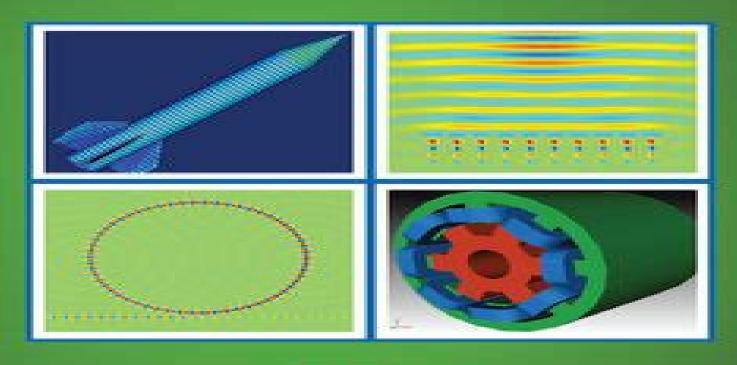
# The Finite Element Method in Electromagnetics

THIRD EDITION



JIAN-MING JIN



P. P. Silvester, Ronald Leslie Ferrari

**The Finite Element Method in Electromagnetics** Jian-Ming Jin, 2014-03-31 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 The Finite Element Method in Electromagnetics Jianming Jin, 2003-01-21 Finite Element Method in Electromagnetics Paper SEA Jian-Ming Jin, 1994-11-14 FINITE ELEMENT-BOUNDARY ELEMENT METHODS FOR ELECTROMAGNETIC SCATTERING. Jianming Jin, 1989 The use of isoparametric elements is subsequently presented for modeling arbitrarily shaped and curved geometries This leads to an improved efficiency and accuracy not shared with traditional elements Introduction to the Finite Element Method in Electromagnetics Anastasis C. Polycarpou, 2006-12-01 This series lecture is an introduction to the finite element method with applications in electromagnetics. The finite element method is a numerical method that is used to solve boundary value problems characterized by a partial differential equation and a set of boundary conditions. The geometrical domain of a boundary value problem is discretized using sub domain elements called the finite elements and the differential equation is applied to a single element after it is brought to a weak integro differential form A set of shape functions is used to represent the primary unknown variable in the element domain A set of linear equations is obtained for each element in the discretized domain A global matrix system is formed after the assembly of all elements This lecture is divided into two chapters Chapter 1 describes one dimensional boundary value problems with applications to electrostatic problems described by the Poisson's equation The accuracy of the finite element method is evaluated for linear and higher order elements by computing the

numerical error based on two different definitions Chapter 2 describes two dimensional boundary value problems in the areas of electrostatics and electrodynamics time harmonic problems For the second category an absorbing boundary condition was imposed at the exterior boundary to simulate undisturbed wave propagation toward infinity Computations of the numerical error were performed in order to evaluate the accuracy and effectiveness of the method in solving electromagnetic problems Both chapters are accompanied by a number of Matlab codes which can be used by the reader to solve one and two dimensional boundary value problems These codes can be downloaded from the publisher's URL www morganclaypool com page polycarpou This lecture is written primarily for the nonexpert engineer or the undergraduate or graduate student who wants to learn for the first time the finite element method with applications to electromagnetics It is also targeted for research engineers who have knowledge of other numerical techniques and want to familiarize themselves with the finite element method The lecture begins with the basics of the method including formulating a boundary value problem using a weighted residual method and the Galerkin approach and continues with imposing all three types of boundary conditions including absorbing boundary conditions Another important topic of emphasis is the development of shape functions including those of higher order In simple words this series lecture provides the reader with all information necessary for someone to apply successfully the finite element method to one and two dimensional boundary value problems in electromagnetics It is suitable for newcomers in the field of finite elements in electromagnetics The H-p Version of the Finite Element Method in Three Dimensions Jianming Zhang, 2008 Finite Element Method Electromagnetics John L. Volakis, Arindam Chatterjee, Leo C. Kempel, 1998-06-15 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 Frequency Domain Hybrid Finite Element Methods in Electromagnetics John. L Volakis, Kubilay Sertel, Brian C Usner, 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 sutility 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 Method for Electromagnetic Modeling Gérard Meunier, 2010-01-05 The Finite Element Method for Electromagnetic Modeling Written by specialists in the modeling of 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 Static magnetodynamic and fixed formulations are first covered before the discussion moves on to different macroscopic behavior laws of materials and their implementation in a finite element context and to more specific formulations the modeling of thin regions when finite elements become ill fitting the coupling of 2D and 3D formulations with circuit equations taking into account the presence of eddy currents and the treatment of geometric symmetries when the sources are not symmetric Coupled problems are then outlined before the book concludes with coverage of different meshing methods in the context of electromagnetism and optimization techniques Finite Elements for Electrical Engineers Peter Peet Silvester, Ronald L. Ferrari, 1996-09-05 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 Finite Elements, Electromagnetics and Design S.R.H. Hoole, 1995-05-19 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 Finite Elements for Electrical *Engineers* P. P. Silvester, Ronald Leslie Ferrari, 1990-03-01 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 Quick Finite Elements for Electromagnetic Waves Giuseppe Pelosi, Roberto Coccioli, Stefano Selleri, 2009 The classic 1998 Artech House book Quick Finite Elements for Electromagnetic Waves has now been revised and expanded to bring you up to date with the latest developments in the Field You find brand new discussions on finite elements in 3D 3D resonant cavities and 3D waveguide devices Moreover the second edition supplies you with MATLAB code making this resource easier to comprehend and use for your projects in the field This practical book and accompanying software enables you to guickly 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 With this unique book and software set in hand you can compute the dispersion diagram of arbitrarily shaped inhomogeneous isotropic lossless or lossy guiding structures analyze E and H plane waveguide discontinuities and devices and understand the reflection from and transmission through simple 2D and 3D inhomogeneous periodic structures CD ROM Included Easy to use finite element software contains ready made MATLAB and FORTRAN source code that you can use immediately to solve a wide range of microwave and EM problems The package is fully compatible with Internet freeware so you can perform advanced engineering functions without having to purchase expensive pre and post processing tools Finite Element Method for Eigenvalue Problems in Electromagnetics C. J. Reddy,1994 Electromagnetics Through the Finite Element Method Jos?e Roberto Cardoso, 2017 Finite Elements for Wave Electromagnetics IEEE Antennas and Propagation Society, 1994 Finite Elements-based Optimization S. Ratnajeevan H. Hoole, Yovahn Yesuraiyan R. Hoole, 2019-07-24 This book is intended to be a cookbook for students and researchers to understand the finite element method and optimization methods and couple them to effect shape optimization The optimization part of the book will survey optimization methods and focus on the genetic algorithm and Powell's method for implementation in the codes It will contain pseudo code for the relevant algorithms and homework problems to reinforce the theory to compile finite element programs capable of shape optimization Features Enables readers to understand the finite element method and optimization methods and couple them to effect shape optimization Presents simple approach with algorithms for synthesis Focuses on automated computer aided design CAD of electromagnetic devices Provides a unitary framework involving optimization and numerical modelling Discusses how to integrate open source mesh generators into your code Indicates how parallelization of algorithms especially matrix solution and optimization may be approached cheaply using the graphics processing unit GPU that is available on most PCs today Includes coupled problem optimization using

hyperthermia as an example MATLAB-based Finite Element Programming in Electromagnetic Modeling Özlem Özgün, Mustafa Kuzuoğlu, 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 **Electromagnetic** Modeling by Finite Element Methods João Pedro A. Bastos, Nelson Sadowski, 2003-04-01 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 Introduction to the Finite Element Method in Electromagnetics (Synthesis Lectures on Computational Electromagnetics). Anastasis C. Polycarpou,

Unveiling the Magic of Words: A Review of "The Finite Element Method In Electromagnetics 3rd Edition By Jin Jian Ming 2014 Hardcover"

In some sort of defined by information and interconnectivity, the enchanting power of words has acquired unparalleled significance. Their capability to kindle emotions, provoke contemplation, and ignite transformative change is really awe-inspiring. Enter the realm of "The Finite Element Method In Electromagnetics 3rd Edition By Jin Jian Ming 2014 Hardcover," a mesmerizing literary masterpiece penned with a distinguished author, guiding readers on a profound journey to unravel the secrets and potential hidden within every word. In this critique, we shall delve into the book is central themes, examine its distinctive writing style, and assess its profound affect the souls of its readers.

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