

## Computational Electrodynamics The Finite Difference Time Domain Method Third Edition

Essentials of Computational Electromagnetics provides an in-depth introduction of the three main full-wave numerical methods in computational electromagnetics (CEM); namely, the method of moment (MoM), the finite element method (FEM), and the finite-difference time-domain (FDTD) method. Numerous monographs can be found addressing one of the above three methods. However, few give a broad general overview of essentials embodied in these methods, or were published too early to include recent advances. Furthermore, many existing monographs only present the final numerical results without specifying practical issues, such as how to convert discretized formulations into computer programs, and the numerical characteristics of the computer programs. In this book, the authors elaborate the above three methods in CEM using practical case studies, explaining their own research experiences along with a review of current literature. A full analysis is provided for typical cases, including characteristics of numerical methods, helping beginners to develop a quick and deep understanding of the essentials of CEM. Outlines practical issues, such as how to convert discretized formulations into computer programs Gives typical computer programs and their characteristics along with line by line explanations of programs Uses practical examples from the authors' own work as well as in the current literature Includes exercise problems to give readers a better understanding of the material Introduces the available commercial software and their limitations This book is intended for graduate-level students in antennas and propagation, microwaves, microelectronics, and electromagnetics. This text can also be used by researchers in electrical and electronic engineering, and software developers interested in writing their own code or understanding the detailed workings of code. Companion website for the book: www.wiley.com/go/sheng/cem

"To my knowledge [this] is the first book to address specifically the use of high-order discretizations in the time domain to solve wave equations. [...] I recommend the book for its clear and cogent coverage of the material selected by its author." --Physics Today, March 2003

This book is an indispensable resource for making efficient and accurate formulations for electromagnetics applications and their numerical treatment, Employing a unified and coherent approach that is unmatched in the field, the authors deatil both integral and differential equations using the method-of-moments and finite-element procedures.

A self-study tutorial which presents the fundamental principles and rigorous numerical validations of a major contemporary branch in frequency-domain computational electromagnetics.

Computational Methods for Physics
The Finite Difference Time Domain Method for Electromagnetics

Numerical Methods in Electromagnetism

Electromagnetic Compatibility Engineering

EMI/EMC Computational Modeling Handbook

Computational Methods for Electromagnetic Phenomena

Introduction to the Finite-Difference Time-Domain (FDTD) Method for Electromagnetics provides a comprehensive tutorial of the most widely used method for solving Maxwell's equations -- the Finite Difference Time-Domain Method. This book is an essential guide for students, researchers, and professional engineers who want to gain a fundamental knowledge of the FDTD method. It can accompany an undergraduate or entry-level graduate course or be used for self-study. The book provides all the background required to either research or apply the FDTD method for the solution of Maxwell's equations to practical problems in engineering and science. Introduction to the Finite-Difference Time-Domain (FDTD) Method for Electromagnetics guides the reader through the foundational theory of the FDTD method starting with the one-dimensional transmission-line problem and then progressing to the solution of Maxwell's equations in three dimensions. It also provides step by step guides to modeling physical sources, lumped-circuit components, absorbing boundary conditions, perfectly matched layer absorbers, and sub-cell structures. Post processing methods such as network parameter extraction and far-field transformations are also detailed. Efficient implementations of the FDTD method in a high level language are also provided. Table of Contents: Introduction / 1D FDTD Modeling of the Transmission Line Equations / Yee Algorithm for Maxwell's Equations / Source Excitations / Absorbing Boundary Conditions / The Perfectly Matched Layer (PML) Absorbing Medium / Subcell Modeling / Post Processing

Positioning itself at the common boundaries of several disciplines, this work provides new perspectives on modern nanoscale problems where fundamental science meets technology and computer modeling. In addition to well-known computational techniques such as finite-difference schemes and Ewald summation, the book presents a new finite-difference calculus of Flexible Local Approximation Methods (FLAME) that qualitatively improves the numerical accuracy in a variety of problems.

Describes most popular computational methods used to solve problems in electromagnetics Matlab code is included throughout, so that the reader can implement the various techniques discussed Exercises included

This book is an electromagnetics classic. Originally published in 1941, it has been used by many generations of students, teachers, and researchers ever since. Since it is classic electromagnetics, every chapter continues to be referenced to this day. This classic reissue contains the entire, original edition first published in 1941. Additionally, two new forewords by Dr. Paul E. Gray (former MIT President and colleague of Dr. Stratton) and another by Dr. Donald G. Dudley, Editor of the IEEE Press Series on E/M Waves on the significance of the book s contribution to the field of Electromagnetics.

Photonic Crystals

Numerical Electromagnetics

Electromagnetic Simulation Using the FDTD Method with Python

Photonics and Nanotechnology

Direct and Inverse Problems

Molding the Flow of Light - Second Edition

Electromagnetics is the foundation of our electric technology. It describes the fundamental principles upon which electricity is generated and used. This includes electric machines, high voltage transmission, telecommunication, radar, and recording and digital computing. Numerical Methods in Electromagnetism will serve both as an introductory text for graduate students and as a reference book for professional engineers and researchers. This book leads the uninitiated into the realm of numerical methods for solving electromagnetic field problems by examples and illustrations. Detailed descriptions of advanced techniques are also included for the benefit of working engineers and research students. Comprehensive descriptions of numerical methods In-depth introduction to finite differences, finite elements, and integral equations Illustrations and applications of linear and nonlinear solutions for multi-dimensional analysis Numerical examples to facilitate understanding of the methods Appendices for quick reference of mathematical and numerical methods employed

Computational Electromagnetics is a young and growing discipline, expanding as a result of the steadily increasing demand for software for the design and analysis of electrical devices. This book introduces three of the most popular numerical methods for simulating electromagnetic fields: the finite difference method, the finite element method and the method of moments. In particular it focuses on how these methods are used to obtain valid approximations to the solutions of Maxwell's equations, using, for example, "staggered grids" and "edge elements." The main goal of the book is to make the reader aware of different sources of errors in numerical computations, and also to provide the tools for assessing the accuracy of numerical methods and their solutions. To reach this goal, convergence analysis, extrapolation, von Neumann stability analysis, and dispersion analysis are introduced and used frequently throughout the book. Another major goal of the book is to provide students with enough practical understanding of the methods so they are able to write simple programs on their own. To achieve this, the book contains several MATLAB programs and detailed description of practical issues such as assembly of finite element matrices and handling of unstructured meshes. Finally, the book aims at making the students well-aware of the strengths and weaknesses of the different methods, so they can decide which method is best for each problem. In this second edition, extensive computer projects are added as well as new material throughout. Reviews of previous edition: "The well-written monograph is devoted to students at the undergraduate level, but is also useful for practising engineers." (Zentralblatt MATH, 2007)

These ten detailed and authoritative survey articles on numerical methods for direct and inverse wave propagation problems are written by leading experts. Researchers and practitioners in computational wave propagation, from postgraduate level onwards, will find the breadth and depth of coverage of recent developments a valuable resource. The articles describe a wide range of topics on the application and analysis of methods for time and frequency domain PDE and boundary integral formulations of wave propagation problems. Electromagnetic, seismic and acoustic equations are considered. Recent developments in methods and analysis ranging from finite differences to hp-adaptive finite elements, including high-accuracy and fast methods are described with extensive references.

Praise for Noise Reduction Techniques IN electronic systems "Henry Ott has literally 'written the book' on the subject of EMC. . . . He not only knows the subject, but has the rare ability to communicate that knowledge to others." —EE Times Electromagnetic Compatibility Engineering is a completely revised, expanded, and updated version of Henry Ott's popular book Noise Reduction Techniques in Electronic Systems. It reflects the most recent developments in the field of electromagnetic compatibility (EMC) and noise reductionand their practical applications to the design of analog and digital circuits in computer, home entertainment, medical, telecom, industrial process control, and automotive equipment, as well as military and aerospace systems. While maintaining and updating the core information—such as cabling, grounding, filtering, shielding, digital circuit grounding and layout, and ESD—that made the previous book such a wide success, this new book includes additional coverage of: Equipment/systems grounding Switching power supplies and variable-speed motor drives Digital circuit power distribution and decoupling PCB layout and stack-up Mixed-signal PCB layout RF and transient immunity Power line disturbances Precompliance EMC measurements New appendices on dipole antennae, the theory of partial inductance, and the ten most common EMC problems The concepts presented are applicable to analog and digital circuits operating from below audio frequencies to those in the GHz range. Throughout the book, an emphasis is placed on cost-effective EMC designs, with the amount and complexity of mathematics kept to the strictest minimum. Complemented with over 250 problems with answers, Electromagnetic Compatibility Engineering equips readers with the knowledge needed to design electronic equipment that is compatible with the electromagnetic environment and compliant with national and international EMC regulations. It is an essential resource for practicing engineers who face EMC and regulatory compliance issues and an ideal textbook for EE courses at the advanced undergraduate and graduate levels.

The FDTD Method

The Finite-Difference Time-Domain Method

Advances in FDTD Computational Electrodynamics

Advances in Computational Electrodyamics

Computational Electrodynamics

Theory and Computation of Electromagnetic Fields

Beginning with the development of finite difference equations, and leading to the complete FDTD algorithm, this is a coherent introduction to the FDTD method (the method of choice for modeling Maxwell's equations). It provides students and professional engineers with everything they need to know to begin writing FDTD simulations from scratch and to develop a thorough understanding of the inner workings of commercial FDTD software. Stability, numerical dispersion, sources and boundary conditions are all discussed in detail, as are dispersive and anisotropic materials. A comparative introduction of the finite volume and finite element methods is also provided. All concepts are introduced from first principles, so no prior modeling experience is required, and they are made easier to understand through numerous illustrative examples and the inclusion of both intuitive explanations and mathematical derivations.

A straightforward, easy-to-read introduction to the finite-difference time-domain (FDTD) method Finite-difference time-domain (FDTD) is one of the primary computational electrodyamics modeling techniques available. Since it is a time-domain method, FDTD solutions can cover a wide frequency range with a single simulation run and treat nonlinear material properties in a natural way. Written in a tutorial fashion, starting with the simplest programs and guiding the reader up from one-dimensional to the more complex, three-dimensional programs, this book provides a simple, yet comprehensive introduction to the most widely used method for electromagnetic simulation. This fully updated edition presents many new applications, including the FDTD method being used in the design and analysis of highly resonant radio frequency (RF) coils often used for MRI. Each chapter contains a concise explanation of an essential concept and instruction on its implementation into computer code. Projects that increase in complexity are included, ranging from simulations in free space to propagation in dispersive media. Additionally, the text offers downloadable MATLAB and C programming languages from the book support site (http://booksupport.wiley.com). Simple to read and classroom-tested, Electromagnetic Simulation Using the FDTD Method is a useful reference for practicing engineers as well as undergraduate and graduate engineering students.

Finite-Difference Time-Domain (FD-TD) modeling is arguably the most popular and powerful means available to perform detailed electromagnetic engineering analyses. Edited by the pioneer and foremost authority on the subject, here is the first book to assemble in one resource the latest techniques and results of the leading theoreticians and practitioners of FD-TD computational electromagnetics modeling.

"Numerical simulation is an irreplaceable tool in earthquake ground motion research. Among all the numerical methods in seismology, the finite-difference (FD) technique is the most widely-used, providing the best balance of accuracy and computational efficiency. Now, for the first time, this book offers a comprehensive introduction to this method and its applications to earthquake motion"--

The Finite Element Method in Electromagnetics

Theory, Computation and Applications

Computational Reality

A Gentle Introduction to Numerical Simulations with Python

Computational Electromagnetics

First-ever comprehensive introduction to the major new subject of quantum computing and quantum information.

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.

This book presents the theory of continuum mechanics for mechanical, thermodynamical, and electrodynamic systems. It shows how to obtain governing equations and it applies them by computing the reality. It uses only open-source codes developed under the FEniCS project and includes codes for 2D engineering applications from mechanics, fluid dynamics, applied thermodynamics, and electromagnetism. Moreover, it derives and utilizes the constitutive equations including coupling terms, which allow to compute multiphysics problems by incorporating interactions between primitive variables, namely, motion, temperature, and electromagnetic fields. An engineering system is described by the primitive variables satisfying field equations that are partial differential equations in space and time. The field equations are mostly coupled and nonlinear, in other words, difficult to solve. In order to solve the coupled, nonlinear system of partial differential equations, the book uses a novel collection of open-source packages developed under the FEniCS project. All primitive variables are solved at once in a fully coupled fashion by using finite difference method in time and finite element method in space.

The application of computational electromagnetics to practical EMI/EMC engineering is an emerging technology. Because of the increased complexity in EMI/EMC issues resulting from advancements in electronics and telecommunications, it is no longer possible to rely exclusively on traditional techniques and tools to solve the growing list of electronic engineering design problems. EMI/EMC Computational Modeling Handbook introduces modeling and simulation of electromagnetics to real-world EMI/EMC engineering. It combines the essentials of electromagnetics, computational techniques, and actual EMI/EMC applications. Included are such popular full-wave computational modeling techniques as the Method of Moments, Finite-Difference Time Domain Technique, Finite Element Method, and several others. The authors have included a myriad of applications for computers, telecommunications, consumer electronics, medical electronics, and military uses. EMI/EMC Computational Modeling Handbook is an invaluable reference work for practicing EMI/EMC engineers, electronic design engineers, and any engineer involved in computational electromagnetics.

A Gentle Introduction to Numerical Simulations with MATLAB/Octave

Computational Electromagnetics for RF and Microwave Engineering

Solving Nonlinear and Coupled Problems in Continuum Mechanics

Proceedings of the GAMM Workshop on Computational Electromagnetics, Kiel, Germany, January 26 – 28, 2001

Computational Methods for Nanoscale Applications

Gratings: Theory and Numeric Applications

This work represents a university text and professional/research reference on the finite-difference time-domain computational solution method for Maxwell's equations. Sections cover numerical stability, numerical dispersion and dispersive, nonlinear and gain methods of FD-TD and antenna analysis.

Computational electrodyamics is a vast research field with a wide variety of tools. In physics, the principle of gauge invariance plays a pivotal role as a guide towards a sensible formulation of the laws of nature as well as for computing the properties of elementary particles using the lattice formulation of gauge theories. However, the gauge principle has played a much less pronounced role in performing computation in classical electrodyamics. In this work, the author demonstrates that starting from the gauge formulation of electrodyamics using the electromagnetic potentials leads to computational tools that can very well compete with the conventional electromagnetic field-based tools. Once accepting the formulation based on gauge fields, the computational code is very transparent due to the mimetic mapping of the electrodynamic variables on the computational grid. Although the illustrations and applications originate from microelectronic engineering, the method has a much larger range of applicability. Therefore this book will be useful to everyone having interest in computational electrodyamics. The volume is organized as follows: In part 1, a detailed introduction and overview is presented of the Maxwell equations as well as the derivation of the current and charge densities in different materials. Semiconductors are responding to electromagnetic fields in a non-linear way, and the induced complications are discussed in detail. Part 2, using the gauge potentials, presents the transition of electrodyamics theory to a formulation that can serve as the gateway to computational code. In part 3, a collection of microelectronic device designs demonstrate the feasibility and success of the methods in Part 2. Part 4 focuses on a set of topical themes that brings the reader to the frontier of research in building the simulation tools, using the gauge principle in computational electrodyamics. Technical topics discussed in the book include: - Electromagnetic Field Equations - Constitutive Relations - Discretization and Numerical Analysis - Finite Element and Finite Volume Methods - Design of Integrated Passive Components

This fourth edition of the text reflects the continuing increase in awareness and use of computational electromagnetics and incorporates advances and refinements made in recent years. Most notable among these are the improvements made to the standard algorithm for the finite-difference time-domain (FDTD) method and treatment of absorbing boundary conditions in FDTD, finite element, and transmission-line-matrix methods. It teaches the readers how to pose, numerically analyze, and solve EM problems, to give them the ability to expand their problem-solving skills using a variety of methods, and to prepare them for research in electromagnetism. Includes new homework problems in each chapter. Each chapter is updated with the current trends in CEM. Adds a new appendix on CEM codes, which covers commercial and free codes. Provides updated MATLAB code.

Provides an introduction to the Finite Difference Time Domain method and shows how Python code can be used to implement various simulations This book allows engineering students and practicing engineers to learn the finite-difference time-domain (FDTD) method and properly apply it toward their electromagnetic simulation projects. Each chapter contains a concise explanation of an essential concept and instruction on its implementation into computer code. Included projects increase in complexity, ranging from simulations in free space to propagation in dispersive media. This third edition utilizes the Python programming language, which is becoming the preferred computer language for the engineering and scientific community. Electromagnetic Simulation Using the FDTD Method with Python, Third Edition is written with the goal of enabling readers to learn the FDTD method in a manageable amount of time. Some basic applications of signal processing theory are explained to enhance the effectiveness of FDTD simulation. Topics covered in include one-dimensional simulation with the FDTD method, two-dimensional simulation, and three-dimensional simulation. The book also covers advanced Python features and deep regional hyperthermia treatment planning. Electromagnetic Simulation Using the FDTD Method with Python: Guides the reader from basic programs to complex, three-dimensional programs in a tutorial fashion Includes a rewritten fifth chapter that illustrates the most interesting applications in FDTD and the advanced graphics techniques of Python Covers peripheral topics pertinent to time-domain simulation, such as Z-transforms and the discrete Fourier transform Provides Python simulation programs on an accompanying website An ideal book for senior undergraduate engineering students studying FDTD, Electromagnetic Simulation Using the FDTD Method with Python will also benefit scientists and engineers interested in the subject.

Discontinuous Galerkin Methods

Computational Electromagnetics and Its Applications

A Gauge Approach with Applications in Microelectronics

A Student's Guide to Vectors and Tensors

Particles, Plasmons and Waves

Higher-Order Numerical Methods for Transient Wave Equations

*A class of finite element methods, the Discontinuous Galerkin Methods (DGM), has been under rapid development recently and has found its use very quickly in such diverse applications as aeroacoustics, semi-conductor device simula tion, turbomachinery, turbulent flows, materials processing, MHD and plasma simulations, and image processing. While there has been a lot of interest from mathematicians, physicists and engineers in DGM, only scattered information is available and there has been no prior effort in organizing and publishing the existing volume of knowledge on this subject. In May 24-26, 1999 we organized in Newport (Rhode Island, USA), the first international symposium on DGM with equal emphasis on the theory, numerical implementation, and applications. Eighteen invited speakers, lead ers in the field, and thirty-two contributors presented various aspects and addressed open issues on DGM. In this volume we include forty-nine papers presented in the Symposium as well as a survey paper written by the organiz ers. All papers were peer-reviewed. A summary of these papers is included in the survey paper, which also provides a historical perspective of the evolution of DGM and its relation to other numerical methods. We hope this volume will become a major reference in this topic. It is intended for students and researchers who work in theory and application of numerical solution of convection dominated partial differential equations. The papers were written with the assumption that the reader has some knowledge of classical finite elements and finite volume methods.*

*This book presents computer programming as a key method for solving mathematical problems. There are two versions of the book, one for MATLAB and one for Python. The book was inspired by the Springer book TCSE 6: A Primer on Scientific Programming with Python (by Langtangen), but the style is more accessible and concise, in keeping with the needs of engineering students. The book outlines the shortest possible path from no previous experience with programming to a set of skills that allows the students to write simple programs for solving common mathematical problems with numerical methods in engineering and science courses. The emphasis is on generic algorithms, clean design of programs, use of functions, and automatic tests for verification.*

*This publication documents the proceedings of the first Workshop on Computational Electromagnetics (CEM) and Applications, hosted by the Institute for Computer Applications in Science and Engineering (ICASE) and the NASA Langley Research Center, Hampton, Virginia, 29-31 May, 1996, and attended by approximately 70 people from academia, government laboratories, and industry. ICASE's charter mission in 1972 remains today - to explore novel computer environments (vector in the 1970s; parallel in the 1990s) for scientific computing. These proceedings provide a necessary foundation for symposia in computational electromagnetics for future aerospace applications. The objectives of this CEM Workshop were to provide a forum for many of the leaders of the community to assess the state of CEM technology and to discuss areas of research for future programmatic planning activities. Workshop sessions included topics on optimization, industrial applications, algorithms, and a special panel session was provided during which issues were discussed and future research areas were identified. Hopefully, this publication will stimulate and improve communication among multidisciplinary researchers as well as highlighting several CEM areas that need improvement - especially for highly challenging problems. The two most important criteria in the selection of speakers for the workshop were their substantial contribution to large-scale CEM problems and their ability to articulate the issues confronting the CEM research community. Based on the results obtained, it is anticipated that this publication will be useful to government, industry, and university researchers to plan future research tasks in CEM analytical methods and applications.*

*The first book of its kind to cover a wide range of computational methods for electromagnetic phenomena, from atomistic to continuum scales, this integrated and balanced treatment of mathematical formulations, algorithms and the underlying physics enables us to engage in innovative and advanced interdisciplinary computational research.*

Computational Methods for Electromagnetics

Quantum Computation and Quantum Information

Electromagnetic Simulation Using the FDTD Method

The Finite-Difference Modelling of Earthquake Motions

Computational Electromagnetics with MATLAB, Fourth Edition

Topics in Computational Wave Propagation

Advances in photonics and nanotechnology have the potential to revolutionize humanity's ability to communicate and compute. To pursue these advances, it is mandatory to understand and properly model interactions of light with materials such as silicon and gold at the nanoscale, i.e., the span of a few tens of atoms laid side by side. These interactions are governed by the fundamental Maxwell's equations of classical electrodyamics, supplemented by quantum electrodyamics. This book presents the current state-of-the-art in formulating and implementing computational models of these interactions. Maxwell's equations are solved using the finite-difference time-domain (FDTD) technique, pioneered by the senior editor, whose prior Artech House books in this area are among the top ten most-cited in the history of engineering. This cutting-edge resource helps readers understand the latest developments in computational modeling of nanoscale optical microscopy and microchip lithography, as well as nanoscale plasmonics and biophotonics.

There is an increasing need for undergraduate students in physics to have a core set of computational tools. Most problems in physics benefit from numerical methods, and many of them resist analytical solution altogether. This textbook presents numerical techniques for solving familiar physical problems where a complete solution is inaccessible using traditional mathematical methods. The merical techniques for solving the problems are clearly laid out, with a focus on the logic and applicability of the method. The same problems are revisited multiple times using different numerical techniques, so readers can easily compare the methods. The book features over 250 end-of-chapter exercises. A website hosted by the author features a complete set of programs used to generate the examples and figures, which can be used as a starting point for further investigation. A link to this can be found at www.cambridge.org/9781107034303.

Computational ElectrodynamicsThe Finite-difference Time-domain MethodArtech House Antenna Library a

*The dimmed outlines of phenomenal things all into one another unless we put on the merge focusing-glass of theory, and screw it up some times to one pitch of definition and sometimes to another, so as to see down into different depths through the great millstone of the modern James Clerk Maxwell (1831 – 1879) For a long time after the foundation of the modern theory of electromag netism by James Clerk Maxwell in the 19th century, the mathematical ap proach to electromagnetic field problems was for a long time dominated by the analytical investigation of Maxwell's equations. The rapid development of computing facilities during the last century has then necessitated appropriate numerical methods and algorithmic tools for the simulation of electromagnetic phenomena. During the last few decades, a new research area "Computational Electromagnetics" has emerged com prising the mathematical analysis, design, implementation, and application of numerical schemes to simulate all kinds of relevant electromagnetic pro cesses. This area is still rapidly evolving with a wide spectrum of challenging issues featuring, among others, such problems as the proper choice of spatial discretizations (finite differences, finite elements, finite volumes, bounded elements), fast solvers for the discretized equations (multilevel techniques, domain decomposition methods, multipole, panel clustering), and multiscale aspects in microelectronics and micromagnetics.*

Programming for Computations – Python

Electrostatics in Solvation, Scattering, and Electron Transport

Essentials of Computational Electromagnetics

Waves and Ruptures

Introduction to the Finite-difference Time-domain (FDTD) Method for Electromagnetics

Introduction to the Finite Element Method in Electromagnetics

**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.

Vectors and tensors are among the most powerful problem-solving tools available, with applications ranging from mechanics and electromagnetics to general relativity. Understanding the nature and application of vectors and tensors is critically important to students of physics and engineering. Adopting the same approach used in his highly popular *A Student's Guide to Maxwell's Equations*, Fleisch explains vectors and tensors in plain language. Written for undergraduate and beginning graduate students, the book provides a thorough grounding in vectors and vector calculus before transitioning through contra and covariant components to tensors and their applications. Matrices and their algebra are reviewed on the book's supporting website, which also features interactive solutions to every problem in the text where students can work through a series of hints or choose to see the entire solution at once. Audio podcasts give students the opportunity to hear important concepts in the book explained by the author.

Introduces CEM methods, applying the codes that implement them to real-world engineering problems.

This lecture is written primarily for the non-expert engineer or the undergraduate or graduate student who wants to learn, for the first time, the finite element method with applications to electromagnetics. It is also designed for research engineers who have knowledge of other numerical techniques and want to familiarize themselves with the finite element method. Finite element method is a numerical method used to solve boundary-value problems characterized by a partial differential equation and a set of boundary conditions. Author Anastasis Polycarpou provides the reader with all information necessary to successfully apply the finite element method to one- and two-dimensional boundary-value problems in electromagnetics. The book is accompanied by a number of codes written by the author in Matlab. These are the finite element codes that were used to generate most of the graphs presented in this book. Specifically, there are three Matlab codes for the one-dimensional case (Chapter 1) and two Matlab codes for the two-dimensional case (Chapter 2). The reader may execute these codes, modify certain parameters such as mesh size or object dimensions, and visualize the results. The codes are available on the Morgan & Claypool Web site at <http://www.morganclaypool.com>.

Electromagnetic Theory

*The Finite-Difference Time-Domain Method for Electromagnetics with MATLAB® Simulations*

*Programming for Computations – MATLAB/Octave*

The Finite-Difference Time-domain (FDTD) method allows you to compute electromagnetic interaction for complex problem geometries with ease. The simplicity of the approach coupled with its far-reaching usefulness, create the powerful, popular method presented in *The Finite Difference Time Domain Method for Electromagnetics*. This volume offers timeless applications and formulations you can use to treat virtually any material type and geometry. The Finite Difference Time Domain Method for Electromagnetics explores the mathematical foundations of FDTD, including stability, outer radiation boundary conditions, and different coordinate systems. It covers derivations of FDTD for use with PEC, metal, lossy dielectrics, gyrotropic materials, and anisotropic materials. A number of applications are completely worked out with numerous figures to illustrate the results. It also includes a printed FORTRAN 77 version of the code that implements the technique in three dimensions for lossy dielectric materials. There are many methods for analyzing electromagnetic interactions for problem geometries. With *The Finite Difference Time Domain Method for Electromagnetics*, you will learn the simplest, most useful of these methods, from the basics through to the practical applications.

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.

This book introduces the powerful Finite-Difference Time-Domain method to students and interested researchers and readers. An effective introduction is accomplished using a step-by-step process that builds competence and confidence in developing complete working codes for the design and analysis of various antennas and microwave devices. This book will serve graduate students, researchers, and those in industry and government who are using other electromagnetics tools and methods for the sake of performing independent numerical confirmation. No previous experience with finite-difference methods is assumed of readers.