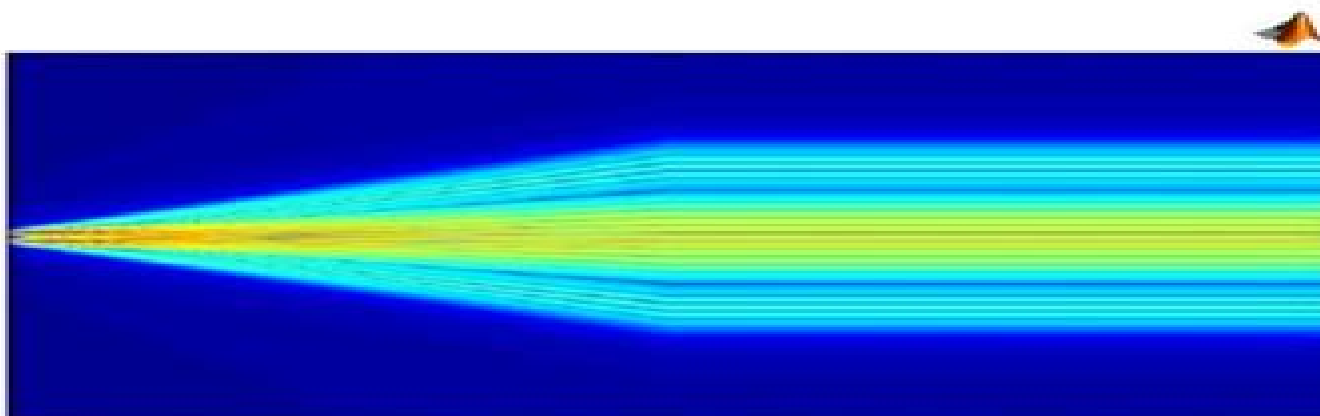


Optical waveguide analysis using Beam Propagation Method

Term Paper for "Introduction to Optoelectronics" spring 2006
Prof. Frank Barnes



Page 10: My MATLAB® implementation of double slit diffraction
Using Beam Propagation Method

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Propagating Beam Analysis Of Optical Waveguides

Slawomir Sujecki



Propagating Beam Analysis Of Optical Waveguides:

Propagating Beam Analysis of Optical Waveguides Junji Yamauchi, 2003 This book is for graduate students and scientists interested in the numerical analysis of dielectric waveguides Engineers in industries should be interested since optical waveguide analysis is becoming popular and indispensable in designing various optical devices at a small cost of time and labour This text is a comprehensive introduction to a beam propagation analysis of optical waveguides and is the summary of the research investigations made at Hosei University Japan The subject described in the book includes the finite difference beam propagation method BPM in Cartesian cylindrical and oblique coordinates For the Cartesian coordinates based BPM semivectorial and fullvectorial BPMs are presented with some applications Improved finite difference formulas are introduced to accurately analyze graded index and step index waveguides The alternating direction implicit method is employed to efficiently treat three dimensional structures To deal with a reflection problem a time domain BPM scalar FD TD method and vectorial FD TD method are provided A hybrid technique that combines the BPM and the FD TD method is also described

Fundamentals of Optical Waveguides Katsunari Okamoto, 2010-08-04 Fundamentals of Optical Waveguides is an essential resource for any researcher professional or student involved in optics and communications engineering Any reader interested in designing or actively working with optical devices must have a firm grasp of the principles of lightwave propagation Katsunari Okamoto has presented this difficult technology clearly and concisely with several illustrations and equations Optical theory encompassed in this reference includes coupled mode theory nonlinear optical effects finite element method beam propagation method staircase concatenation method along with several central theorems and formulas Since the publication of the well received first edition of this book planar lightwave circuits and photonic crystal fibers have fully matured With this second edition the advances of these fibers along with other improvements on existing optical technologies are completely detailed This comprehensive volume enables readers to fully analyze design and simulate optical atmospheres Exceptional new chapter on Arrayed Waveguide Grating AWG In depth discussion of Photonic Crystal Fibers PCFs Thorough explanation of Multimode Interference Devices MMI Full coverage of polarization Mode Dispersion PMD

Beam Propagation Method for Design of Optical Waveguide Devices Ginés Lifante Pedrola, 2015-10-20 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

Optical Waveguides Maria L. Calvo, Vasudevan Lakshminarayanan, 2018-10-03 Although the theory and principles of optical waveguides have been established for more than a century the technologies have only been realized in recent decades *Optical Waveguides From Theory to Applied Technologies* combines the most relevant aspects of waveguide theory with the study of current detailed waveguiding technologies in particular photonic devices telecommunication applications and biomedical optics With self contained chapters written by well known specialists the book features both fundamentals and applications The first three chapters examine the theoretical foundations and bases of planar optical waveguides as well as critical optical properties such as birefringence and nonlinear optical phenomena The next several chapters focus on contemporary waveguiding technologies that include photonic devices and telecommunications The book concludes with discussions on additional technological applications including biomedical optical waveguides and the potential of neutron waveguides As optical waveguides play an increasing part in modern technology photonics will become to the 21st century what electronics were to the 20th century Offering both novel insights for experienced professionals and introductory material for novices this book facilitates a better understanding of the new information era the photonics century

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

Waveguide Optoelectronics J.H. Marsh, Richard M. de la Rue, 2012-12-06 The NATO Advanced Study on Waveguide Optoelectronics was held at the Kelvin Conference Centre in Glasgow Scotland between 30 July and 10 August 1990 In all 30 students and 15 lecturers attended the ASI The success of the meeting was due not only to the high quality of the presentations but also to the enthusiasm of all the participants and their willingness to take part in the discussion and poster sessions 1990 was also the year in which Glasgow was the European City of Culture This resulted in

interesting diversions during the middle weekend of the school and also made the meeting probably the first NATO ASI to share accommodation with the Bolshoi Opera and Ballet who gave memorable performances as part of the City's celebrations. This volume is however intended to be more than merely a record of presentations at the NATO meeting. The authors have written their material so as to be approachable by a first degree graduate with some background in optoelectronics. The principal materials considered are the III-V semiconductors, lithium niobate and silica. Recent developments towards optoelectronic integration in semiconductors, developments in devices fabricated in doped silica and doped lithium niobate and developments in all optical switching networks are highlighted. The role of reduced dimensional structures is examined in some detail. **Handbook of Optoelectronic Device Modeling and Simulation** Joachim Piprek, 2017-10-10

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. **Scientific and**

Technical Aerospace Reports, 1980 *Electromagnetic Theory and Applications for Photonic Crystals* Kiyotoshi Yasumoto, 2018-10-03. Photonic technology promises much faster computing, massive parallel processing and an evolutionary step in the digital age. The search continues for devices that will enable this paradigm and these devices will be based on photonic crystals. Modeling is a key process in developing crystals with the desired characteristics and performance and *Electromagnetic Theory and Applications for Photonic Crystals* provides the electromagnetic theoretical models that can be effectively applied to modeling photonic crystals and related optical devices. The book supplies eight self-contained chapters that detail various analytical, numerical and computational approaches to the modeling of scattering and guiding problems. For each model, the chapter begins with a brief introduction, detailed formulations of periodic structures and photonic crystals and practical applications to photonic crystal devices. Expert contributors discuss the scattering matrix method, multipole theory of scattering and propagation, model of layered periodic arrays for photonic crystals, the multiple multipole program, the mode matching method for periodic metallic structures, the method of lines, the finite difference frequency domain technique and the finite difference time domain technique. Based on original research and application efforts, *Electromagnetic Theory and Applications for Photonic Crystals* supplies a broad array of practical tools for analyzing and designing devices that will form the basis for a new age in computing. Computational Photonics Salah Obayya, 2011-06-20. This book explores the state of the art in computational modelling techniques for photonic devices. In this book, the author

provides a comprehensive coverage of modern numerical modelling techniques for designing photonic devices for use in modern optical telecommunications systems. In addition, the book presents the state of the art in computational photonics techniques covering methods such as full vectorial finite element beam propagation, bidirectional beam propagation, complex envelope, alternative direction, implicit finite difference time domain, multiresolution time domain, and finite volume time domain. The book guides the reader through the concepts of modelling, analysing, designing, and optimising the performance of a wide range of photonic devices by building their own numerical code using these methods.

Key Features: Provides a thorough presentation of the state of the art in computational modelling techniques for photonics. Contains broad coverage of both frequency and time domain techniques to suit a wide range of photonic devices. Reviews existing commercial software packages for photonics. Presents the advantages and disadvantages of the different modelling techniques as well as their suitability for various photonic devices. Shows the reader how to model, analyse, design, and optimise the performance of a wide range of photonic devices by building their own numerical code using these methods. Accompanying website contains the numerical examples representing the numerical techniques in this book as well as several design examples. http://www.wiley.com/go/obayya_computational

This book will serve as an invaluable reference for researchers, optical telecommunications engineers, engineers in the photonics industry, PhD and MSc students undertaking courses in the areas of photonics and optical telecommunications, and will also find this book of interest.

The Handbook of Photonics Mool C. Gupta, John Ballato, 2018-10-03

Reflecting changes in the field in the ten years since the publication of the first edition, *The Handbook of Photonics* Second Edition explores recent advances that have affected this technology. In this new updated second edition, editor Mool Gupta is joined by John Ballato, strengthening the handbook with their combined knowledge and the continued contributions of world class researchers. New in the Second Edition: Information on optical fiber technology and the economic impact of photonics. Coverage of emerging technologies in nanotechnology. Sections on optical amplifiers and polymeric optical materials. The book covers photonics materials, devices, and systems respectively. An introductory chapter new to this edition provides an overview of photonics technology innovation and economic development. Resting firmly on the foundation set by the first edition, this new edition continues to serve as a source for introductory material and a collection of published data for research and training in this field, making it the reference of first resort.

Journal of the Optical Society of America, 1989

Photonic Devices for Telecommunications George Guekos, 2012-12-06

This book is subdivided into three main Parts. The common spirit in these parts is to provide at the beginning of each a comprehensive introduction into the subject treated, followed by specific aspects pertaining to the modelling and/or measuring particularities arising from the investigation of photonic devices for telecommunications. Some of the devices treated here can be considered as widely known and well established. Others are rather new and their potential for applications is not yet fully exploited. The methods to model and measure photonic in this book and the comparison of results obtained, devices and structures outlined by

applying such methods are likely to interest both the engineer investigating the of a device in a system and the engineer looking for new ways to explore behaviour the possibilities offered by emerging devices Many authors have contributed to this book There are two main reasons for this in photonic device research modelling First the book addresses two broad fields and measurements for which a vast knowledge exists in many research groups that was not integrated in a book before Second a significant number of laboratories decided to closely co operate in order to gain additional information on merits and drawbacks of their own methods for simulation and experimentation of devices as compared to the methods used by their colleagues in other laboratories The outcome are new aspects and approaches that would not have been investigated in the absence of a framework for a co operative programme

Handbook of Laser Technology and Applications Chunlei Guo,Subhash Chandra Singh,2021-06-23 This comprehensive handbook gives a fully updated guide to lasers and laser technologies including the complete range of their technical applications The first volume outlines the fundamental components of lasers their properties and working principles Key Features Offers a complete update of the original bestselling work including many brand new chapters Deepens the introduction to fundamentals from laser design and fabrication to host matrices for solid state lasers energy level diagrams hosting materials dopant energy levels and lasers based on nonlinear effects Covers new laser types including quantum cascade lasers silicon based lasers titanium sapphire lasers terahertz lasers bismuth doped fiber lasers and diode pumped alkali lasers Discusses the latest applications e g lasers in microscopy high speed imaging attosecond metrology 3D printing optical atomic clocks time resolved spectroscopy polarization and profile measurements pulse measurements and laser induced fluorescence detection Adds new sections on laser materials processing laser spectroscopy lasers in imaging lasers in environmental sciences and lasers in communications This handbook is the ideal companion for scientists engineers and students working with lasers including those in optics electrical engineering physics chemistry biomedicine and other relevant areas

Emerging Waveguide Technology Kok Yeow You,2018-08-01 Recently the rapid development of radiofrequency RF microwave and photonic optical waveguide technologies has had a significant impact on the current electronic industrial medical and information and communication technology ICT fields This book is a self contained collection of valuable scholarly papers related to waveguide design modeling and applications This book contains 20 chapters that cover three main subtopics of waveguide technologies namely RF and microwave waveguide photonic and optical waveguide and waveguide analytical solutions Hence this book is particularly useful to the academics scientists practicing researchers and postgraduate students whose work relates to the latest waveguide technologies

Interconnects in VLSI Design Hartmut Grabinski,2012-12-06 This book presents an updated selection of the most representative contributions to the 2nd and 3rd IEEE Workshops on Signal Propagation on Interconnects SPI which were held in Travemünde Baltic Sea Side Germany May 13 15 1998 and in Titisee Neustadt Black Forest Germany May 19 21 1999 This publication addresses the need of developers and researchers in the

field of VLSI chip and package design It offers a survey of current problems regarding the influence of interconnect effects on the electrical performance of electronic circuits and suggests innovative solutions In this sense the present book represents a continuation and a supplement to the first book *Signal Propagation on Interconnects* Kluwer Academic Publishers 1998 The papers in this book cover a wide area of research directions Beneath the description of general trends they deal with the solution of signal integrity problems the modeling of interconnects parameter extraction using calculations and measurements and last but not least actual problems in the field of optical interconnects *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

Research in Progress ,1973 *Handbook of Terahertz Technologies* Ho-Jin Song,Tadao Nagatsuma,2015-04-15 Terahertz waves which lie in the frequency range of 0.1-10 THz have long been investigated in a few limited fields such as astronomy because of a lack of devices for their generation and detection Several technical breakthroughs made over the last couple of decades now allow us to radiate and detect terahertz waves more easily which has triggered **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 Key features Offers a unique source of 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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