NUMERICAL METHODS
in
ELECTROMAGNETIC
FIELDS

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Narosa

Numerical Methods In Electromagnetic Fields

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Numerical Methods In Electromagnetic Fields:

Numerical Methods in Electromagnetism M. V.K. Chari,Sheppard Salon,2000 Electromagnetics is the foundation of our electric technology It describes the fundamental principles upon which electricity is generated and used This includes electric machines high voltage transmission telecommunication radar and recording and digital computing Numerical Methods in Electromagnetism will serve both as an introductory text for graduate students and as a reference book for professional engineers and researchers This book leads the uninitiated into the realm of numerical methods for solving electromagnetic field problems by examples and illustrations Detailed descriptions of advanced techniques are also included for the benefit of working engineers and research students Comprehensive descriptions of numerical methods In depth introduction to finite differences finite elements and integral equations Illustrations and applications of linear and nonlinear solutions for multi dimensional analysis Numerical examples to facilitate understanding of the methods Appendices for quick reference of mathematical and numerical methods employed   Numerical Analysis of Electromagnetic Fields Pei-bai Zhou,2012-12-06 Numerical methods for solving boundary value problems have developed rapidly Knowledge of these methods is important both for engineers and scientists There are many books published that deal with various approximate methods such as the finite element method the boundary element method and so on However there is no textbook that includes all of these methods This book is intended to fill this gap The book is designed to be suitable for graduate students in engineering science for senior undergraduate students as well as for scientists and engineers who are interested in electromagnetic fields Objective Numerical calculation is the combination of mathematical methods and field theory A great number of mathematical concepts principles and techniques are discussed and many computational techniques are considered in dealing with practical problems The purpose of this book is to provide students with a solid background in numerical analysis of the field problems The book emphasizes the basic theories and universal principles of different numerical methods and describes why and how different methods work Readers will then understand any methods which have not been introduced and will be able to develop their own new methods Organization Many of the most important numerical methods are covered in this book All of these are discussed and compared with each other so that the reader has a clear picture of their particular advantage disadvantage and the relation between each of them The book is divided into four parts and twelve chapters   Numerical Methods in Electromagnetic Fields V. Subbarao,2011 Numerical solution of electromagnetic field problems arise in high frequency light current and low frequency heavy current situations Such problems are governed by Maxwell field equations in differential and integral form and their solution is dependent upon ht geometry properties of the medium and the boundary and initial conditions Elliptic partial differential equations such as the Laplace poisson and Helmholtz equations are associated with steady state phenomena i e boundary value problems usually modeling closed or bounded solution regions Parabolic equations are generally associated with problems of diffusion as

electromagnetic field penetration and related effects of eddy current phenomena Hyperbolic equations arise in propagation problems an example being the electromagnetic wave equation The solution region is usually open so that a solution advances outwards indefinitely from initial conditions while always satisfying specified boundary conditions Access to high speed computers and numerical methods has enabled us to solve many complex electromagnetic problems faster and at less cost Of even greater significance is the fact that the approach enables us to undertake problems that could never have been attempted without them **Electromagnetic Fields, Waves, and Numerical Methods** Zijad Haznadar,Željko Štih,2000 **Numerical Methods in Computational Electrodynamics** Ursula van Rienen,2012-12-06 treated in more detail They are just specimen of larger classes of schemes Es sentially we have to distinguish between semi analytical methods discretiza tion methods and lumped circuit models The semi analytical methods and the discretization methods start directly from Maxwell s equations Semi analytical methods are concentrated on the analytical level They use a computer only to evaluate expressions and to solve resulting linear algebraic problems The best known semi analytical methods are the mode matching method which is described in subsection 2 1 the method of integral equations and the method of moments In the method of integral equations the given boundary value problem is transformed into an integral equation with the aid of a suitable Greens function In the method of moments which includes the mode matching method as a special case the solution function is represented by a linear combination of appropriately weighted basis func tions The treatment of complex geometrical structures is very difficult for these methods or only possible after geometric simplifications In the method of integral equations the Greens function has to satisfy the boundary condi tions In the mode matching method it must be possible to decompose the domain into subdomains in which the problem can be solved analytically thus allowing to find the basis functions Nevertheless there are some ap plications for which the semi analytic methods are the best suited solution methods For example an application from accelerator physics used the mode matching technique see subsection 5 4 **Numerical Methods for Engineering** Karl F. Warnick,2020-09-26 The revised and updated second edition of this textbook teaches students to create computer codes used to engineer antennas microwave circuits and other critical technologies for wireless communications and other applications of electromagnetic fields and waves Worked code examples are provided for MATLAB technical computing software *Theory and Computation of Electromagnetic Fields* Jian-Ming Jin,2011-03-16 This book is intended to serve as a textbook for an entry level graduate course on electromagnetics first seven chapters and for an advanced level graduate course on computational electromagnetics last five chapters Whereas there are several textbooks available for the graduate electromagnetics course no textbook is available for the advanced course on computational electromagnetics This book is intended to fill this void and present electromagnetic theory in a systematic manner so that students can advance from the first course to the second without much difficulty Even though the first part of the book covers the standard basic electromagnetic theory the coverage is different from that in existing textbooks This is mainly the

result of the undergraduate curriculum reform that occurred during the past two decades Many universities reduced the number of required courses in order to give students more freedom to design their own portfolio As a result only one electromagnetics course is required for undergraduate students in most electrical engineering departments in the country New graduate students come to take the graduate electromagnetics course with a significant difference in their knowledge of basic electromagnetic theory To meet the challenge to benefit all students of backgrounds this book covers both fundamental theories such as vector analysis Maxwell s equations and boundary conditions and transmission line theory and advanced topics such as wave transformation addition theorems and scattering by a layered sphere Numerical Methods in Electromagnetics W.H.A. SCHILDERS,E.J.W. TER MATEN,2005-04-04 This special volume provides a broad overview and insight in the way numerical methods are being used to solve the wide variety of problems in the electronics industry Furthermore its aim is to give researchers from other fields of application the opportunity to benefit from the results wich have been obtained in the electronics industry Complete survey of numerical methods used in the electronic industry Each chapter is selfcontained Presents state of the art applications and methods Internationally recognised authors **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 **Field Models in Electricity and Magnetism** Paolo Di Barba,Antonio Savini,Slawomir Wiak,2008-02-20 Covering the development of field computation in the past forty years this book is a concise comprehensive and up to date introduction to methods for the analysis and synthesis of electric and magnetic fields A broad view of the subject of field models in electricity and magnetism ranging from basic theory to numerical applications is offered The approach throughout is to solve field problems directly from partial differential equations in terms of vector quantities *Electromagnetics through the Finite Element Method* José Roberto Cardoso,2016-10-03 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 **Computational Electromagnetics** Thomas Rylander,Pär Ingelström,Anders Bondeson,2012-11-06 Computational Electromagnetics is a young and growing discipline expanding as a result of the steadily increasing demand for software for the design and analysis of electrical devices This book introduces three of the most popular numerical methods for simulating electromagnetic fields the finite difference method the finite element method and the method of moments In particular it focuses on how these methods are used to obtain valid approximations to the solutions of Maxwell s equations using for example staggered grids and edge elements The main goal of the book is to make the reader aware of different sources of errors in numerical computations and also to provide the tools for assessing the accuracy of numerical methods and their solutions To reach this goal convergence analysis extrapolation von Neumann stability analysis and dispersion analysis are introduced and used frequently throughout the book Another major goal of the book is to provide students with enough practical understanding of the methods so they are able to write simple programs on their own To achieve this the book contains several MATLAB programs and detailed description of practical issues such as assembly of finite element matrices and handling of unstructured meshes Finally the book aims at making the students well aware of the strengths and weaknesses of the different methods so they can decide which method is best for each problem In this second edition extensive computer projects are added as well as new material throughout Reviews of previous edition The well written monograph is devoted to students at the undergraduate level but is also useful for practising engineers Zentralblatt MATH 2007 **Integral Methods in Low-Frequency Electromagnetics** Pavel Solin,Ivo Dolezel,Pavel Karban,Bohus Ulrych,2009-08-11 A modern presentation of integral methods in low frequency electromagnetics This book provides state of the art knowledge on integral methods in low frequency electromagnetics Blending theory with numerous examples it introduces key aspects of the integral methods used in engineering as a powerful alternative to PDE based models Readers will get complete coverage of The electromagnetic field and its basic characteristics An overview of solution methods Solutions of electromagnetic fields by integral expressions Integral and integrodifferential methods Indirect solutions of electromagnetic fields by the boundary element method Integral equations in the solution of selected coupled problems Numerical methods for integral equations All computations presented in the book are done by means of the authors own codes and a significant amount of their own results is included At the book s end they also discuss novel integral

techniques of a higher order of accuracy which are representative of the future of this rapidly advancing field Integral Methods in Low Frequency Electromagnetics is of immense interest to members of the electrical engineering and applied mathematics communities ranging from graduate students and PhD candidates to researchers in academia and practitioners in industry   **Introduction to the Finite Element Method in Electromagnetics** Anastasis C. Polycarpou,2022-05-31 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   **Computational Methods for Electromagnetics** Andrew F. Peterson,Scott L. Ray,Raj Mittra,1998 Computational Methods for Electromagnetics is an indispensable resource for making efficient and accurate formulations for electromagnetics applications and their numerical treatment Employing a unified coherent approach that is unmatched in the

field the authors detail both integral and differential equations using the method of moments and finite element procedures In addition readers will gain a thorough understanding of numerical solution procedures Detail is provided to enable the reader to implement concepts in software and in addition a collection of related computer programs are available via the Internet Computational Methods for Electromagnetics is designed for graduate level classroom use or self study and every chapter includes problems It will also be of particular interest to engineers working in the aerospace defense telecommunications wireless electromagnetic compatibility and electronic packaging industries Amazon com   Finite Elements in Electrical and Magnetic Field Problems M. V. K. Chari,Peter Peet Silvester,1980 Finite elements the basic concepts and an application to 3 D magnetostatic problems The fundamental equations of eletric 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   *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

Numerical Computation of Electric and Magnetic Fields Charles W. Steele,2012-12-06 Since the first edition of this book was published in 1987 there have been several important changes in the state of numerical field computation as discussed in

the Introduction These changes have motivated the publication of this second edition As with the first edition the objective of this second edition is to give the newcomer to field computation the information needed to perform practical field computations Again clarity of presentation is given greater emphasis than a high degree of sophistication or the state of the art And again the basic concepts of field computation are presented as well as the commonly used algorithms Several persons have provided much valuable information for this second edition I wish to thank Professor Giorgio Molinari of the University of Genoa Italy for advice regarding adaptive mesh generation Dr C R E Emson of Vector Fields Ltd England and Dr John Brauer of McNeal Schwendler Corp for their advice on transient eddy current computation and Dr Zoltan Cendes of Ansoft Corp for information about their adaptive mesh generator Again I would like to acknowledge the support for this second edition by my wife Candace Again I could not have written this book without her support *Computational Methods in Electromagnetic Compatibility* Dragan Poljak,Khalil El Khamlichi Drissi,2018-04-24 Offers a comprehensive overview of the recent advances in the area of computational electromagnetics Computational Method in Electromagnetic Compatibility offers a review of the most recent advances in computational electromagnetics The authors noted experts in the field examine similar problems by taking different approaches related to antenna theory models and transmission line methods They discuss various solution methods related to boundary integral equation techniques and finite difference techniques The topics covered are related to realistic antenna systems including antennas for air traffic control or ground penetrating radar antennas grounding systems such as grounding systems for wind turbines biomedical applications of electromagnetic fields such as transcranial magnetic stimulation and much more The text features a number of illustrative computational examples and a reference list at the end of each chapter The book is grounded in a rigorous theoretical approach and offers mathematical details of the formulations and solution methods This important text Provides a trade off between a highly efficient transmission line approach and antenna theory models providing analysis of high frequency and transient phenomena Contains the newest information on EMC analysis and design principles Discusses electromagnetic field coupling to thin wire configurations and modeling in bioelectromagnetics Written for engineering students senior researchers and practicing electrical engineers Computational Method in Electromagnetic Compatibility provides a valuable resource in the design of equipment working in a common electromagnetic environment Computational Methods for Electromagnetic and Optical Systems, Second Edition John M. Jarem,Partha P. Banerjee,2011 This text examines a variety of spectral computational techniques including k space theory Floquet theory and beam propagation that are used to analyze electromagnetic and optical problems The authors tie together different applications in EM and optics in which the state variable method is used Emphasizing the analysis of planar diffraction gratings using rigorous coupled wave analysis the book presents many cases that are analyzed using a full field vector approach to solve Maxwell s equations in anisotropic media where a standard wave equation approach is intractable

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