# *Finite Element Electromagnetic Wiley Ieee*

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 numerical 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
This book is a self-contained, programming-oriented and learner-centered book on finite element method (FEM), with special emphasis given to developing MATLAB® programs for numerical modeling of electromagnetic boundary value problems. It provides a deep understanding and intuition of FEM programming by means of step-by-step MATLAB® programs with detailed descriptions, and eventually enabling the readers to modify, adapt and

apply the provided programs and formulations to develop FEM codes for similar problems through various exercises. It starts with simple one-dimensional static and time-harmonic problems and extends the developed theory to more complex two- or three-dimensional problems. It supplies sufficient theoretical background on the topic, and it thoroughly covers all phases (pre-processing, main body and post-processing) in FEM. FEM formulations are obtained for boundary value problems governed by a

partial differential equation that is expressed in terms of a generic unknown function, and then, these formulations are specialized to various electromagnetic applications together with a post-processing phase. Since the method is mostly described in a general context, readers from other disciplines can also use this book and easily adapt the provided codes to their engineering problems. After forming a solid background on the fundamentals of FEM by means of canonical problems, readers are guided to

more advanced applications of FEM in electromagnetics through a survey chapter at the end of the book. Offers a self-contained and easy-to-understand introduction to the theory and programming of finite element method. Covers various applications in the field of static and time-harmonic electromagnetics. Includes one-, two- and three-dimensional finite element codes in MATLAB®. Enables readers to develop finite element programming skills through various MATLAB® codes and exercises. Promotes self-directed learning

skills and provides an effective instruction tool.

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.

Filled with illustrations, examples and approximately 300 homework problems, this accessible and informative text provides an extensive treatment of electromagnetism and microwave engineering with particular emphasis on microwave and telecommunications applications. Also stresses computational electromagnetics through the use of MathCad and finite element methods to elucidate design

problems, analysis and applications. Tutorials on the use of MathCad and PSpice are included. An accessible textbook for students and valuable reference for engineers already in the field.

Computational Electromagnetics for RF and Microwave Engineering

Three-dimensional Finite-element Time-domain Modeling of the Marine Controlled-source Electromagnetic Method

Inverse Problems and Optimal Design in Electricity and Magnetism

Electromechanical System Applications and

Optimization
Electromagnetic Modeling and Simulation
A comprehensive review of the recent advances in anechoic chamber and reverberation chamber designs and measurements Anechoic and Reverberation Chambers is a guide to the latest systematic solutions for designing anechoic chambers that rely on state-of-the-art computational electromagnetic algorithms. This essential resource contains a theoretical and practical

understanding for electromagnetic compatibility and antenna testing. The solutions outlined optimise chamber performance in the structure, absorber layout and antenna positions whilst minimising the overall cost. The anechoic chamber designs are verified by measurement results from Microwave Vision Group that validate the accuracy of the solution. Anechoic and Reverberation Chambers fills this gap in the literature by providing a

comprehensive reference to electromagnetic measurements, applications and over-the-air tests inside chambers. The expert contributors offer a summary of the latest developments in anechoic and reverberation chambers to help scientists and engineers apply the most recent technologies in the field. In addition, the book contains a comparison between reverberation and anechoic chambers and identifies their

strengths and weaknesses. This important resource: • Provides a systematic solution for anechoic chamber design by using state-of-the-art computational electromagnetic algorithms • Examines both types of chamber in use: comparing and contrasting the advantages and disadvantages of each • Reviews typical over-the-air measurements and new applications in reverberation chambers • Offers a timely and complete

reference written by authors working at the cutting edge of the technology • Contains helpful illustrations, photographs, practical examples and comparison between measurements and simulations Written for both academics and industrial engineers and designers, Anechoic and Reverberation Chambers explores the most recent advances in anechoic chamber and reverberation chamber designs and measurements.
A fully updated, easy-to-read guide on

magnetic actuators and sensors The Second Edition of this must-have book for today's engineers includes the latest updates and advances in the field of magnetic actuators and sensors. Magnetic Actuators and Sensors emphasizes computer-aided design techniques—especially magnetic finite element analysis; offers many new sections on topics ranging from magnetic separators to spin valve sensors; and features numerous worked

calculations, illustrations, and real-life applications. To aid readers in building solid, fundamental, theoretical background and design know-how, the book provides in-depth coverage in four parts: PART I: MAGNETICS Introduction Basic Electromagnetics Reluctance Method Finite-Element Method Magnetic Force Other Magnetic Performance Parameters PART II: ACTUATORS Magnetic Actuators Operated by Direct Current Magnetic

Actuators Operated by Alternating Current Magnetic Actuator Transient Operation PART III: SENSORS Hall Effect and Magnetoresistive Sensors Other Magnetic Sensors PART IV: SYSTEMS Coil Design and Temperature Calculations Electromagnetic Compatibility Electromechanical Finite Elements Electromechanical Analysis Using Systems Models Coupled Electrohydraulic Analysis Using Systems Models With access to a support website containing

downloadable software data files (including MATLAB® data files) for verifying design techniques and analytical methods, Magnetic Actuators and Sensors, Second Edition is an exemplary learning tool for practicing engineers and engineering students involved in the design and application of magnetic actuators and sensors.

Time Domain Electromagnetics deals with a specific technique in electromagnetics within the general

area of electrical engineering. This mathematical method has become a standard for a wide variety of applications for design and problem solving. This method of analysis in electromagnetics is directly related to advances in cellular and mobile communications technology, as well as traditional EM areas such as radar, antennas, and wave propagation. Most of the material is available in the research journals which is difficult

for a non-specialist to locate, read, understand, and effectively use for the problem at hand. Only book currently available to practicing engineers and research scientists exclusively devoted to this subject Includes contributions by the world's leading experts in electromagnetics Presents the most popular methods used in time domain analysis are included at one place with thorough discussion of the methods in an easily understandable style In each

chapter, many simple and practical examples are discussed thoroughly to illustrate the salient points of the material presented All chapters are written in a consistent style that allows the book to be of use for self-study by professionals as well as for use in a graduate-level course in electrical engineering

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.

Electromagnetics

Advances in FDTD Computational

Electrodynamics
Multiphysics Simulation
Finite Element Analysis of Antennas and Arrays
Theory and Computation of Electromagnetic Fields

This is the first truly comprehensive and most up-to-date handbook available on modern reflector antennas and feed sources for diversified space and ground applications. There has never been such an all-encompassing reflector handbook in print, and no currently available title offers coverage of such recent research developments. The Handbook consists of three volumes. Volume II focuses on

feed sources. Reflector antennas are extraordinary devices that combine high gain with geometrical simplicity, and can operate in broad frequency bands. Their performance, however, depends on the electrical characteristics of the feed system with which they operate. This comprehensive volume provides you with a solid understanding of feed system theory, design, and analysis. Featuring chapters authored by experts in each aspect of feed systems, this book takes you from fundamental mathematical techniques, electrically small and large dual reflectors, feed geometry and telemetry, tracking and command antennas, and more. Throughout the book numerous examples are provided to guide you in the practical aspects of feed design. Employed in a large number of commercial electromagnetic

simulation packages, the finite element method is one of the most popular and well-established numerical techniques in engineering. This book covers the theory, development, implementation, and application of the finite element method and its hybrid versions to electromagnetics. FINITE ELEMENT METHOD FOR ELECTROMAGNETICS begins with a step-by-step textbook presentation of the finite method and its variations then goes on to provide up-to-date coverage of three dimensional formulations and modern applications to open and closed domain problems. Worked out examples are included to aid the reader with the fine features of the method and the implementation of its hybridization with other techniques for a robust simulation of large scale radiation and scattering. The crucial treatment of local

boundary conditions is carefully worked out in several stages in the book. Sponsored by: IEEE Antennas and Propagation Society.

This is the first comprehensive monograph that featuresstate-of-the-art multigrid methods for enhancing the modelingversatility, numerical robustness, and computational efficiency ofone of the most popular classes of numerical electromagnetic fieldmodeling methods: the method of finite elements. The focus of thepublication is the development of robust preconditioners for theiterative solution of electromagnetic field boundary value problems(BVPs) discretized by means of finite methods. Specifically, the authors set forth their own successful attemptsto utilize concepts from multigrid and multilevel

methods for theeffective preconditioning of matrices resulting from theapproximation of electromagnetic BVPs using finite methods.Following the authors' careful explanations and step-by-stepinstruction, readers can duplicate the authors' results and takeadvantage of today's state-of-the-art multigrid/multilevelpreconditioners for finite element-based iterative electromagneticfield solvers. Among the highlights of coverage are: * Application of multigrid, multilevel, and hybridmultigrid/multilevel preconditioners to electromagnetic scatteringand radiation problems * Broadband, robust numerical modeling of passive microwavecomponents and circuits * Robust, finite element-based modal analysis of electromagneticwaveguides and cavities * Application of

Krylov subspace-based methodologies forreduced-order macromodeling of electromagnetic devices andsystems * Finite element modeling of electromagnetic waves in periodicstructures The authors provide more than thirty detailed algorithms alongsidepseudo-codes to assist readers with practical computerimplementation. In addition, each chapter includes an applicationssection with helpful numerical examples that validate the authors'methodologies and demonstrate their computational efficiency androbustness. This groundbreaking book, with its coverage of an exciting newenabling computer-aided design technology, is an essentialreference for computer programmers, designers, and engineers, aswell as graduate students in engineering

and applied physics.

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.

Theory, Techniques, and Engineering Paradigms

Magnetic Actuators and Sensors

Computational Electromagnetics

Computational Methods for Electromagnetics

**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.**
**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 electrodynamics, supplemented by quantum electrodynamics. 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.**

**Engineers do not have the time to wade through rigorously theoretical books when trying to solve a problem. Beginners lack the expertise required to understand highly specialized treatments of individual topics. This is especially problematic for a field as broad as electromagnetics, which propagates into many diverse engineering fields. The time h**

**Emerging Topics in Computational Electromagnetics in Computational Electromagnetics presents advances in Computational Electromagnetics. This book is designed to fill the existing gap in current CEM literature that only cover the conventional numerical techniques for solving traditional EM problems. The book examines new algorithms, and applications of these algorithms for solving problems of current interest that are not readily amenable to efficient treatment by using the existing techniques. The authors discuss solution techniques for problems arising in nanotechnology, bioEM, metamaterials, as well as multiscale problems. They present techniques that utilize recent advances in computer technology, such as parallel architectures, and**

**the increasing need to solve large and complex problems in a time efficient manner by using highly scalable algorithms.**

**MATLAB-based Finite Element Programming in Electromagnetic Modeling**

**Steel Heat Treatment Handbook**

**Finite Element Method Electromagnetics**

**Real-Time Electromagnetic Transient Simulation of AC-DC Networks**

**Introduction to Subsurface Imaging**

**The impact of optimization methods in electromagnetism has been much less than in mechanical engineering and particularly the solution**

**of inverse problems in structural mechanics. This book addresses this omission: it will serve as a guide to the theory as well as the computer implementation of solutions. It is self-contained covering all the mathematical theory necessary.**

**This comprehensive resource provides practical, modern approaches to steel heat treatment topics such as sources of residual stress and distortion, hardenability prediction, modeling, effects of steel alloy chemistry on heat treatment, quenching, carburizing, nitriding, vacuum heat treatment, metallography, and process equipment. Containing**

**recent data and developments from international experts, the Steel Treatment Handbook discusses the principles of heat treatment; quenchants, quenching systems, and quenching technology; strain gauge procedures, X-ray diffraction, and other residual stress measurement methods; carburizing and carbonitriding; powder mettalurgy technology; metallography and physical property determination; ecological regulations and safety standards; and more. Well illustrated with nearly 1000 tables, equations, figures, and photographs, the Steel Heat Treatment Handbook is an excellent reference for materials,**

**manufacturing, heat treatment, maintenance, mechanical, industrial, process and quality control, design, and research engineers; department or corporate metallurgists; and upper-level undergraduate and graduate students in these disciplines.**

**A comprehensive, step-by-step reference to the Nyström Method for solving Electromagnetic problems using integral equations Computational electromagnetics studies the numerical methods or techniques that solve electromagnetic problems by computer programming. Currently, there are mainly**

**three numerical methods for electromagnetic problems: the finite-difference time-domain (FDTD), finite element method (FEM), and integral equation methods (IEMs). In the IEMs, the method of moments (MoM) is the most widely used method, but much attention is being paid to the Nyström method as another IEM, because it possesses some unique merits which the MoM lacks. This book focuses on that method—providing information on everything that students and professionals working in the field need to know. Written by the top researchers in electromagnetics, this complete reference book is a**

**consolidation of advances made in the use of the Nyström method for solving electromagnetic integral equations. It begins by introducing the fundamentals of the electromagnetic theory and computational electromagnetics, before proceeding to illustrate the advantages unique to the Nyström method through rigorous worked out examples and equations. Key topics include quadrature rules, singularity treatment techniques, applications to conducting and penetrable media, multiphysics electromagnetic problems, time-domain integral equations, inverse scattering problems and incorporation with multilevel fast multiple**

**algorithm. Systematically introduces the fundamental principles, equations, and advantages of the Nyström method for solving electromagnetic problems Features the unique benefits of using the Nyström method through numerical comparisons with other numerical and analytical methods Covers a broad range of application examples that will point the way for future research The Nystrom Method in Electromagnetics is ideal for graduate students, senior undergraduates, and researchers studying engineering electromagnetics, computational methods, and applied mathematics. Practicing engineers and other industry**

**professionals working in engineering electromagnetics and engineering mathematics will also find it to be incredibly helpful.**

**Presents applied theory and advanced simulation techniques for electric machines and drives This book combines the knowledge of experts from both academia and the software industry to present theories of multiphysics simulation by design for electrical machines, power electronics, and drives. The comprehensive design approach described within supports new applications required by technologies sustaining high drive efficiency. The highlighted**

**framework considers the electric machine at the heart of the entire electric drive. The book also emphasizes the simulation by design concept—a concept that frames the entire highlighted design methodology, which is described and illustrated by various advanced simulation technologies. Multiphysics Simulation by Design for Electrical Machines, Power Electronics and Drives begins with the basics of electrical machine design and manufacturing tolerances. It also discusses fundamental aspects of the state of the art design process and includes examples from industrial practice. It explains FEM-based analysis techniques**

**for electrical machine design—providing details on how it can be employed in ANSYS Maxwell software. In addition, the book covers advanced magnetic material modeling capabilities employed in numerical computation; thermal analysis; automated optimization for electric machines; and power electronics and drive systems. This valuable resource: Delivers the multi-physics know-how based on practical electric machine design methodologies Provides an extensive overview of electric machine design optimization and its integration with power electronics and drives Incorporates case studies from**

**industrial practice and research and development projects Multiphysics Simulation by Design for Electrical Machines, Power Electronics and Drives is an incredibly helpful book for design engineers, application and system engineers, and technical professionals. It will also benefit graduate engineering students with a strong interest in electric machines and drives.**

**Space Antenna Handbook**

**Essentials of Computational Electromagnetics**

**Computational Models in Dosimetry**

**The RF and Microwave Handbook - 3 Volume Set**

## Field Solutions on Computers

Describing and evaluating the basic principles and methods of subsurface sensing and imaging, Introduction to Subsurface Imaging is a clear and comprehensive treatment that links theory to a wide range of real-world applications in medicine, biology, security and geophysical/environmental exploration. It integrates the different sensing techniques (acoustic, electric, electromagnetic, optical, x-ray or particle beams) by unifying the underlying

physical and mathematical similarities, and computational and algorithmic methods. Time-domain, spectral and multisensor methods are also covered, whilst all the necessary mathematical, statistical and linear systems tools are given in useful appendices to make the book self-contained. Featuring a logical blend of theory and applications, a wealth of color illustrations, homework problems and numerous case studies, this is suitable for use as both a course text and as a professional reference.

The survey design and data interpretation of the marine controlled-source electromagnetic (CSEM) method require modeling of complex and often subtle offshore geology with accuracy and efficiency. In this dissertation, I develop two efficient finite-element time-domain (FETD) algorithms for the simulation of three-dimensional (3D) electromagnetic (EM) diffusion phenomena. The two FETD algorithms are used to investigate the time-domain CSEM (TDCSEM) method in realistic shallow offshore

environments and the effects of seafloor topography and seabed anisotropy on the TDCSEM method. The first FETD algorithm directly solves electric fields by applying the Galerkin method to the electric-field diffusion equation. The time derivatives of the magnetic fields are interpolated at receiver positions via Faraday's law only when the EM fields are output. Therefore, this approach minimizes the total number of unknowns to solve. To ensure both numerical stability and an efficient time-step, the system of FETD

equations is discretized using an implicit backward Euler scheme. A sparse direct solver is employed to solve the system of equations. In the implementation of the FETD algorithm, I effectively mitigate the computational cost of solving the system of equations at every time step by reusing previous factorization results. Since the high frequency contents of the transient electric fields attenuate more rapidly in time, the transient electric fields diffuse increasingly slowly over time. Therefore, the FETD algorithm adaptively

doubles a time-step size, speeding up simulations. Although the first FETD algorithm has the minimum number of unknowns, it still requires a large amount of memory because of its use of a direct solver. To mitigate this problem, the second FETD algorithm is derived from a vector-and-scalar potential equation that can be solved with an iterative method. The time derivative of the Lorenz gauge condition is used to split the ungauged vector-and-scalar potential equation into a diffusion equation for the vector

potential and Poisson's equation for the scalar potential. The diffusion equation for the time derivative of the magnetic vector potentials is the primary equation that is solved at every time step. Poisson's equation is considered a secondary equation and is evaluated only at the time steps where the electric fields are output. A major advantage of this formulation is that the system of equations resulting from the diffusion equation not only has the minimum number of unknowns but also can be solved stably

with an iterative solver in the static limit. The developed FETD algorithms are used to simulate the TDCSEM method in shallow offshore models that are derived from SEG salt model. In the offshore models, horizontal and vertical electric-dipole-source configurations are investigated and compared with each other. FETD simulation and visualization play important roles in analyzing the EM diffusion of the TDCSEM configurations. The partially-'guided' diffusion of transient electric fields through a thin

reservoir is identified on the cross-section of the seabed models. The modeling studies show that the TDCSEM method effectively senses the localized reservoir close to the large-scale salt structure in the shallow offshore environment. Since the reservoir is close to the salt, the non-linear interaction of the electric fields between the reservoir and the salt is observed. Regardless of whether a horizontal or vertical electric-dipole source is used in the shallow offshore models, inline vertical electric fields at

intermediate-to-long offsets are approximately an order of magnitude smaller than horizontal counterparts due to the effect of the air-seawater interface. Consequently, the vertical electric-field measurements become vulnerable to the receiver tilt that results from the irregular seafloor topography. The 3D modeling studies also illustrate that the short-offset VED-Ex configuration is very sensitive to Discover an innovative and fresh approach to teaching classical electromagnetics at

a foundational level Introduction to Electromagnetic Waves with Maxwell's Equations delivers an accessible and practical approach to teaching the wellknown topics all electromagnetics instructors must include in their syllabus. Based on the author's decades of experience teaching the subject, the book is carefully tuned to be relevant to an audience of engineering students who have already been exposed to the basic curricula of linear algebra and multivariate calculus. Forming the

backbone of the book, Maxwell's equations are developed step-by-step in consecutive chapters, while related electromagnetic phenomena are discussed simultaneously. The author presents accompanying mathematical tools alongside the material provided in the book to assist students with retention and comprehension. The book contains over 100 solved problems and examples with stepwise solutions offered alongside them. An accompanying website provides readers with additional problems and solutions. Readers will also benefit

from the inclusion of: A thorough introduction to preliminary concepts in the field, including scalar and vector fields, cartesian coordinate systems, basic vector operations, orthogonal coordinate systems, and electrostatics, magnetostatics, and electromagnetics An exploration of Gauss' Law, including integral forms, differential forms, and boundary conditions A discussion of Ampere's Law, including integral and differential forms and Stoke's Theorem An examination of Faraday's Law, including

integral and differential forms and the Lorentz Force Law Perfect for third-and fourth-year undergraduate students in electrical engineering, mechanical engineering, applied maths, physics, and computer science, Introduction to Electromagnetic Waves with Maxwell's Equations will also earn a place in the libraries of graduate and postgraduate students in any STEM program with applications in electromagnetics.

This unique book presents simple, easy-to-use, but effectiveshort codes as well as

virtual tools that can be used byelectrical, electronic, communication, and computer engineers in abroad range of electrical engineering problems Electromagnetic modeling is essential to the design and modelingof antenna, radar, satellite, medical imaging, and otherapplications. In this book, author Levent Sevgi explains techniquesfor solving real-time complex physical problems using MATLAB-basedshort scripts and comprehensive virtual tools. Unique in coverage and tutorial approach,

ElectromagneticModeling and Simulation covers fundamental analytical andnumerical models that are widely used in teaching, research, andengineering designs—including mode and ray summationapproaches with the canonical 2D nonpenetrable parallel platewaveguide as well as FDTD, MoM, and SSPE scripts. The book alsoestablishes an intelligent balance among the essentials of EMMODSIM: The Problem (the physics), The Theory and Models(mathematical background and analytical solutions), and TheSimulations (code developing plus

validation, verification, andcalibration). Classroom tested in graduate-level and short courses,Electromagnetic Modeling and Simulation: Clarifies concepts through numerous worked problems and quizzesprovided throughout the book Features valuable MATLAB-based, user-friendly, effectiveengineering and research virtual design tools Includes sample scenarios and video clips recorded duringcharacteristic simulations that visually impactlearning—available on wiley.com Provides readers with their

first steps in EM MODSIM as well astools for medium and high-level code developers and users Electromagnetic Modeling and Simulation thoroughly coversthe physics, mathematical background, analytical solutions, andcode development of electromagnetic modeling, making it an idealresource for electrical engineers and researchers.

Electromagnetics of Body Area Networks

Finite Elements, Electromagnetics and Design

Finite Element Modeling Methods for

Photonics
Multigrid Finite Element Methods for Electromagnetic Field Modeling
Computational Electromagnetics with MATLAB, Fourth Edition

***Explore a comprehensive and state-of-the-art presentation of real-time electromagnetic transient simulation technology by leaders in the field Real-Time Electromagnetic Transient Simulation of AC-DC Networks delivers a detailed exposition of field programmable gate array (FPGA) hardware based real-time electromagnetic transient (EMT) emulation for all fundamental equipment used in AC-DC power grids. The***

*book focuses specifically on detailed device-level models for their hardware realization in a massively parallel and deeply pipelined manner as well as decomposition techniques for emulating large systems. Each chapter contains fundamental concepts, apparatus models, solution algorithms, and hardware emulation to assist the reader in understanding the material contained within. Case studies are peppered throughout the book, ranging from small didactic test circuits to realistically sized large-scale AC-DC grids. The book also provides introductions to FPGA and hardware-in-the-loop (HIL) emulation procedures, and large-scale networks constructed by the foundational components described in earlier chapters. With a strong focus on high-voltage*

*direct-current power transmission grid applications, Real-Time Electromagnetic Transient Simulation of AC-DC Networks covers both system-level and device-level mathematical models. Readers will also enjoy the inclusion of: A thorough introduction to field programmable gate array technology, including the evolution of FPGAs, technology trends, hardware architectures, and programming tools An exploration of classical power system components, e.g., linear and nonlinear passive power system components, transmission lines, power transformers, rotating machines, and protective relays A comprehensive discussion of power semiconductor switches and converters, i.e., AC-DC and DC-DC converters, and*

***specific power electronic apparatus such as DC circuit breakers An examination of decomposition techniques used at the equipment-level as well as the large-scale system-level for real-time EMT emulation of AC-DC networks Chapters that are supported by simulation results from well-defined test cases and the corresponding system parameters are provided in the Appendix Perfect for graduate students and professional engineers studying or working in electrical power engineering, Real-Time Electromagnetic Transient Simulation of AC-DC Networks will also earn a place in the libraries of simulation specialists, senior modeling and simulation engineers, planning and design engineers, and system studies engineers.***

*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.*

*The book is a comprehensive treatment of the field, covering fundamental theoretical principles and new technological advancements, state-of-the-art device design, and reviewing examples encompassing a wide range of related sub-areas. In particular, the first area focuses on the recent development of novel wearable and implantable antenna concepts and designs including*

*metamaterial-based wearable antennas, microwave circuit integrated wearable filtering antennas, and textile and/or fabric material enabled wearable antennas. The second set of topics covers advanced wireless propagation and the associated statistical models for on-body, in-body, and off-body modes. Other sub-areas such as efficient numerical human body modeling techniques, artificial phantom synthesis and fabrication, as well as low-power RF integrated circuits and related sensor technology are also discussed. These topics have been carefully selected for their transformational impact on the next generation of body-area network systems and beyond.*

*Field Solutions on Computers covers a broad range of*

*practical applications involving electric and magnetic fields. The text emphasizes finite-element techniques to solve real-world problems in research and industry. After introducing numerical methods with a thorough treatment of electrostatics, the book moves in a structured sequence to advanced topics. These include magnetostatics with non-linear materials, permanent magnet devices, RF heating, eddy current analysis, electromagnetic pulses, microwave structures, and wave scattering. The mathematical derivations are supplemented with chapter exercises and comprehensive reviews of the underlying physics. The book also covers essential supporting techniques such as mesh generation, interpolation, sparse matrix*

***inversions, and advanced plotting routines.***
***Time Domain Electromagnetics***
***Recent Advances and Engineering Applications***
***Theory, Design, and Measurements***
***Electromagnetics through the Finite Element Method***
***Antennas, Propagation, and RF Systems***

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

*Shelving Guide: Electrical Engineering Since the 1980s more than 100 books on the finite element method have been published, making this numerical method the most popular. The*

*features of the finite element method gained worldwide popularity due to its flexibility for simulating not only any kind of physical phenomenon described by a set of differential equations, but also for the possibility of simulating non-linearity and time-dependent studies. Although a number of high-quality books cover all subjects in engineering problems, none of them seem to make this method simpler and easier to understand. This book was written with the goal of simplifying the mathematics of the finite*

*element method for electromagnetic students and professionals relying on the finite element method for solving design problems. Filling a gap in existing literature that often uses complex mathematical formulas, Electromagnetics through the Finite Element Method presents a new mathematical approach based on only direct integration of Maxwell's equation. This book makes an original, scholarly contribution to our current understanding of this important numerical method.*

*This book addresses a broad range of topics on antennas for space applications. First, it introduces the fundamental methodologies of space antenna design, modelling and analysis as well as the state-of-the-art and anticipated future technological developments. Each of the topics discussed are specialized and contextualized to the space sector. Furthermore, case studies are also provided to demonstrate the design and implementation of antennas in actual applications. Second, the authors present a detailed review of*

*antenna designs for some popular applications such as satellite communications, space-borne synthetic aperture radar (SAR), Global Navigation Satellite Systems (GNSS) receivers, science instruments, radio astronomy, small satellites, and deep-space applications. Finally it presents the reader with a comprehensive path from space antenna development basics to specific individual applications. Key Features: Presents a detailed review of antenna designs for applications such as satellite communications,*

*space-borne SAR, GNSS receivers, science instruments, small satellites, radio astronomy, deep-space applications Addresses the space antenna development from different angles, including electromagnetic, thermal and mechanical design strategies required for space qualification Includes numerous case studies to demonstrate how to design and implement antennas in practical scenarios Offers both an introduction for students in the field and an in-depth reference for antenna engineers who develop space antennas This*

*book serves as an excellent reference for researchers, professionals and graduate students in the fields of antennas and propagation, electromagnetics, RF/microwave/millimetrewave systems, satellite communications, radars, satellite remote sensing, satellite navigation and spacecraft system engineering, It also aids engineers technical managers and professionals working on antenna and RF designs. Marketing and business people in satellites, wireless, and electronics area who*

*want to acquire a basic understanding of the technology will also find this book of interest. During the last twenty years the lifestyle of a large portion of the inhabitants of our planet has changed dramatically. This would never have been possible without the massive use of electronic and photonic technology, telecommuni cations, and computers. These disciplines are designed to code, transmit, detect, decode, and process signals and related information, and can be broadly addressed as information science and*

*technology. In the sophisticated society in which we live and operate, this science is diffused transversely and plays a major role in almost every human activity. Information science and technology is the basis of a powerful industry that does not suffer the shortcomings of more traditional human enterprises. Information is a renewable source and its control and processing rely on software codes, which are a creation of the mind, and on related hardware, incredibly sophisticated but made out of simple,*

*abundant materials. The rate of change and transformation of this industry is the highest mankind has ever experienced, and it requires not only the replacement of technologies but also a continuous updating of expertise to keep up with the rapid transformation. There is no doubt that this calls for a change in university training, to avoid students graduating at an already obsolete level.*
*Multiphysics Simulation by Design for Electrical Machines, Power Electronics and Drives*

*The Nystrom Method in Electromagnetics*
*Introduction to Electromagnetic and Microwave Engineering*
*Handbook of Engineering Electromagnetics*
*Introduction to Electromagnetic Waves with Maxwell's Equations*

Advanced topics of research in field computation are explored in this publication. Contributions have been sourced from international experts, ensuring a comprehensive specialist perspective. A unity of style has been achieved by the editor, who has specifically inserted appropriate cross-references throughout the volume, plus a single collected set of references at the end. The book provides a multi-faceted

overview of the power and effectiveness of computation techniques in engineering electromagnetics. In addition to examining recent and current developments, it is hoped that it will stimulate further research in the field.

Human Interaction with Electromagnetic Fields: Computational Models in Dosimetry presents some highly rigorous and sophisticated integral equation techniques from computational electromagnetics (CEM), along with practical techniques for the calculation and measurement of internal dosimetry. Theory is accompanied by numerical modeling algorithms and illustrative computational examples that range from academic to full real-world scenarios. Covers both deterministic and stochastic modeling Presents implementations of integral equation approaches, overcoming

the limitations of the FDTD approach Presents various biomedical applications

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. The Most Complete, Up-to-Date Coverage of the Finite Element Analysis and Modeling of Antennas and Arrays Aimed at researchers as well as practical engineers—and packed with over 200 illustrations including twenty-two color plates—Finite Element Analysis of Antennas and Arrays presents: Time- and frequency-domain formulations and mesh truncation techniques Antenna source modeling and parameter calculation Modeling of complex materials and fine geometrical details Analysis and modeling of narrowband and broadband antennas Analysis and modeling of infinite and finite phased-array antennas Analysis and modeling of

antenna and platform interactions Recognizing the strengths of other numerical methods, this book goes beyond the finite element method and covers hybrid techniques that combine the finite element method with the finite difference time-domain method, the method of moments, and the high-frequency asymptotic methods to efficiently deal with a variety of complex antenna problems. Complemented with numerous examples, this cutting-edge resource fully demonstrates the power and capabilities of the finite element analysis and its many practical applications.

Human Interaction with Electromagnetic Fields

Anechoic and Reverberation Chambers

Compendium On Electromagnetic Analysis - From Electrostatics To Photonics: Fundamentals And Applications

For Physicists And Engineers (In 5 Volumes)
The Finite Element Method in Electromagnetics
A Simplified Approach Using Maxwell's Equations

**The first book applying HBFEM to practical electronic nonlinear field and circuit problems • Examines and solves wide aspects of practical electrical and electronic nonlinear field and circuit problems presented by HBFEM • Combines the latest research work with essential background knowledge, providing an all-encompassing reference for researchers, power engineers and students of applied**

**electromagnetics analysis • There are very few books dealing with the solution of nonlinear electric- power-related problems • The contents are based on the authors' many years' research and industry experience; they approach the subject in a well-designed and logical way • It is expected that HBFEM will become a more useful and practical technique over the next 5 years due to the HVDC power system, renewable energy system and Smart Grid, HF magnetic used in DC/DC converter, and Multi-pulse transformer for HVDC power supply • HBFEM**

**can provide effective and economic solutions to R&D product development • Includes Matlab exercises**

**The five-volume set may serve as a comprehensive reference on electromagnetic analysis and its applications at all frequencies, from static fields to optics and photonics. The material includes micro- and nanomagnetics, the new generation of electric machines, renewable energy, hybrid vehicles, low-noise motors; antennas and microwave devices, plasmonics, metamaterials, lasers, and more.Written at a**

**level accessible to both graduate students and engineers, Electromagnetic Analysis is a comprehensive reference, covering methods and applications at all frequencies (from statics to optical). Each volume contains pedagogical/tutorial material of high archival value as well as chapters on state-of-the-art developments.**

**By 1990 the wireless revolution had begun. In late 2000, Mike Golio gave the world a significant tool to use in this revolution: The RF and Microwave Handbook. Since then, wireless**

**technology spread across the globe with unprecedented speed, fueled by 3G and 4G mobile technology and the proliferation of wireless LANs. Updated to reflect this tremendous growth, the second edition of this widely embraced, bestselling handbook divides its coverage conveniently into a set of three books, each focused on a particular aspect of the technology. Six new chapters cover WiMAX, broadband cable, bit error ratio (BER) testing, high-power PAs (power amplifiers), heterojunction bipolar transistors (HBTs), as**

**well as an overview of microwave engineering. Over 100 contributors, with diverse backgrounds in academic, industrial, government, manufacturing, design, and research reflect the breadth and depth of the field. This eclectic mix of contributors ensures that the coverage balances fundamental technical issues with the important business and marketing constraints that define commercial RF and microwave engineering. Focused chapters filled with formulas, charts, graphs, diagrams, and tables make the information easy to locate and apply to**

**practical cases. The new format, three tightly focused volumes, provides not only increased information but also ease of use. You can find the information you need quickly, without wading through material you don't immediately need, giving you access to the caliber of data you have come to expect in a much more user-friendly format.**

**Applications in Nonlinear Electromagnetics and Power Systems**

**Photonics and Nanotechnology**

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**Applications**
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