Chapter 5 Finite Difference Methods York University

A MATLAB-Based Introduction
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Finite Element and Finite Difference Methods in Electromagnetic Scattering
Fitted Numerical Methods for Singular Perturbation Problems
A Modern Software Approach
Finite Difference Methods in Heat Transfer
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Boundary Methods and Nonconforming Combinations
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Computational Fluid Mechanics and Heat Transfer, Second Edition
Advanced Numerical and Semi-Analytical Methods for Differential Equations
Computational Partial Differential Equations Using MATLAB
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Water Pollution
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Shallow Water Hydrodynamics
Quantitative Finance
Iterative Methods for Sparse Linear Systems
Conservative Finite-Difference Methods on General Grids
Modeling and Computational Methods for Kinetic Equations
Computational Fluid Mechanics and Heat Transfer
Revival: Numerical Solution Of Convection-Diffusion Problems (1996)
From Analysis to Algorithms

BRENDEN CLARENCE

A MATLAB-Based Introduction
Springer Science & Business Media
This second volume in the Progress in Electromagnetic Research series examines recent advances in computational electromagnetics, with emphasis on scattering, as brought about by new formulations and algorithms which use finite element or finite difference techniques. Containing contributions by some of the world's leading experts, the papers thoroughly review and analyze this rapidly evolving area of computational electromagnetics. Covering topics ranging from the new finite-element based formulation for representing time-harmonic vector fields in 3-D inhomogeneous media using two coupled scalar potentials, to the consideration of conforming boundary elements and leap-frog time-marching in transient field problems involving corners and wedges in two and three dimensions, the volume will provide an indispensable reference source for practitioners and students of computational electromagnetics.
A MATLAB-Based Introduction CRC Press
This book introduces finite difference methods for both ordinary differential equations (ODEs) and partial differential equations (PDEs) and discusses the similarities and differences between algorithm design and stability analysis for different types of equations. A unified view of stability theory for ODEs and PDEs is presented, and the interplay between ODE and PDE analysis is stressed. The text emphasizes standard classical methods, but several newer approaches also are introduced and are described in the context of simple motivating examples.
Finite Element and Finite Difference Methods in Electromagnetic Scattering
Elsevier
A concise guide to the theory and application of numerical methods for predicting ocean acoustic propagation, also providing an introduction to numerical methods, with an overview of those methods presently in use. An in-depth development of the implicit-finite-difference technique is presented together with bench-mark test examples included to demonstrate its application to realistic ocean environments. Other applications include atmospheric acoustics, plasma physics, quantum mechanics, optics and seismology.
Fitted Numerical Methods for Singular Perturbation Problems
Butterworth-Heinemann
This textbook introduces several major numerical methods for solving various partial differential equations (PDEs) in science and engineering, including elliptic, parabolic, and hyperbolic equations. It covers traditional techniques that include the classic finite difference method and the finite element method as well as state-of-the-art numerical methods, such as the high-order compact difference method and the radial basis function meshless method. Helps Students Better Understand Numerical Methods through Use of MATLAB® The authors uniquely emphasize both theoretical numerical analysis and practical implementation of the algorithms in MATLAB, making the book useful for students in computational science and engineering. They provide students with simple, clear implementations instead of sophisticated usages of MATLAB functions. All the Material Needed for a Numerical Analysis

Course Based on the authors' own courses, the text only requires some knowledge of computer programming, advanced calculus, and difference equations. It includes practical examples, exercises, references, and problems, along with a solutions manual for qualifying instructors. Students can download MATLAB code from www.crcpress.com, enabling them to easily modify or improve the codes to solve their own problems.

A Modern Software Approach Finite Difference Methods for Ordinary and Partial Differential EquationsSteady-State and Time-Dependent Problems Computational Methods in Engineering Boundary Value Problems

Finite Difference Methods in Heat Transfer Birkhäuser

Finite Difference Methods in Heat Transfer presents a clear, step-by-step delineation of finite difference methods for solving engineering problems governed by ordinary and partial differential equations, with emphasis on heat transfer applications. The finite difference techniques presented apply to the numerical solution of problems governed by similar differential equations encountered in many other fields. Fundamental concepts are introduced in an easy-to-follow manner. Representative examples illustrate the application of a variety of powerful and widely used finite difference techniques. The physical situations considered include the steady state and transient heat conduction, phase-change involving melting and solidification, steady and transient forced convection inside ducts, free convection over a flat plate, hyperbolic heat conduction, nonlinear diffusion, numerical grid generation techniques, and hybrid numerical-analytic solutions.

Technical Bulletin CRC Press

Quantitative Finance: An Object-Oriented Approach in C++ provides readers with a foundation in the key methods and models of quantitative finance. Keeping the material as self-contained as possible, the author introduces computational finance with a focus on practical implementation in C++. Through an approach based on C++ classes and templates, the text highlights the basic principles common to various methods and models while the algorithmic implementation guides readers to a more thorough, hands-on understanding. By moving beyond a purely theoretical treatment to the actual implementation of the models using C++, readers greatly enhance their career opportunities in the field. The book also helps readers implement models in a trading or research environment. It presents recipes and extensible code building blocks for some of the most widespread methods in risk management and option pricing. Web Resource The author's website provides fully functional C++ code, including additional C++ source files and examples. Although the code is used to illustrate concepts (not as a finished software product), it nevertheless compiles, runs, and deals with full, rather than toy, problems. The website also includes a suite of practical exercises for each chapter covering a range of difficulty levels and problem complexity.

Boundary Methods and Nonconforming Combinations John Wiley & Sons

Until now, novices had to painstakingly dig through the literature to discover how to use Monte Carlo techniques for solving electromagnetic problems. Written by one of the foremost researchers in the field, Monte Carlo Methods for Electromagnetics provides a solid understanding of these methods and their applications in electromagnetic computation. Including much of his own work, the author brings together essential information from several different publications. Using a simple, clear writing style, the author begins with a historical background and review of electromagnetic theory. After addressing probability and statistics, he introduces the finite difference method as well as the fixed and floating random walk Monte Carlo methods. The text then applies the Exodus method to Laplace’s and Poisson’s equations and presents Monte Carlo techniques for handing Neumann problems. It also deals with whole field computation using the Markov chain, applies Monte Carlo methods to time-varying diffusion problems, and explores wave scattering due to random rough surfaces. The final chapter covers multidimensional integration. Although numerical techniques have become the standard tools for solving practical, complex electromagnetic problems, there is no book currently available that focuses exclusively on Monte Carlo techniques for electromagnetics. Alleviating this problem, this book describes Monte Carlo methods as they are used in the field of electromagnetics.

The Computation of Tides and Currents in Estuaries and Canals
SIAM

Finite Difference Methods in Heat Transfer, Second Edition focuses on finite difference methods and their application to the solution of heat transfer problems. Such methods are based on the discretization of governing equations, initial and boundary conditions, which then replace a continuous partial differential problem by a system of algebraic equations. Finite difference methods are a versatile tool for scientists and for engineers. This updated book serves university students taking graduate-level coursework in heat transfer, as well as being an important reference for researchers and engineering. Features Provides a self-contained approach in finite difference methods for students and professionals Covers the use of finite difference methods in convective, conductive, and radiative heat transfer Presents numerical solution techniques to elliptic, parabolic, and hyperbolic problems Includes hybrid analytical–numerical approaches

Ocean Acoustic Propagation by Finite Difference Methods CRC Press

This book is open access under a CC BY 4.0 license. This easy-to-read book introduces the basics of solving partial differential equations by means of finite difference methods. Unlike many of the traditional academic works on the topic, this book was written for practitioners. Accordingly, it especially addresses: the construction of finite difference schemes, formulation and implementation of algorithms, verification of implementations, analyses of physical behavior as implied by the numerical solutions, and how to apply the methods and software to solve problems in the fields of physics and biology.

Finite Difference Methods SIAM

Completely updated, the seventh edition provides engineers with an in-depth look at the key concepts in the field. It incorporates new discussions on emerging areas of heat transfer, discussing technologies that are related to nanotechnology, biomedical engineering and alternative energy. The

example problems are also updated to better show how to apply the material. And as engineers follow the rigorous and systematic problem-solving methodology, they'll gain an appreciation for the richness and beauty of the discipline.
Finite Difference Methods on Irregular Networks CRC Press
This comprehensive text provides basic fundamentals of computational theory and computational methods. The book is divided into two parts. The first part covers material fundamental to the understanding and application of finite-difference methods. The second part illustrates the use of such methods in solving different types of complex problems encountered in fluid mechanics and heat transfer. The book is replete with worked examples and problems provided at the end of each chapter.
Monte Carlo Methods for Electromagnetics CRC Press
This book gives an introduction to the finite element method as a general computational method for solving partial differential equations approximately. Our approach is mathematical in nature with a strong focus on the underlying mathematical principles, such as approximation properties of piecewise polynomial spaces, and variational formulations of partial differential equations, but with a minimum level of advanced mathematical machinery from functional analysis and partial differential equations. In principle, the material should be accessible to students with only knowledge of calculus of several variables, basic partial differential equations, and linear algebra, as the necessary concepts from more advanced analysis are introduced when needed. Throughout the text we emphasize implementation of the involved algorithms, and have therefore mixed mathematical theory with concrete computer code using the numerical software MATLAB is and its PDE-Toolbox. We have also had the ambition to cover some of the most important applications of finite elements and the basic finite element methods developed for those applications, including diffusion and transport phenomena, solid and fluid mechanics, and also electromagnetics.
Computational Methods in Solid Mechanics John Wiley & Sons
This textbook is designed for a one year course covering the fundamentals of partial differential equations, geared towards advanced undergraduates and beginning graduate students in mathematics, science, engineering, and elsewhere. The exposition carefully balances solution techniques, mathematical rigor, and significant applications, all illustrated by numerous examples. Extensive exercise sets appear at the end of almost every subsection, and include straightforward computational problems to develop and reinforce new techniques and results, details on theoretical developments and proofs, challenging projects both computational and conceptual, and supplementary material that motivates the student to delve further into the subject. No previous experience with the subject of partial differential equations or Fourier theory is assumed, the main prerequisites being undergraduate calculus, both one- and multi-variable, ordinary differential equations, and basic linear algebra. While the classical topics of separation of variables, Fourier analysis, boundary value problems, Green's functions, and special functions continue to form the core of an introductory course, the inclusion of

nonlinear equations, shock wave dynamics, symmetry and similarity, the Maximum Principle, financial models, dispersion and solutions, Huygens' Principle, quantum mechanical systems, and more make this text well attuned to recent developments and trends in this active field of contemporary research. Numerical approximation schemes are an important component of any introductory course, and the text covers the two most basic approaches: finite differences and finite elements.

Finite Difference Methods for Ordinary and Partial Differential Equations Springer Science & Business Media

This book is the most comprehensive, up-to-date account of the popular numerical methods for solving boundary value problems in ordinary differential equations. It aims at a thorough understanding of the field by giving an in-depth analysis of the numerical methods by using decoupling principles. Numerous exercises and real-world examples are used throughout to demonstrate the methods and the theory. Although first published in 1988, this republication remains the most comprehensive theoretical coverage of the subject matter, not available elsewhere in one volume. Many problems, arising in a wide variety of application areas, give rise to mathematical models which form boundary value problems for ordinary differential equations. These problems rarely have a closed form solution, and computer simulation is typically used to obtain their approximate solution. This book discusses methods to carry out such computer simulations in a robust, efficient, and reliable manner.

Computational Methods CRC Press

In recent years kinetic theory has developed in many areas of the physical sciences and engineering, and has extended the borders of its traditional fields of application. This monograph is a self-contained presentation of such recently developed aspects of kinetic theory, as well as a comprehensive account of the fundamentals of the theory. Emphasizing modeling techniques and numerical methods, the book provides a unified treatment of kinetic equations not found in more focused works. Specific applications presented include plasma kinetic models, traffic flow models, granular media models, and coagulation-fragmentation problems. The work may be used for self-study, as a reference text, or in graduate-level courses in kinetic theory and its applications.

Computational Methods in Engineering Boundary Value Problems Springer

This volume presents an introduction to the three numerical methods most commonly used in the mechanical analysis of deformable solids, viz. the finite element method (FEM), the linear iteration method (LIM), and the finite difference method (FDM). The book has been written from the point of view of simplicity and unity; its originality lies in the comparable emphasis given to the spatial, temporal and nonlinear dimensions of problem solving. This leads to a neat global algorithm. Chapter 1 addresses the problem of a one-dimensional bar, with emphasis being given to the virtual work principle. Chapters 2--4 present the three numerical methods. Although the discussion relates to a one-dimensional model, the formalism used is extendable to two-dimensional situations. Chapter 5 is devoted to a detailed discussion of the compact combination of the three methods, and contains several sections concerning their computer implementation. Finally, Chapter 6 gives a generalization to two and three dimensions of both the mechanical and numerical aspects. For graduate students and researchers whose work involves the theory and application of computational solid mechanics.

Mathematical Theory and Numerical Solution for a Two-dimensional System of Shallow-water Equations

SIAM

The finite difference and finite element methods are powerful tools for the approximate solution of differential equations governing diverse physical phenomena, and there is extensive literature on these discre tization methods. In the last two decades, some extensions of the finite difference method to irregular networks have been described and applied to solving boundary value problems in science and engineering. For instance, "box integration methods" have been widely used in electro nics. There are several papers on this topic, but a comprehensive study of these methods does not seem to have been attempted. The purpose of this book is to provide a systematic treatment of a generalized finite difference method on irregular networks for solving numerically elliptic boundary value problems. Thus, several disadvan tages of the classical finite difference method can be removed, irregular networks of triangles known from the finite element method can be applied, and advantageous properties of the finite difference approxima tions will be obtained. The book is written for advanced undergraduates and graduates in the area of numerical analysis as well as for mathematically inclined workers in engineering and science. In preparing the material for this book, the author has greatly benefited from discussions and collaboration with many colleagues who are concerned with finite difference or (and) finite element methods.

Finite Difference Computing with PDEs

SIAM

Stochastic control is a very active area of research. This monograph, written by two leading authorities in the field, has been updated to reflect the latest developments. It covers effective numerical methods for stochastic control problems in continuous time on two levels, that of practice and that of mathematical development. It is broadly accessible for graduate students and researchers.

Steady-State and Time-Dependent Problems Springer

The investigation was concerned with analysis of one-dimensional tidal motion in the two principal types of tidal waterways: (1) estuaries open to the ocean at one end and merging with a river at the opposite end; and (2) canals or waterways connecting two independent tidal bodies. The objectives of the research program were to classify tidal problems in terms of boundary conditions, to discuss available analytical and numerical procedures, and to recommend an appropriate method of solution for tidal problems. (Author).