Finite Element Analysis Of Electrical Machines

RIVAS ANDREWS

Multiphysics Simulation by Design for Electrical Machines, Power Electronics and Drives Springer Science & Business Media
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.
Some Applications of the Finite Element Method in Electrical Engineering Design Oxford University Press on Demand
Finite Element Analysis of Electrical MachinesSpringer Science & Business Media
The Finite Element Method in Engineering Finite Element Analysis of Electrical Machines
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 Elements, Electromagnetics and Design Oxford University Press, USA
This book is devoted to students, PhD students, postgraduates of electrical engineering, researchers, and scientists dealing with the analysis, design, and optimization of electrical machine properties. The purpose is to present methods used for the analysis of transients and steady-state conditions. In three chapters the following methods are presented: (1) a method in which the parameters (resistances and inductances) are calculated on the basis of geometrical dimensions and material properties made in the design process, (2) a method of general theory of electrical machines, in which the transients are investigated in two perpendicular axes, and (3) FEM, which is a mathematical method applied to electrical machines to investigate many of their properties.
Transients, Control Principles, Finite Element Analysis, and Optimal Design with MATLAB® Cambridge University Press
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.
The Finite Element Method for Electromagnetic Modeling Elsevier
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.
Finite Element Analysis Of Electrical Machines Pergamon
This Second Edition extensively covers advanced issues/subjects in electric machines, starting from principles, to applications and case studies with ample graphical (numerical) results. This textbook is intended for second (and third) semester courses covering topics such as modeling of transients, control principles, electromagnetic and thermal finite element analysis, and optimal design (dimensioning). Notable recent knowledge with strong industrialization potential has been added to this edition, such as: Orthogonal models of multiphase a.c. machines Thermal Finite Element Analysis of (FEA) electric machines FEA–based–only optimal design of a PM motor case study Line start synchronizing premium efficiency PM induction machines Induction machines (three and single phase), synchronous machines with DC excitation, with PM-excitation, and with magnetically salient rotor and a linear Pm oscillatory motor are all investigated in terms of transients, electromagnetic FEM analysis and control principles. Case studies, numerical examples, and lots of discussion of FEM results for PMSM and IM are included throughout the book. The optimal design is treated in detail using Hooke–Jeeves and GA algorithms with case comparison studies in dedicated chapters for IM and PMSM. Numerous computer simulation programs in MATLAB® and Simulink® are available online that illustrate performance characteristics present in the chapters, and the FEM and optimal design case studies (and codes) may be used as homework to facilitate a deeper understanding of fundamental issues.
Finite Element Analysis of Stator Winding Losses in Large Rotating Electrical Machines CRC Press
Unlike any other source in the field, this valuable reference clearly examines key aspects of the finite element method (FEM) for electromagnetic analysis of low-frequency electrical devices. The authors examine phenomena such as nonlinearity, mechanical force, electrical circuit coupling, vibration, heat, and movement for applications in the elect
Finite-element Analysis of Nonlinear Fields in Electric Machines CRC Press
From the fan motor in your PC to precision control of aircraft, electrical machines of all sizes, varieties, and levels of complexity permeate our world. Some are very simple, while others require exacting and application-specific design. Electrical Machine Analysis Using Finite Elements provides the tools necessary for

the analysis and design of any type of electrical machine by integrating mathematical/numerical techniques with analytical and design methodologies. Building successively from simple to complex analyses, this book leads you step-by-step through the procedures and illustrates their implementation with examples of both traditional and innovative machines. Although the examples are of specific devices, they demonstrate how the procedures apply to any type of electrical machine, introducing a preliminary theory followed by various considerations for the unique circumstance. The author presents the mathematical background underlying the analysis, but emphasizes application of the techniques, common strategies, and obtained results. He also supplies codes for simple algorithms and reveals analytical methodologies that universally apply to any software program. With step-by-step coverage of the fundamentals and common procedures, Electrical Machine Analysis Using Finite Elements offers a superior analytical framework that allows you to adapt to any electrical machine, to any software platform, and to any specific requirements that you may encounter.

Proceedings of 2017 IEEE Global Engineering Education Conference (EDUCON) CRC Press

An introduction to the practice of the Finite Element Method and a comparison of solutions via its various methods including software used in industry.

Finite Element Method Electromagnetics John Wiley & Sons

In Finite Element Analysis of Electrical Machines the author covers two-dimensional analysis, emphasizing the use of finite elements to perform the most common calculations required of machine designers and analysts. The book explains what is inside a finite element program, and how the finite element method can be used to determine the behavior of electrical machines. The material is tutorial and includes several completely worked out examples. The main illustrative examples are synchronous and induction machines. The methods described have been used successfully in the design and analysis of most types of rotating and linear machines. Audience: A valuable reference source for academic researchers, practitioners and designers of electrical machinery.

Finite Element Analysis with Personal Computers John Wiley & Sons

Like the earlier editions, this text begins by deriving finite elements for the simplest familiar potential fields, then advances to formulate finite elements for a wide range of applied electromagnetics problems. A wide selection of demonstration programs allows the reader to follow the practical use of the methods.

The Finite Element Method in Heat Transfer Analysis John Wiley & Sons

Designed for a one-semester course in Finite Element Method, this compact and well-organized text presents FEM as a tool to find approximate solutions to differential equations. This provides the student a better perspective on the technique and its wide range of applications. This approach reflects the current trend as the present-day applications range from structures to biomechanics to electromagnetics, unlike in conventional texts that view FEM primarily as an extension of matrix methods of structural analysis. After an introduction and a review of mathematical preliminaries, the book gives a detailed discussion on FEM as a technique for solving differential equations and variational formulation of FEM. This is followed by a lucid presentation of one-dimensional and two-dimensional finite elements and finite element formulation for dynamics. The book concludes with some case studies that focus on industrial problems and Appendices that include mini-project topics based on near-real-life problems. Postgraduate/Senior undergraduate students of civil, mechanical and aeronautical engineering will find this text extremely useful; it will also appeal to the practising engineers and the teaching community.

Analysis of Electrical Machines John Wiley & Sons

Unlike any other source in the field, this valuable reference clearly examines key aspects of the finite element method (FEM) for electromagnetic analysis of low-frequency electrical devices. The authors examine phenomena such as nonlinearity, mechanical force, electrical circuit coupling, vibration, heat, and movement for applications in the electrical, mechanical, nuclear, aeronautics, and transportation industries. Electromagnetic Modeling by Finite Element Methods offers a wide range of examples, including torque, vibration, and iron loss calculation; coupling of the FEM with mechanical equations, circuits, converters, and thermal effects; material modeling; and proven methods for hysteresis implementation into FEM codes. Providing experimental results and comparisons from the authors' personal research, Electromagnetic Modeling by Finite Element Methods supplies techniques to implement FEM for solving Maxwell's equations, analyze electrical and magnetic losses, determine the behavior of electrical machines, evaluate force distribution on a magnetic medium, simulate movement in electrical machines and electromagnetic devices fed by external circuits or static converters, and analyze the vibrational behavior of electrical machines.

Finite Element Analysis of Electrical Machines, Transformers and Electromagnetic Actuators World Scientific Publishing Company Incorporated

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 broadoverview 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 Analysis Springer Science & Business Media

The book discusses the underlying physical principles of piezoelectric materials, important properties of ferroelectric/piezoelectric materials used in today’s transducer technology, and the principles used in transducer design. It provides examples of a wide range of applications of such materials along with the appertaining rationales. With contributions from distinguished researchers, this is a comprehensive reference on all the pertinent aspects of piezoelectric materials.

The Finite Element Method in Electromagnetics CRC Press

Electric Field Analysis is both a student-friendly textbook and a valuable tool for engineers and physicists engaged in the design work of high-voltage insulation systems. The text begins by introducing the physical and mathematical fundamentals of electric fields, presenting problems from power and dielectric engineering to show how the theories are put into practice. The book then describes various techniques for electric field analysis and their significance in the validation of numerically computed results, as well as: Discusses finite difference, finite element, charge simulation, and surface charge simulation methods for the numerical computation of electric fields Provides case studies for electric field distribution in a cable termination, around a post insulator, in a condenser bushing, and around a gas-insulated substation (GIS) spacer Explores numerical field calculation for electric field optimization, demonstrating contour correction and examining the application of artificial neural networks Explains how high-voltage field optimization studies are carried out to meet the desired engineering needs Electric Field Analysis is accompanied by an easy-to-use yet comprehensive software for electric field computation. The software, along with a wealth of supporting content, is available for download with qualifying course adoption.

Combination of two-dimensional finite element analysis of electrical machines with circuit simulation techniques CRC Press

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.

Finite Element Methods in Electrical Power Engineering John Wiley & Sons

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.

Piezoelectric and Acoustic Materials for Transducer Applications Elsevier

Heat transfer analysis is a problem of major significance in a vast range of industrial applications. These extend over the fields of mechanical engineering, aeronautical engineering, chemical engineering and numerous applications in civil and electrical engineering. If one considers the heat conduction equation alone the number of practical problems amenable to solution is extensive. Expansion of the work to include features such as phase change, coupled heat and mass transfer, and thermal stress analysis provides the engineer with the capability to address a further series of key engineering problems. The complexity of practical problems is such that closed form solutions are not generally possible. The use of numerical techniques to solve such problems is therefore considered essential, and this book presents the use of the powerful finite element method in heat transfer analysis. Starting with the fundamental general heat conduction equation, the book moves on to consider the solution of linear steady state heat conduction problems, transient analyses and non-linear examples. Problems of melting and solidification are then considered at length followed by a chapter on convection. The application of heat and mass transfer to drying problems and the calculation of both thermal and shrinkage stresses conclude the book. Numerical examples are used to illustrate the basic concepts introduced. This book is the outcome of the teaching and research experience of the authors over a period of more than 20 years.

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