Frequency Domain Hybrid Finite Element Methods In Electromagnetics Synthesis Lectures On Computational Electromagnetics

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Computational Electromagnetics and Its Applications - Thomas G. Campbell 2012-12-06
This volume contains the proceedings of the first ICASE/LaRC Work shop on Computational Electromagnetics and Its Applications conducted by the Institute for Computer Applications in Science and Engineering and NASA Langley Research Center. We had several goals in mind when we decided, jointly with the Elec tromagnetics Research Branch, to organize this workshop on Computa tional Electromagnetics (CEM). Among our goals were a desire to obtain an overview of the current state of CEM, covering both algorithms and ap plications and their effect on NASA's activities in this area. In addition, we wanted to provide an attractive setting for computational scientists with expertise in other fields, especially computational fluid dynamics (CFD), to observe the algorithms and tools of CEM at work. Our expectation was that scientists from both fields would discover mutually beneficial inter connections and relationships. Another goal was to learn of progress in solution algorithms for electromagnetic optimization and design problems; such problems make extensive use of field solvers and computational effi ciency is at a premium. To achieve these goals we assembled the renowned group of speakers from academia and industry whose talks are contained in this volume. The papers are printed in the same order in which the talks were pre sented at the meeting. The first paper is an overview of work currently being performed in the Electromagnetic Research Branch at the Langley Research Center.

The Pseudospectral Method for Simulating Wave Propagation - Dean Clifford Witte 1989

Digest - IEEE Antennas and Propagation Society. International Symposium 2005

Science Abstracts - 1993

Robust Development of Hybrid Finite Element Methods for Antennas and Microwave Circuits - Jian Gong 1996

Antenna Engineering Handbook - John Volakis 2018-11-05

The gold-standard reference on the design and application of classic and modern antennas—fully updated to reflect the latest advances and technologies This new edition of the “bible of antenna engineering” has been updated to provide start-to-finish coverage of the latest innovations in antenna design and application. You will find in-depth discussion of antennas used in modern communication systems, mobile and personal wireless technologies, satellites, radar deployments, flexible electronics, and other emerging technologies, including 5G, terahertz, and wearable electronics. Antenna Engineering Handbook, Fifth Edition, is bolstered by real-world examples, hundreds of illustrations, and an emphasis on the practical aspects of antennas. Featuring 60 chapters and contributions from more than 80 renowned experts, this acclaimed resource is edited by one of the world’s leading antenna authorities. This edition features all of the classic antenna types, plus new and emerging designs, with 13 all-new chapters and important updates to nearly all chapters from past editions. Antenna Engineering Handbook, Fifth Edition, clearly explains cutting-edge applications in WLANs, automotive systems, PDAs, and handheld devices, making it an indispensable companion for today’s antenna practitioners and developers. Coverage includes: •Antenna basics and classic antennas•Design approaches for antennas and arrays•Wideband and multiband antennas•Antennas for mobile devices and PDAs, automotive applications, and aircraft•Base station and smart antennas•Beamforming and 5G antennas•Millimeter-wave and terahertz

antennas•Flexible, wearable, thin film, origami, dielectric, and on-chip antennas•MIMO antennas and phased arrays•Direction-finding and GPS antennas•Active antennas•Low-profile wideband antennas•Nanoantennas•Reflectors and other satellite and radio-telescope antennas•Low-frequency, HF, VHF, UHF, ECM, and ESM antennas•Impedance-matching techniques and material characteristics•Metastructured and frequency selective surfaces•Propagation and guided structures•Computational techniques and toolsets•Indoor and outdoor measurements

Integral Equation Methods for Electromagnetics - John L. Volakis 2012-06-30

This text/reference is a detailed look at the development and use of integral equation methods for electromagnetic analysis, specifically for antennas and radar scattering. Developers and practitioners will appreciate the broad-based approach to understanding and utilizing integral equation methods and the unique coverage of historical developments that led to the current state-of-the-art. In contrast to existing books, Integral Equation Methods for Electromagnetics lays the groundwork in the initial chapters so students and basic users can solve simple problems and work their way up to the most advanced and current solutions.

1993 International Symposium Digest - 1993

Compliant Offshore Structures - Minoo H Patel 2013-10-22

Compliant Offshore Structures deals with some aspects of the mechanics of compliant offshore structures. Analysis methods for determining the hydrostatic and hydrodynamic behavior, at wave frequencies only, of conventional and novel compliant structure types are described. The contribution of hull configuration for tandem hull vessels and of pneumatic compliances for ship shape and semi-submersible vessels is also emphasized. Comprised of 11 chapters, this book begins with an overview of the various

conventional and emerging methods of hydrostatic and hydrodynamic analysis that are available for characterizing compliant marine structures. The response of compliant structures to ocean waves is given emphasis, along with the hydrostatic stability of a compliant vessel. The discussion then turns to the use of analysis methods for a variety of conventional and novel compliant structures such as semi-submersibles, ship forms, tensioned buoyant platforms, crane vessels, and vertical marine risers. However, those compliant structures that are believed to have a future application or, alternatively, are useful in illustrating an interesting performance feature are also considered. Among such structures are those with articulated joints, pneumatic compliances, and tandem hull marine vehicles. This monograph is intended for practicing engineers as well as undergraduate and postgraduate students.

Scientific and Technical Aerospace Reports - 1994

Electrical & Electronics Abstracts - 1997

Analysis of Microwave Heating of Dielectric Materials - ganapathy K. Ayappa 1992

Frequency Domain Hybrid Finite Element Methods for Electromagnetics - John Leonidas Volakis 2006

This book provides a brief overview of the popular Finite Element Method (FEM) and its hybrid versions for electromagnetics with applications to radar scattering, antennas and arrays, guided structures, microwave components, frequency selective surfaces, periodic media, and RF materials characterizations and related topics. It starts by presenting concepts based on Hilbert and Sobolev spaces as well as Curl and Divergence spaces for generating matrices, useful in all engineering simulation methods. It then proceeds to present applications of the finite element and finite element-boundary integral

methods for scattering and radiation. Applications to periodic media, metamaterials and bandgap structures are also included. The hybrid volume integral equation method for high contrast dielectrics and is presented for the first time. Another unique feature of the book is the inclusion of design optimization techniques and their integration within commercial numerical analysis packages for shape and material design. To aid the reader with the method's utility, an entire chapter is devoted to two-dimensional problems. The book can be considered as an update on the latest developments since the publication of our earlier book (Finite Element Method for Electromagnetics, IEEE Press, 1998). The latter is certainly complementary companion to this one.

The Shock and Vibration Digest - 2003

Proceedings of the National Science Council, Republic of China - 2001

Numerical Techniques in Electromagnetics with MATLAB - Matthew N.O. Sadiku 2018-10-08

Despite the dramatic growth in the availability of powerful computer resources, the EM community lacks a comprehensive text on the computational techniques used to solve EM problems. The first edition of Numerical Techniques in Electromagnetics filled that gap and became the reference of choice for thousands of engineers, researchers, and students. This third edition of the bestselling text reflects the continuing increase in awareness and use of numerical techniques 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. The author also has added a chapter on the method of lines.

Numerical Techniques in Electromagnetics with MATLAB®, Third Edition continues to teach 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. Now the Third Edition goes even further toward providing a comprehensive resource that addresses all of the most useful computation methods for EM problems and includes MATLAB code instead of FORTRAN.

Methods and Applications of Analysis - 2004

The Journal of the Acoustical Society of America - Acoustical Society of America 2006

Radio Science - 2003

MATLAB-based Finite Element Programming in Electromagnetic Modeling - Özlem Özgün 2018-09-03

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.

Frequency Domain Hybrid Finite Element Methods in Electromagnetics - John Volakis 2007-12-31

This book provides a brief overview of the popular Finite Element Method (FEM) and its hybrid versions for electromagnetics with applications to radar scattering, antennas and arrays, guided structures, microwave components, frequency selective surfaces, periodic media, and RF materials characterizations and related topics. It starts by presenting concepts based on Hilbert and Sobolev spaces as well as Curl and Divergence spaces for generating matrices, useful in all engineering simulation methods. It then proceeds to present applications of the finite element and finite element-boundary integral methods for scattering and radiation. Applications to periodic media, metamaterials and bandgap structures are also included. The

hybrid volume integral equation method for high contrast dielectrics and is presented for the first time. Another unique feature of the book is the inclusion of design optimization techniques and their integration within commercial numerical analysis packages for shape and material design. To aid the reader with the method's utility, an entire chapter is devoted to two-dimensional problems. The book can be considered as an update on the latest developments since the publication of our earlier book (Finite Element Method for Electromagnetics, IEEE Press, 1998). The latter is certainly complementary companion to this one.

Mixed and Hybrid Finite Element Methods - Franco Brezzi 2012-12-06

Research on non-standard finite element methods is evolving rapidly and in this text Brezzi and Fortin give a general framework in which the development is taking place. The presentation is built around a few classic examples: Dirichlet's problem, Stokes problem, Linear elasticity. The authors provide with this publication an analysis of the methods in order to understand their properties as thoroughly as possible.

Finite Element Analysis of Antennas and Arrays - Jian-Ming Jin 2009-02-23

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.

The Finite-Difference Modelling of Earthquake Motions - Peter Moczo 2014-04-24

"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"--

International Aerospace Abstracts - 1998

A Collection of Technical Papers: Structural dynamics II - 1991

Computational Methods in Large Scale Simulation - Khin-Yong Lam 2005-10-26

This volume documents the research carried out by visiting scientists attached to the Institute for Mathematical Sciences (IMS) at the National University of Singapore and the Institute of High Performance Computing (IHPC) under the program “Advances and Mathematical Issues in Large Scale Simulation.” From 2002 to 2003, researchers from various countries gathered to initiate interesting and innovative work on various themes related to multiscale simulation and fast algorithms. Today, modeling and simulation are used extensively to solve complex problems and to reduce the use of experimentation during the design and analysis stage. It is important to know the various issues

that have to be considered in the successful development of computational methodologies for such work. This volume is a compilation of the research by various visiting scientists in the area of modeling and multiscale simulation. Each article covers a major project and documents how computational methodology, mathematical modeling, high performance computing and simulation are combined in a multiscale scheme to solve a variety of complex problems. Some of these include the design, synthesis, processing, characterization and manufacture of nanomaterials and nanostructures, new algorithms for computational work, and grid computing. Through the included examples, readers can realize the vast potential of computational modeling and large scale simulation for the solution of problems in a variety of disciplines and applications. Contents:Methods of Multiscale Modeling in Mechanics (W A Curtin)Efficient and Accurate Boundary Methods for Computational Optics (C Hafner & J Smajic)Finite Element Modeling of Periodic Structures (Z Lou & J-M Jin)Factorization of Potential and Field Distributions without Utilizing the Addition Theorem (A-R Baghi-Wadji & E Li)Virtualization-Aware Application Framework for Hierarchical Multiscale Simulations on a Grid (A Nakano et al.)Molecular Dynamics Simulation and Local Quantities (T Ikeshoji)Recent Advances in Modeling and Simulation of High-Speed Interconnects (M Nakhla & R Achar)Multiscale Modeling of Degradation and Failure of Interconnect Lines Driven by Electromigration and Stress Gradients (R Atkinson & A M Cuitiño) Readership: Engineers, scientists and graduate students who need further insights into the applications and power of computational methodology for the solution of a wide array of problems. Keywords:Large Scale Simulation;High Performance Computing;Multiscale Simulation;Fast Algorithms;Computational MethodologyKey

Features:Provides insight into the applications and power of computational methodology in solving a wide array of complex problems

The Finite Element Method in Electromagnetics - Jian-Ming Jin 2015-02-18

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

book for engineering students as well as for professionals in the field.

Advances in Information Technologies for Electromagnetics - Luciano Tarricone 2006-09-21

This book offers a broad panorama on recently achieved and potentially obtainable advances in electromagnetics with innovative IT technologies. Simple tutorial chapters introduce cutting edge technologies. These include parallel and distributed computing, object-oriented technologies, grid computing, semantic grids, agent based computing and service-oriented architectures. The book is a unique tool bridging the gap between IT and EM communities.

International Symposium Digest, Antennas and Propagation - IEEE Antennas and Propagation Society. International Symposium 1993

Quick Finite Elements for Electromagnetic Waves - Giuseppe Pelosi 1998

Now you can quickly and more easily work out challenging microwave engineering and high-frequency electromagnetic problems using the finite element method (FEM) with this practical book and software package. Using clear, concise text and dozens of real-world application examples, the book provides a detailed description of FEM implementation, while the software provides the code and tools needed to solve the three major types of EM problems: guided propagation, scattering, and radiation.

Computational Modelling and Advanced Simulations - Justín Murín 2010-12-25

This book contains selected, extended papers presented at the thematic ECCOMAS conference on Computational Modelling and Advanced Simulations (CMAS2009) held in Bratislava, Slovakia, June 30 – July 3, 2009. Modelling and simulation of engineering problems play a very important role in the classic and new composite material sciences, and in design and computational prototyping of modern and

advanced technologic parts and systems. According to this, the existing numerical methods have been improved and new numerical methods have been established for modelling and simulation of more and more complex and complicated engineering problems. The present book should contribute to the effort to make modelling and simulation more effective and accurate.

Spectral Element Method in Structural Dynamics - Usik Lee 2009-07-31

Spectral Element Method in Structural Dynamics is a concise and timely introduction to the spectral element method (SEM) as a means of solving problems in structural dynamics, wave propagations, and other related fields. The book consists of three key sections. In the first part, background knowledge is set up for the readers by reviewing previous work in the area and by providing the fundamentals for the spectral analysis of signals. In the second part, the theory of spectral element method is provided, focusing on how to formulate spectral element models and how to conduct spectral element analysis to obtain the dynamic responses in both frequency- and time-domains. In the last part, the applications of SEM to various structural dynamics problems are introduced, including beams, plates, pipelines, axially moving structures, rotor systems, multi-layered structures, smart structures, composite laminated structures, periodic lattice structures, blood flow, structural boundaries, joints, structural damage, and impact forces identifications, as well as the SEM-FEM hybrid method. Presents all aspects of SEM in one volume, both theory and applications Helps students and professionals master associated theories, modeling processes, and analysis methods Demonstrates where and how to apply SEM in practice Introduces real-world examples across a variety of structures Shows how models can be used to evaluate the accuracy of other solution methods Cross-checks against solutions

obtained by conventional FEM and other solution methods Comes with downloadable code examples for independent practice Spectral Element Method in Structural Dynamics can be used by graduate students of aeronautical, civil, naval architectures, mechanical, structural and biomechanical engineering. Researchers in universities, technical institutes, and industries will also find the book to be a helpful reference highlighting SEM applications to various engineering problems in areas of structural dynamics, wave propagations, and other related subjects. The book can also be used by students, professors, and researchers who want to learn more efficient and more accurate computational methods useful for their research topics from all areas of engineering, science and mathematics, including the areas of computational mechanics and numerical methods.

Proceedings of the Summer Computer Simulation Conference - 1998

Iterative and Self-adaptive Finite-elements in Electromagnetic Modeling - Magdalena Salazar-Palma 1998

Ensure the accuracy of your results when applying the Finite Element Method (FEM) to electromagnetic and antenna problems with this self-contained reference. It provides you with a solid understanding of the method, describes its key elements and numerical techniques, and identifies various approaches to using the FEM in solving real-world microwave field problems.

Computer Modeling in Engineering & Sciences - 2009

Antenna Engineering Handbook, Fourth Edition - John Volakis 2007-06-07

This edition contains 21 new chapters and a bonus eight page color insert, and new material on specialty antennas such as wideband patch antennas, antenna arrays, smart antennas, and more.

Frequency Domain Hybrid Finite Element

Methods in Electromagnetics - John Volakis 2022-06-01

This book provides a brief overview of the popular Finite Element Method (FEM) and its hybrid versions for electromagnetics with applications to radar scattering, antennas and arrays, guided structures, microwave components, frequency selective surfaces, periodic media, and RF materials characterizations and related topics. It starts by presenting concepts based on Hilbert and Sobolev spaces as well as Curl and Divergence spaces for generating matrices, useful in all engineering simulation methods. It then proceeds to present applications of the finite element and finite element-boundary integral methods for scattering and radiation. Applications to periodic media, metamaterials and bandgap structures are also included. The hybrid volume integral equation method for high contrast dielectrics and is presented for the first time. Another unique feature of the book is the inclusion of design optimization techniques and their integration within commercial numerical analysis packages for shape and material design. To aid the reader with the method's utility, an entire chapter is devoted to two-dimensional problems. The book can be considered as an update on the latest developments since the publication of our earlier book (Finite Element Method for Electromagnetics, IEEE Press, 1998). The latter is certainly complementary companion to this one.

Electromagnetic Shielding - Salvatore Celozzi 2022-11-18

Comprehensive Resource for Understanding Electromagnetic Shielding Concepts and Recent Developments in the Field This book describes the fundamental, theoretical, and practical aspects to approach electromagnetic shielding with a problem-solving mind, either at a design stage or in the context of an issue-fixing analysis of an existing configuration. It examines the main shielding mechanisms and how to analyze

any shielding configuration, taking into account all the involved aspects. A detailed discussion on the possible choices of parameters suitable to ascertain the performance of a given shielding structure is also presented by considering either a continuous wave EM field source or a transient one. To aid in reader comprehension, both a theoretical and a practical engineering point of view are presented with several examples and applications included at the end of main chapters. Sample topics discussed in the book include: Concepts in transient shielding including performance parameters and canonical configurations Time domain performance of shielding structures, thin shields, and overall performance of shielding enclosures (cavities) How to install adequate barriers around the most sensitive components/systems to reduce or eliminate interference Details on solving core fundamental issues for electronic and telecommunications systems via electromagnetic shielding For industrial researchers, telecommunications/electrical engineers, and academics studying the design of EM shielding structures, this book serves as an important resource for understanding both the logistics and practical applications of electromagnetic shielding. It also includes all recent developments in the field to help professionals stay ahead of the curve in their respective disciplines.

Multigrid Finite Element Methods for Electromagnetic Field Modeling - Yu Zhu 2006-02-03

This is the first comprehensive monograph that features state-of-the-art multigrid methods for enhancing the modeling versatility, numerical robustness, and computational efficiency of one of the most popular classes of numerical electromagnetic field modeling methods: the method of finite elements. The focus of the publication is the development of robust preconditioners for the iterative solution of

electromagnetic field boundary value problems (BVPs) discretized by means of finite methods. Specifically, the authors set forth their own successful attempts to utilize concepts from multigrid and multilevel methods for the effective preconditioning of matrices resulting from the approximation of electromagnetic BVPs using finite methods. Following the authors' careful explanations and step-by-step instruction, readers can duplicate the authors' results and take advantage of today's state-of-the-art multigrid/multilevel preconditioners for finite element-based iterative electromagnetic field solvers. Among the highlights of coverage are: * Application of multigrid, multilevel, and hybrid multigrid/multilevel preconditioners to electromagnetic scattering and radiation problems * Broadband, robust numerical modeling of passive microwave components and circuits * Robust, finite element-based modal analysis of electromagnetic waveguides and cavities * Application of Krylov subspace-based methodologies for reduced-order macromodeling of electromagnetic devices and systems * Finite element modeling of electromagnetic waves in periodic structures The authors provide more than thirty detailed algorithms alongside pseudo-codes to assist readers with practical computer implementation. In addition, each chapter includes an applications section with helpful numerical examples that validate the authors' methodologies and demonstrate their computational efficiency and robustness. This groundbreaking book, with its coverage of an exciting new enabling computer-aided design technology, is an essential reference for computer programmers, designers, and engineers, as well as graduate students in engineering and applied physics.