
Finite Elements For Electrical Engineering

Frequency Domain Hybrid Finite Element Methods in Electromagnetics
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Finite Elements in Electrical and Magnetic Field Problems
The finite element method applied to rotating electrical machines
Electric Machines
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Frequency Domain Hybrid Finite Element Methods in Electromagnetics Cambridge University Press

A systematic treatment of the finite element method "Anyone interested in the state of the art in finite element formulations will find this book an interesting read. In particular, I would strongly recommend it to those members of the electromagnetic community who are involved in high-frequency applications." -Measurement Science and Technology The finite element method is one of the preeminent simulation techniques for obtaining solutions to boundary-value problems in mathematical physics. It has applications in a variety of engineering and scientific studies, such as antennas, radar, microwave engineering, high-speed/high-frequency circuits, wireless communication, electro-optical engineering, remote sensing, bioelectromagnetics, and geoelectromagnetics. This Second Edition of an essential text teaches the finite element method for electromagnetic analysis. It offers engineers a methodical way to quickly master this very powerful technique for solving practical, often complicated, engineering problems. This book provides the first systematic treatment of this numerical analysis technique for electromagnetics, including a brief overview of the two classic methods-the Ritz variational method and Galerkin's method-which form the foundation of the finite element function. Employing an example to introduce the concept of the finite element method and describe the essential steps of the technique, the author lays the groundwork for a broad-based understanding of the finite element method's usefulness. He completes his coverage by describing the finite element analysis of one-, two-, and three-dimensional problems, developing for each problem a rigorous finite element solution in general form from which solutions to specific problems can be deduced. Carefully updated to include the most recent developments, the Second Edition now includes new coverage of: * Absorbing boundary conditions * A hybrid technique for pen-region scattering and radiation problems * Eigenfunction expansions on elliptical boundaries * Time-domain analysis of transient electromagnetic problems * The method of moments and its fast solvers

The Finite Element Method in Engineering Cambridge University Press

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.

Finite Elements in Electrical and Magnetic Field Problems Firenze University Press

Dieses zweibändige Lehrwerk führt systematisch und fundiert in die Finite-Element-Methoden für die Kontinuumsmechanik ein. Es geht damit weit über das traditionelle Anwendungsgebiet innerhalb der Strukturmechanik hinaus und zeigt auf, wie analytisch nicht oder nur unbefriedigend behandelbare Probleme innerhalb der Elasto-, Plasto- und Kriechmechanik, der Fluidmechanik, der Wärmeübertragung, aber auch der Elektrotechnik numerisch gelöst werden können. Angesprochen werden Studierende fast aller ingenieurwissenschaftlicher Fächer. Jeder Band enthält eine Vielzahl von Übungsaufgaben mit vollständig ausgearbeiteten und diskutierten Lösungen. Der zweite Band behandelt die fortgeschrittenen Methoden.

The finite element method applied to rotating electrical machines Finite Elements for Electrical Engineers

Written by specialists of modeling in electromagnetism, this book provides a comprehensive review of the finite element method for low frequency applications. Fundamentals of the method as well as new advances in the field are described in detail. Chapters 1 to 4 present general 2D and 3D static and dynamic formulations by the use of scalar and vector unknowns and adapted interpolations for the fields (nodal, edge, face or volume). Chapter 5 is dedicated to the presentation of different macroscopic behavior laws of materials and their implementation in a finite element context: anisotropy and hysteretic properties for magnetic sheets, iron losses, non-linear permanent magnets and superconductors. More specific formulations are then proposed: the modeling of thin regions when finite elements become misfit (Chapter 6), infinite domains by using geometrical transformations (Chapter 7), the coupling of 2D and 3D formulations with circuit equations (Chapter 8), taking into account the movement, particularly in the presence of Eddy currents (Chapter 9) and an original approach for the treatment of geometrical symmetries when the sources are not symmetric (Chapter 10). Chapters 11 to 13 are devoted to coupled problems: magneto-thermal coupling for induction heating, magneto-mechanical coupling by introducing the notion of strong and weak coupling and magneto-hydrodynamical coupling focusing on electromagnetic instabilities in fluid conductors. Chapter 14 presents different meshing methods in the context of electromagnetism (presence of air) and introduces self-adaptive mesh refinement procedures. Optimization techniques are then covered in Chapter 15, with the adaptation of deterministic and probabilistic methods to the numerical finite element environment. Chapter 16 presents a variational approach of electromagnetism, showing how Maxwell equations are derived from thermodynamic principles.

Electric Machines Artech House

This volume includes contributions on: field theory and advanced computational electromagnetics; electrical machines and transformers; optimization and interactive design; electromagnetics in

materials; coupled field and electromagnetic components in mechatronics; induction heating systems; bioelectromagnetics; and electromagnetics in education.

Finite Elements, Electromagnetics and Design John Wiley & Sons

Finite elements - the basic concepts and an application to 3-D magnetostatic problems. The fundamental equations of electric and magnetic fields. Shape functions. Software engineering aspects of finite elements. Finite element solution of magnetic and electric field problems in electrical machines and devices. Numerical analysis of Eddy-Current problems. The high-order polynomial finite element method in electromagnetic field computation. Transient solution of the diffusion equation by discrete Fourier transformation. Mutually constrained partial differential and integral equation field formulations. Applications of integral equation methods to the numerical solution of magnetostatic and Eddy-Current problems.

Finite Elements for Electrical Engineers Springer-Verlag

Presents Boundary Element Method (BEM) in a simple fashion in order to help the beginner to understand the very basic principles of the method. This book initially derives BEM for the simplest potential problems, and subsequently builds on these to formulate BEM for a wide range of applications in electromagnetics.

Boundary Element Techniques in Engineering Springer

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.

Finite Element Analysis of Electrical Machines Cambridge University Press

The finite element method (FEM) can be successfully applied to various field problems in solid mechanics, fluid mechanics and electrical engineering. This text discusses finite element methods for structures with large stochastic variations.

Finite Element Analysis Of Electrical Machines Springer Science & Business Media

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.

Modeling and Application of Electromagnetic and Thermal Field in Electrical Engineering Wiley-Interscience

Finite element methods have become essential design tools for managing the complex structures and devices needed in modern microwave technology. Long the preferred techniques of both researchers and engineers, their migration from research lab to routine industrial use has been accelerated by hardware and software improvements. The last decade has seen the widespread availability of good commercial finite element programs for an extensive range of applications. Finite Element Software for Microwave Engineering provides the first comprehensive overview of this burgeoning field. With its unique focus on current and future industrial applications rather than on mathematical methodology, this book is an invaluable complement to the existing literature on finite element methods. Directed to practicing engineers and researchers, the book describes user experience with current software, shows how existing programs can be used to solve problems not foreseen by their designers, and attempts to predict which methods may appear in the commercial products of tomorrow.

The Finite Element Method in Charged Particle Optics Springer Nature

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.

A First Course in Finite Elements Stylus Publishing, LLC

Finite Element Analysis, second edition is a comprehensive guide that explores the versatility and affordability of the finite element method (FEM) as a powerful tool for solving engineering problems across various industries. This book provides a practical introduction to FEM analysis, covering

applications in mechanical engineering, civil engineering, electrical engineering, and physics. It presents a balanced blend of theory and applications, catering to both beginners and those seeking to enhance their FEM skills. The book emphasizes a comparative approach by presenting solutions to problems through three different methods: analytical, FEM hand calculations, and software-based methods. This enables readers to grasp the strengths and limitations of each approach, enhancing their understanding of FEM techniques. FEATURES: Covering mathematical preliminaries to advanced engineering applications, the book covers a wide range of topics, including axial loaded members, trusses, beams, stress analysis, thermal analysis, fluid flow analysis, dynamic analysis, and engineering electromagnetics analysis. Includes a comparison of solutions to the problems obtained by the analytical method, FEM hand calculations, and the software method. Includes over 35 solved problems using software applications such as MATLAB, COMSOL, and ANSYS. Features companion files containing executable models and animations related to each solved problem.

Multigrid Finite Element Methods for Electromagnetic Field Modeling CRC Press

This third edition of the principal text on the finite element method for electrical engineers and electronics specialists presents the method in a mathematically undemanding style, accessible to undergraduates who may be encountering it for the first time. Like the earlier editions, it begins by deriving finite elements for the simplest familiar potential fields, and then formulates finite elements for a wide range of applied electromagnetics problems. These include wave propagation, diffusion, and static fields; open-boundary problems and nonlinear materials; axisymmetric, planar and fully three-dimensional geometries; and scalar and vector fields. A wide selection of demonstration programs allows the reader to follow the practical use of the methods. Besides providing all that is needed for the beginning undergraduate student, this textbook is also a valuable reference text for professional engineers and research students.

Finite Element Methods in Electrical Power Engineering Springer Nature

Co-authored by an international research group with a long-standing cooperation, this book focuses on engineering-oriented electromagnetic and thermal field modeling and application. It presents important contributions, including advanced and efficient finite element analysis used in the solution of electromagnetic and thermal field problems for large and multi-scale engineering applications involving application script development; magnetic measurement of both magnetic materials and components under various, even extreme conditions, based on well-established (standard and non-standard) experimental systems; and multi-level validation based on both industrial test systems and extended TEAM P21 benchmarking platform. Although these are challenging topics, they are useful for readers from both academia and industry.

Finite Elements in Electrical Engineering John Wiley & Sons

The Finite Element Method in Engineering is the only book to provide a broad overview of the underlying principles of finite element analysis and where it fits into the larger context of other mathematically based engineering analytical tools. This is an updated and improved version of a finite element text long noted for its practical applications approach, its readability, and ease of use. Students will find in this textbook a thorough grounding of the mathematical principles underlying the popular, analytical methods for setting up a finite element solution based on mathematical equations. The book provides a host of real-world applications of finite element analysis, from

structural design to problems in fluid mechanics and thermodynamics. It has added new sections on the assemblage of element equations, as well as an important new comparison between finite element analysis and other analytical methods showing advantages and disadvantages of each. This book will appeal to students in mechanical, structural, electrical, environmental and biomedical engineering. The only book to provide a broad overview of the underlying principles of finite element analysis and where it fits into the larger context of other mathematically based engineering analytical tools. New sections added on the assemblage of element equations, and an important new comparison between finite element analysis and other analytical methods, showing the advantages and disadvantages of each.

Finite Element Methods for Maxwell's Equations Oxford University Press on Demand

Demystifies the operation of electric machines by bridging electromagnetic fields, electric circuits, numerical analysis, and computer programming. Ideal for graduates and senior undergraduates taking courses on all aspects of electric machine design and control, and accompanied by downloadable Python code and instructor solutions.

Finite Element Analysis of Antennas and Arrays Springer Science & Business Media

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.

Numerical Simulation of Mechatronic Sensors and Actuators John Wiley & Sons

Developed from the authors, combined total of 50 years undergraduate and graduate teaching experience, this book presents the finite element method formulated as a general-purpose numerical procedure for solving engineering problems governed by partial differential equations. Focusing on the formulation and application of the finite element method through the integration of finite element theory, code development, and software application, the book is both introductory and self-contained, as well as being a hands-on experience for any student. This authoritative text on Finite Elements: Adopts a generic approach to the subject, and is not application specific. In conjunction with a web-based chapter, it integrates code development, theory, and application in one book. Provides an accompanying Web site that includes ABAQUS Student Edition, Matlab data and programs, and instructor resources. Contains a comprehensive set of homework problems at the end of each chapter. Produces a practical, meaningful course for both lecturers, planning a finite element module, and for students using the text in private study. Accompanied by a book companion website housing supplementary material that can be found at

<http://www.wileyeurope.com/college/Fish> A First Course in Finite Elements is the ideal practical introductory course for junior and senior undergraduate students from a variety of science and engineering disciplines. The accompanying advanced topics at the end of each chapter also make it suitable for courses at graduate level, as well as for practitioners who need to attain or refresh their knowledge of finite elements through private study.

Finite Element Programs in Structural Engineering and Continuum Mechanics Springer

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This practical book and accompanying software enables you to quickly and easily work out challenging microwave engineering and high-frequency electromagnetic problems using the finite element method (FEM) 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.