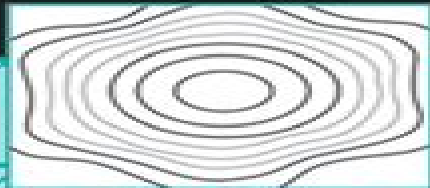


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Finite Element Modeling Methods for PHOTONICS



Finite Element Modeling Methods For Photonics

**Andrei V. Lavrinenko, Jesper
Lægsgaard, Niels Gregersen, Frank
Schmidt, Thomas Søndergaard**

Finite Element Modeling Methods For Photonics Finite Element Modeling Methods For Photonics:

Finite Element Modeling Methods for Photonics B. M. Azizur Rahman ,Arti Agrawal ,2013-08-01 The term photonics can be used loosely to refer to a vast array of components devices and technologies that in some way involve manipulation of light One of the most powerful numerical approaches available to engineers developing photonic components and devices is the Finite Element Method FEM which can be used to model and simulate such components devices and analyze how they will behave in response to various outside influences This resource provides a comprehensive description of the formulation and applications of FEM in photonics applications ranging from telecommunications astronomy and sensing to chemistry imaging and biomedical R D This book emphasizes practical problem solving applications and includes real world examples to assist readers in understanding how mathematical concepts translate to computer code for finite element based methods applicable to a range of photonic structures In addition this is the perfect support to anyone using the COMSOL Multiphysics RF Module

Finite Element Modeling Methods for Photonics B. M. Azizur Rahman,2013 The term photonics can be used loosely to refer to a vast array of components devices and technologies that in some way involve manipulation of light One of the most powerful numerical approaches available to engineers developing photonic components and devices is the Finite Element Method FEM which can be used to model and simulate such components devices and analyze how they will behave in response to various outside influences This resource provides a comprehensive description of the formulation and applications of FEM in photonics applications ranging from telecommunications astron

Numerical Methods in Photonics Andrei V. Lavrinenko,Jesper Lægsgaard,Niels Gregersen, Frank Schmidt,Thomas Søndergaard,2018-09-03 Simulation and modeling using numerical methods is one of the key instruments in any scientific work In the field of photonics a wide range of numerical methods are used for studying both fundamental optics and applications such as design development and optimization of photonic components Modeling is key for developing improved photonic devices and reducing development time and cost Choosing the appropriate computational method for a photonics modeling problem requires a clear understanding of the pros and cons of the available numerical methods Numerical Methods in Photonics presents six of the most frequently used methods FDTD FDFD 1 1D nonlinear propagation modal method Green s function and FEM After an introductory chapter outlining the basics of Maxwell s equations the book includes self contained chapters that focus on each of the methods Each method is accompanied by a review of the mathematical principles in which it is based along with sample scripts illustrative examples of characteristic problem solving and exercises MATLAB is used throughout the text This book provides a solid basis to practice writing your own codes The theoretical formulation is complemented by sets of exercises which allow you to grasp the essence of the modeling tools

Photonic Crystal Fibres Anders Bjarklev,Jes Broeng,Araceli Sanchez Bjarklev,2012-12-06 Photonic Crystal Fibres describes the fundamental properties of the optical waveguides known under the terms of photonic crystal fibres microstructured fibres or holey fibres

It outlines how the fibres are designed and fabricated and how they are treated from a theoretical and numerical point of view The book presents a detailed description of the different classes of photonic crystal and photonic bandgap fibres and it broadens out a spectrum of novel applications and new fibre types

Phase Change Materials-Based Photonic Computing Harish Bhaskaran, Wolfram Pernice, 2024-01-21 Phase Change Materials Based Photonic Computing provides a clear introduction to the field introducing concepts of photonics computing phase change materials and future outlooks Phase change materials are well known and studied in many contexts and photonics is a longstanding field with photonic neuromorphic computing recently gathering interest However the two fields are disparate and few people understand the key concepts needed to integrate the two This book will be the first to do so in this promising field It is suitable for researchers and practitioners in academia and industry working in the disciplines of materials science and engineering electrical engineering and computing Introduces the advanced fundamental concepts of photonics computing and phase change materials Reviews the remaining challenges to translation opportunities and future outlooks Addresses definitions historical context foundational concepts and the latest advances of phase change materials based photonics computing

Computational Photonic Sensors Mohamed Farhat O. Hameed, Salah Obayya, 2018-06-13 This book provides a comprehensive overview of the photonic sensing field by covering plasmonics photonic crystal and SOI techniques from theory to real sensing applications A literature review of ultra sensitive photonic sensors including their design and application in industry makes this a self contained and comprehensive resource for different types of sensors with high value to the biosensor sector in particular The book is organized into four parts Part I covers the basic theory of wave propagation basic principles of sensing surface plasmon resonance and silicon photonics Part II details the computational modeling techniques for the analysis and prediction of photonic sensors Part III and Part IV cover the various mechanisms and light matter interaction scenarios behind the design of photonic sensors including photonic crystal fiber sensors and SOI sensors This book is appropriate for academics and researchers specializing in photonic sensors graduate students in the early and intermediate stages working in the areas of photonics sensors biophysics and biomedical engineering and to biomedical environmental and chemical engineers

Fourier Modal Method and Its Applications in Computational Nanophotonics Hwi Kim, Junghyun Park, Byoung-ho Lee, 2017-12-19 Most available books on computational electrodynamics are focused on FDTD FEM or other specific technique developed in microwave engineering In contrast Fourier Modal Method and Its Applications in Computational Nanophotonics is a complete guide to the principles and detailed mathematics of the up to date Fourier modal method of optical analysis It takes readers through the implementation of MATLAB codes for practical modeling of well known and promising nanophotonic structures The authors also address the limitations of the Fourier modal method Features Provides a comprehensive guide to the principles methods and mathematics of the Fourier modal method Explores the emerging field of computational nanophotonics Presents clear step by step practical explanations on how to use the

Fourier modal method for photonics and nanophotonics applications Includes the necessary MATLAB codes enabling readers to construct their own code Using this book graduate students and researchers can learn about nanophotonics simulations through a comprehensive treatment of the mathematics underlying the Fourier modal method and examples of practical problems solved with MATLAB codes

Handbook of Optoelectronic Device Modeling and Simulation Joachim Piprek,2017-10-12 Optoelectronic devices are now ubiquitous in our daily lives from light emitting diodes LEDs in many household appliances to solar cells for energy This handbook shows how we can probe the underlying and highly complex physical processes using modern mathematical models and numerical simulation for optoelectronic device design analysis and performance optimization It reflects the wide availability of powerful computers and advanced commercial software which have opened the door for non specialists to perform sophisticated modeling and simulation tasks The chapters comprise the know how of more than a hundred experts from all over the world The handbook is an ideal starting point for beginners but also gives experienced researchers the opportunity to renew and broaden their knowledge in this expanding field

Computational Nanophotonics Sarhan Musa,2018-10-08 This reference offers tools for engineers scientists biologists and others working with the computational techniques of nanophotonics It introduces the key concepts of computational methods in a manner that is easily digestible for newcomers to the field The book also examines future applications of nanophotonics in the technical industry and covers new developments and interdisciplinary research in engineering science and medicine It provides an overview of the key computational nanophotonics and describes the technologies with an emphasis on how they work and their key benefits

Diffraction Optics and Nanophotonics V. A. Soifer,2017-09-01 Diffraction Optics and Nanophotonics is devoted to achievements in diffraction optics focusing on the creation of new nanophotonic components and devices as well as instrumentation and available information technology The author describes methods of calculation of diffraction optical elements to solve actual problems of nanophotonics Coverage includes mathematical methods for calculation of diffraction gratings calculation of modes of inhomogeneous waveguides integral methods of calculation of electromagnetic field near the focus and methods of calculation of diffraction optical elements generating vortex laser beams

Photonics Modelling and Design Slawomir Sujecki,2018-09-03 Photonics Modeling and Design delivers a concise introduction to the modeling and design of photonic devices Assuming a general knowledge of photonics and the operating principles of fibre and semiconductor lasers this book Describes the analysis of the light propagation in dielectric media Discusses heat diffusion and carrier transport Applies the presented theory to develop fibre and semiconductor laser models Addresses the propagation of short optical pulses in optical fibres Puts all modeling into practical context with examples of devices currently in development or on the market Providing hands on guidance in the form of MATLAB scripts tips and other downloadable content Photonics Modeling and Design is written for students and professionals interested in modeling photonic devices either for gaining a deeper understanding of the operation or to

optimize the design *Photonic Crystal and Its Applications for Next Generation Systems* Shanmuga Sundar Dhanabalan, Arun Thirumurugan, Ramesh Raju, Sathish-Kumar Kamaraj, Sridarshini Thirumaran, 2023-07-07 This book covers the advanced fabrication techniques challenges and applications of photonic crystals for next generation systems in various applications such as high speed networks photonic integrated circuits health care sensors energy and environmental This book highlights the literature and works put forward by various scientists researchers and academicians in photonic crystals and their real time applications The content of the book appeals to readers such as students researchers and industrial engineers who are working in the design and development of photonics based concepts components and devices for various applications **Diffractive Nanophotonics** Victor A Soifer, 2016-04-19 Diffractive Nanophotonics demonstrates the utility of the well established methods of diffractive computer optics in solving nanophotonics tasks It is concerned with peculiar properties of laser light diffraction by microoptics elements with nanoscale features and light confinement in subwavelength space regions Written by recognized experts in t **Beam Propagation Method for Design of Optical Waveguide Devices** Ginés Lifante Pedrola, 2015-10-13 The basic of the BPM technique in the frequency domain relies on treating the slowly varying envelope of the monochromatic electromagnetic field under paraxial propagation thus allowing efficient numerical computation in terms of speed and allocated memory In addition the BPM based on finite differences is an easy way to implement robust and efficient computer codes This book presents several approaches for treating the light wide angle scalar approach semivectorial treatment and full vectorial treatment of the electromagnetic fields Also special topics in BPM cover the simulation of light propagation in anisotropic media non linear materials electro optic materials and media with gain losses and describe how BPM can deal with strong index discontinuities or waveguide gratings by introducing the bidirectional BPM BPM in the time domain is also described and the book includes the powerful technique of finite difference time domain method which fills the gap when the standard BPM is no longer applicable Once the description of these numerical techniques have been detailed the last chapter includes examples of passive active and functional integrated photonic devices such as waveguide reflectors demultiplexers polarization converters electro optic modulators lasers or frequency converters The book will help readers to understand several BPM approaches to build their own codes or to properly use the existing commercial software based on these numerical techniques Principles of Photonic Integrated Circuits Richard Osgood jr., Xiang Meng, 2021-05-21 This graduate level textbook presents the principles design methods simulation and materials of photonic circuits It provides state of the art examples of silicon indium phosphide and other materials frequently used in these circuits and includes a thorough discussion of all major types of devices In addition the book discusses the integrated photonic circuits chips that are currently increasingly employed on the international technology market in connection with short range and long range data communication Featuring references from the latest research in the field as well as chapter end summaries and problem sets Principles of Photonic Integrated Circuits is ideal for

any graduate level course on integrated photonics or optical technology and communication

On-Chip Photonics Alina Karabchevsky, Amol Choudhary, 2024-08-13 On Chip Photonics Principles Technology and Applications reviews advances in integrated photonic devices and their demonstrated applications including ultrafast high power lasers on a chip mid infrared and overtone spectroscopies all optical processing on a chip logic gates on a chip and cryptography on a chip The summaries in the book s chapters facilitate an understanding of the field and enable the application of optical waveguides in a variety of optical systems The ultimate goal of this work is aimed at accelerating the transition of on chip photonics from academia to the industry Each chapter where appropriate provides an overview of the computational tools fabrication methods and suggestions for the realization of on chip photonic devices Introduces advanced concepts of passive and active on chip photonic components Discusses emerging applications of on chip photonics quantum technologies computing and more Reviews materials computational tools and suggestions for the realization of on chip photonic devices

Plasmonic Optical Fiber Biosensors Christophe Caucheteur, Médéric Loyez, 2023-04-30 This book provides a thorough vision of the current trends in plasmonic optical fiber biochemical sensing It gathers the most recent technological information and shows the maturity reached by the different subsequent technologies Demonstrating roadmaps for the design process and implementation of plasmonic optical fiber biochemical sensors the book bridges the gap between theory and application With this philosophy understanding key physical properties is of paramount importance for the efficient design of sensing platforms that will meet target specifications You will learn about the role of the fiber configuration and the functional coating on the properties of the resulting optrodes You will also get an encompassing overview on all optical fiber configurations used for plasmonic sensing thus far especially on the progress made over the last decade and rendering the technology compatible for use in real conditions The book presents both fundamental aspects and advanced applications while focusing on recent and emerging fields of research such as the use of tilted fiber Bragg gratings the integration of sensors in situ the use of smart interrogation techniques and much more This is a unique reference for both beginners and experts in optical fiber based sensors especially for industrial engineers working in biophotonics and biochemical sensing as it presents state of the art design procedures and sensing features The book s theoretical background combined with recent advances of plasmonic based optical fiber technologies also make it highly beneficial for all researchers academics and students specialized or interested in this flourishing and promising discipline

Optical Waveguiding and Applied Photonics Aimé Lay-Ekuakille, 2014-01-18 Optoelectronics technology based on applications light such as micro nano quantum electronics photonic devices laser for measurements and detection has become an important field of research Many applications and physical problems concerning optoelectronics are analyzed in Optical Waveguiding and Applied Photonics The book is organized in order to explain how to implement innovative sensors starting from basic physical principles Applications such as cavity resonance filtering tactile sensors robotic sensor oil spill detection small antennas and

experimental setups using lasers are analyzed Innovative materials such as nanocomposites are characterized designed and applied in order to provide new ideas about detection principles As with many electric circuitries light applications and architectures suffer from noising due to physical and transmission connections The book illustrates some examples for practical issues The theory and the nanotechnology facilities provide important tools for researchers working with sensing applications

Photonics, Plasmonics and Information Optics Arpan Deyasi, Pampa Debnath, Asit Kumar Datta, Siddhartha Bhattacharyya, 2021-04-19 This edited volume covers technological developments and current research trends in the field of photonics plasmonics and optics focusing on photonic crystals semiconductor optical devices optical communications and optical sensors with an emphasis on practical sectors It broadly contains the latest research domains contributed by experts and researchers in their respective fields with a major focus on the basic physics Works in the area of electromagnetic bandgap structures EBG and metasurfaces are included for applications in different aspects of communications systems Further it covers research phenomena of microwave photonic devices to develop miniaturized high frequency devices

FEATURES Reviews nonlinear optical phenomena related with materials and crystals and plasmonic effects on device fabrications Contains a detailed analysis on photonic crystals with their applications in making all optical passive components Focusses on nonlinear optics more precisely on crystals and materials and computational aspects on evaluating their properties from Maxwell's equations Presents an extensive study on the physics of EBG structures for application in antenna and high frequency communications Includes metamaterials and metasurfaces for applications in photonics as well as in microwave engineering for high frequency communication systems

Photonics Plasmonics and Information Optics Research and Technological Advances is aimed at researchers professionals and graduate students in optical communication silicon photonics photonic crystals semiconductor optical devices metamaterials and metasurfaces and microwave photonics

Computational Liquid Crystal Photonics Salah Obayya, Mohamed Farhat O. Hameed, Nihal F. F. Areed, 2016-05-31 Optical computers and photonic integrated circuits in high capacity optical networks are hot topics attracting the attention of expert researchers and commercial technology companies Optical packet switching and routing technologies promise to provide a more efficient source of power and footprint scaling with increased router capacity integrating more optical processing elements into the same chip to increase on chip processing capability and system intelligence has become a priority This book is an in depth look at modelling techniques and the simulation of a wide range of liquid crystal based modern photonic devices with enhanced high levels of flexible integration and enhanced power processing It covers the physics of liquid crystal materials techniques required for modelling liquid crystal based devices the state of the art liquid crystal photonic based applications for telecommunications such as couplers polarization rotators polarization splitters and multiplexer demultiplexers liquid core photonic crystal fiber LC PCF sensors including biomedical and temperature sensors and liquid crystal photonic crystal based encryption systems for security applications

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in depth learning on the fundamental principles of computational liquid crystal photonics Explains complex concepts such as photonic crystals liquid crystals waveguides and modes and frequency and time domain techniques used in the design of liquid crystal photonic crystal photonic devices in terms that are easy to understand Demonstrates the useful properties of liquid crystals in a diverse and ever growing list of technological applications Requires only a foundational knowledge of mathematics and physics

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Finite Element Modeling Methods For Photonics Finite Element Modeling Methods For Photonics Introduction

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