Finite Difference Computing With PDEs: A Modern Software Approach (Texts In Computational Science And Engineering)

The world of quantitative finance (QF) is one of the fastest growing areas of research and its practical applications to derivatives pricing problem. Since the discovery of the famous Black-Scholes equation in the 1970's we have seen a surge in the number of models for a wide range of products such as plain and exotic options, interest rate derivatives, real options and many others. Gone are the days when it was possible to price these derivatives analytically. For most problems we must resort to some kind of approximate method. In this book we employ partial differential equations (PDE) to describe a range of one-factor and multi-factor derivatives products such as plain European and American options, multi-asset options, Asian options, interest rate options and real options. PDE techniques allow us to create a framework for modeling complex and interesting derivatives products. Having defined the PDE problem we then approximate it using the Finite Difference Method (FDM). This method has been used for many application areas such as fluid dynamics, heat transfer, semiconductor simulation and astrophysics, to name just a few. In this book we apply the same techniques to pricing real-life derivative products. We use both traditional (or well-known) methods as well as a number of advanced schemes that are making their way into the QF literature: Crank-Nicolson, exponentially fitted and higher-order schemes for one-factor and multi-factor options Early exercise features and approximation using front-fixing, penalty and variational methods Modelling stochastic volatility models using Splitting methods Critique of ADI and Crank-Nicolson schemes; when they work and when they don't work Modelling jumps using Partial Integro Differential Equations (PIDE) Free and moving boundary value problems in QF Included with the book is a CD containing information on how to set up FDM algorithms, how to map these algorithms to C++ as well as several working programs for one-factor and two-factor models. We also provide source code so that you can customize the applications to suit your own needs.

What makes this book stand out from the competition is that it is more computational. Once done with both volumes, readers will have the tools to attack a wider variety of problems than those worked out in the competitors' books. The author stresses the use of technology throughout the text, allowing students to utilize it as much as possible.

This book is devoted to the study of partial differential equation problems both from the theoretical and numerical points of view. After presenting modeling aspects, it develops the theoretical analysis of partial differential equation problems for the three main classes of partial differential equations: elliptic, parabolic and hyperbolic. Several numerical approximation methods adapted to each of these examples are analyzed: finite difference, finite element and finite volumes methods, and they are illustrated using numerical simulation results. Although parts of the book are accessible to Bachelor students in mathematics or engineering, it is primarily aimed at Masters students in applied mathematics or computational engineering. The emphasis is on mathematical detail and rigor for the analysis of both continuous and discrete problems.

This book provides an introduction to the immersed interface method (IIM), a powerful numerical method for solving interface problems and problems defined on irregular domains for which analytic solutions are rarely available. This book gives a complete description of the IIM, discusses recent progress in the area, and describes numerical methods for a number of classic interface problems. It also contains many numerical examples that can be used as benchmark problems for numerical methods designed for interface problems on irregular domains.

Finite Difference Computing: Theory and Software Applications

A Gentle Introduction to Numerical Simulations with Python

Nonlinear Partial Differential Equations in Engineering by W F Ames

Numerical Solution of Partial Differential Equations by the Finite Element Method

Finite Difference Computing with Exponential Decay Models

Numerical Solutions of PDEs Involving Interfaces and Irregular Domains

Finite-difference methods (FDM) are a class of numerical techniques which are used for solving differential equations by estimating derivatives with finite differences. It involves discretizing the spatial domain and time interval. The value of the solution at these discrete points is approximated by solving algebraic equations having finite differences and values from adjacent points. Finite difference methods transform ordinary differential equations or partial differential equations, into a system of linear equations that can be solved by matrix algebra techniques. Modern computers can perform these linear algebra computations efficiently, which has led to the widespread use of FDM in modern numerical analysis. It is considered to be one of the most common approaches to the numerical solution of partial differential equations. This book is compiled in such a manner, that it will provide in-depth knowledge about the theory and practice of finite difference computing. Also included herein is a detailed explanation of the various concepts and applications of this method. Students, researchers, experts and all associated with finite-difference methods will benefit alike from this book.

The main theme is the integration of the theory of linear PDE and the theory of finite difference and finite element methods. For each type of PDE, elliptic, parabolic, and hyperbolic, the text contains one chapter on the mathematical theory of the differential equation, followed by one chapter on finite difference methods and one on finite element methods. The chapters on elliptic equations are preceded by a chapter on the two-point boundary value problem for ordinary differential equations. Similarly, the chapters on time-dependent problems are preceded by a chapter on the initial-value problem for ordinary differential equations. There is also one chapter on the elliptic eigenvalue problem and eigenfunction expansion. The presentation does not presume a deep knowledge of mathematical and functional analysis. The required background on linear functional analysis and Sobolev spaces is reviewed in an appendix. The book is suitable for advanced undergraduate and beginning graduate students of applied mathematics and engineering.

Presents numerical methods and computer code in Matlab for the solution of ODEs and PDEs with detailed line-by-line discussion.

Substantially revised, this authoritative study covers the standard finite difference methods of parabolic, hyperbolic, and elliptic equations, and includes the concomitant theoretical work on consistency, stability, and convergence. The new edition includes revised and greatly expanded sections on stability based on the Lax-Richtmeyer definition, the application of Pade approximants to systems of ordinary differential equations for parabolic and hyperbolic equations, and a considerably improved presentation of iterative methods. A fast-paced introduction to numerical methods, this will be a useful volume for students of mathematics and engineering, and for postgraduates and professionals who need a clear, concise grounding in this discipline.

Steady-State and Time-Dependent Problems

Partial Differential Equations

Introduction to Numerical Methods for Variational Problems

Finite Difference Computing With PDEs

Numerical Analysis of Partial Differential Equations

Programming for Computations - MATLAB/Octave

Targeted at students and researchers in computational sciences who need to develop computer codes for solving PDEs, the exposition here is focused on numerics and software related to mathematical models in solid and fluid mechanics. The book teaches finite element methods, and basic finite difference methods from a computational point of view, with the main emphasis on developing flexible computer programs, using the numerical library Diffpack. Diffpack is explained in detail for problems including model equations in applied mathematics, heat transfer, elasticity, and viscous fluid flow. All the program examples, as well as Diffpack for use with this book, are available on the Internet. XXXXXXX NEUER TEXT This book is for researchers who need to develop computer code for solving PDEs. Numerical methods and the application of Diffpack are explained in detail. Diffpack is a modern C++ development environment that is widely used by industrial scientists and engineers working in areas such as oil exploration, groundwater modeling, and materials testing. All the program examples, as well as a test version of Diffpack, are available for free over the Internet.

lead the reader to a theoretical understanding of the subject without neglecting its practical aspects. The outcome is a textbook that is mathematically honest and rigorous and provides its target audience with a wide range of skills in both ordinary and partial differential equations." --Book Jacket.

In this much-expanded second edition, author Yair Shapira presents new applications and a substantial extension of the original object-oriented framework to make this popular and comprehensive book even easier to understand and use. It not only introduces the C and C++ programming languages, but also shows how to use them in the numerical solution of partial differential equations (PDEs). The book leads readers through the entire solution process, from the original PDE, through the discretization stage, to the numerical solution of the resulting algebraic system. The high level of abstraction available in C++ is particularly useful in the implementation of complex mathematical objects, such as unstructured mesh, sparse matrix, and multigrid hierarchy, often used in numerical modeling. The well-debugged and tested code segments implement the numerical methods efficiently and transparently in a unified object-oriented approach.

A gentle introduction to advanced topics such as parallel computing, multigrid methods, and special methods for systems of PDEs. The goal of all chapters is to ‘compute’ solutions to problems, hence algorithmic and software issues play a central role. All software examples use the Diffpack programming environment - some experience with Diffpack is required. There are also some chapters covering complete applications, i.e., the way from a model, expressed as systems of PDEs, through to discretization methods, algorithms, software design, verification, and computational examples. Suitable for readers with a background in basic finite element and finite difference methods for partial differential equations.

Finite Difference Computing with PDEs

Finite Difference Methods for Partial Differential Equations

A Partial Differential Equation Approach

Computational Partial Differential Equations Using MATLAB®

Finite Difference Methods in Financial Engineering

A Compendium of Partial Differential Equation Models

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.?

From the reviews of Numerical Solution of PartialDifferential Equations in Science and Engineering: "The book by Lapidus and Pinder is a very comprehensive, evenexhaustive, survey of the subject . . . [It] is unique in that itcovers equally finite difference and finite element methods." Burrelle's "The authors have selected an elementary (but not simplistic)mode of presentation. Many different computational schemes aredescribed in great detail . . . Numerous practical examples andapplications are described from beginning to the end, often withcalculated results given." Mathematics of Computing "This volume . . . devotes its considerable number of pages tolucid developments of the methods [for solving partial differentialequations] . . . the writing is very polished and I found it apleasure to read!" Mathematics of Computation Of related interest . . . NUMERICAL ANALYSIS FOR APPLIED SCIENCE Myron B. Allen andEli L. Isaacson. A modern, practical look at numerical analysis,this book guides readers through a broad selection of numericalmethods, implementation, and basic theoretical results, with anemphasis on methods used in scientific computation involvingdifferential equations. 1997 (0-471-55266-6) 512 pp. APPLIED MATHEMATICS Second Edition, J. David Logan.Presenting an easily accessible treatment of mathematical methodsfor scientists and engineers, this acclaimed work covers fluidmechanics and calculus of variations as well as more modernmethods-dimensional analysis and scaling, nonlinear wavepropagation, bifurcation, and singular perturbation. 1996(0-471-16513-1) 496 pp.

This book offers a concise and gentle introduction to finite element programming in Python based on the popular FEniCS software library. Using a series of examples, including the Poisson equation, the equations of linear elasticity, the incompressible Navier–Stokes equations, and systems of nonlinear advection–diffusion–reaction equations, it guides readers through the essential steps to quickly solving a PDE in FEniCS, such as how to define a finite variational problem, how to set boundary conditions, how to solve linear and nonlinear systems, and how to visualize solutions and structure finite element Python programs. This book is open access under a CC BY license.

Since the original publication of this book, available computer power has increased greatly. Today, scientific computing is playing an ever more prominent role as a tool in scientific discovery and engineering analysis. In this second edition, the key addition is an introduction to the finite element method. This is a widely used technique for solving partial differential equations (PDEs) in complex domains. This text introduces numerical methods and shows how to develop, analyse, and use them. Complete MATLAB programs for all the worked examples are now available at www.cambridge.org/Moin, and more than 30 exercises have been added. This thorough and practical book is intended as a first course in numerical analysis, primarily for new graduate students in engineering and physical science. Along with mastering the fundamentals of numerical methods, students will learn to write their own computer programs using standard numerical methods.

Numerical Solution of Partial Differential Equations

A First Course in the Numerical Analysis of Differential Equations

Numerical Solution of Partial Differential Equations in Science and Engineering

Finite Difference Methods

Applied Mathematics Series

Programming for Computations - Python

An equation that relates to one or more functions with its derivatives is called a differential equation. A partial differential equation (PDE) is a type of differential equation, in which the equation consists of unknown multi variables with their partial derivatives. This is a special case of an ordinary differential equation. There is a large amount of modern mathematical and scientific research on methods for numerically approximating solutions of particular PDEs using computers. These are numerical methods for approximating the solutions to differential equations using finite difference equations to approximate derivatives. Finite difference computing is one of the most widely used methods for solving PDEs. This book outlines the processes and applications of finite difference computing with PDEs in detail. The topics included herein on finite difference computing with PDEs are of utmost significance and bound to provide incredible insights to readers. The book is appropriate for students seeking detailed information in this area as well as for experts.

Numerical mathematics is a subtopic of scientific computing. The focus lies on the efficiency of algorithms, i.e. speed, reliability, and robustness. This leads to adaptive algorithms. The theoretical derivation und analyses of algorithms are kept as elementary as possible in this book; the needed sligtly advanced mathematical theory is summarized in the appendix. Numerous figures and illustrating examples explain the complex data, as non-trivial examples serve problems from nanotechnology, chirurgy, and physiology. The book addresses students as well as practitioners in mathematics, natural sciences, and engineering. It is designed as a textbook but also suitable for self study.

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.

An accessible introduction to the finite element method for solving numeric problems, this volume offers the keys to an important technique in computational mathematics. Suitable for advanced undergraduate and graduate courses, it outlines clear connections with applications and considers numerous examples from a variety of science- and engineering-related specialties.This text encompasses all varieties of the basic linear partial differential equations, including elliptic, parabolic and hyperbolic problems, as well as stationary and time-dependent problems. Additional topics include finite element methods for integral equations, an introduction to nonlinear problems, and considerations of unique developments of finite element techniques related to parabolic problems, including

methods for automatic time step control. The relevant mathematics are expressed in non-technical terms whenever possible, in the interests of keeping the treatment accessible to a majority of students.

Solving PDEs in C++

Numerical Partial Differential Equations: Finite Difference Methods

Numerical Solution of Differential Equations

Method of Lines Analysis with Matlab

Partial Differential Equations with Numerical Methods

Finite Difference Methods for Ordinary and Partial Differential Equations

This textbook teaches finite element methods from a computational point of view. It focuses on how to develop flexible computer programs with Python, a programming language in which a combination of symbolic and numerical tools is used to achieve an explicit and practical derivation of finite element algorithms. The finite element library FEniCS is used throughout the book, but the content is provided in sufficient detail to ensure that students with less mathematical background or mixed programming-language experience will equally benefit. All program examples are available on the Internet.

A balanced guide to the essential techniques for solving elliptic partial differential equations Numerical Analysis of Partial Differential Equations provides a comprehensive, self-contained treatment of the quantitative methods used to solve elliptic partial differential equations (PDEs), with a focus on the efficiency as well as the error of the presented methods. The author utilizes coverage of theoretical PDEs, along with the nu merical solution of linear systems and various examples and exercises, to supply readers with an introduction to the essential concepts in the numerical analysis of PDEs. The book presents the three main discretization methods of elliptic PDEs: finite difference, finite elements, and spectral methods. Each topic has its own devoted chapters and is discussed alongside additional key topics, including: The mathematical theory of elliptic PDEs Numerical linear algebra Time-dependent PDEs Multigrid and domain decomposition PDEs posed on infinite domains The book concludes with a discussion of the methods for nonlinear problems, such as Newton's method, and addresses the importance of hands-on work to facilitate learning. Each chapter concludes with a set of exercises, including theoretical and programming problems, that allows readers to test their understanding of the presented theories and techniques. In addition, the book discusses important nonlinear problems in many fields of science and engineering, providing information as to how they can serve as computing projects across various disciplines. Requiring only a preliminary understanding of analysis, Numerical Analysis of Partial Differential Equations is suitable for courses on numerical PDEs at the upper-undergraduate and graduate levels. The book is also appropriate for students majoring in the mathematical sciences and engineering.

This introduction to finite difference and finite element methods is aimed at graduate students who need to solve differential equations. The prerequisites are few (basic calculus, linear algebra, and ODEs) and so the book will be accessible and useful to readers from a range of disciplines across science and engineering. Part I begins with finite difference methods. Finite element methods are then introduced in Part II. In each part, the authors begin with a comprehensive discussion of one-dimensional problems, before proceeding to consider two or higher dimensions. An emphasis is placed on numerical algorithms, related mathematical theory, and essential details in the implementation, while some useful packages are also introduced. The authors also provide well-tested MATLAB® codes, all available online.

Partial Differential Equations presents a balanced and comprehensive introduction to the concepts and techniques required to solve problems containing unknown functions of multiple variables. While focusing on the three most classical partial differential equations (PDEs)—the wave, heat, and Laplace equations—this detailed text also presents a broad practical perspective that merges mathematical concepts with real-world application in diverse areas including molecular structure, photon and electron interactions, radiation of electromagnetic waves, vibrations of a solid, and many more. Rigorous pedagogical tools aid in student comprehension; advanced topics are introduced frequently, with minimal technical jargon, and a wealth of exercises reinforce vital skills and invite additional self-study. Topics are presented in a logical progression, with major concepts such as wave propagation, heat and diffusion, electrostatics, and quantum mechanics placed in contexts familiar to students of various fields in science and engineering. By understanding the properties and applications of PDEs, students will be equipped to better analyze and interpret central processes of the natural world.

Finite Difference Schemes and Partial Differential Equations

Finite Difference and Finite Volume Methods

A Modern Software Approach

Fundamentals of Engineering Numerical Analysis

PETSc for Partial Differential Equations: Numerical Solutions in C and Python

A Gentle Introduction to Numerical Simulations with MATLAB/Octave

This book provides an elementary yet comprehensive introduction to the numerical solution of partial differential equations (PDEs). Used to model important phenomena, such as the heating of apartments and the behavior of electromagnetic waves, these equations have applications in engineering and the life sciences, and most can only be solved approximately using computers.? Numerical Analysis of Partial Differential Equations Using Maple and MATLAB provides detailed descriptions of the four major classes of discretization methods for PDEs (finite difference method, finite volume method, spectral method, and finite element method) and runnable MATLAB? code for each of the discretization methods and exercises. It also gives self-contained convergence proofs for each method using the tools and techniques required for the general convergence analysis but adapted to the simplest setting to keep the presentation clear and complete. This book is intended for advanced undergraduate and early graduate students in numerical analysis and scientific computing and researchers in related fields. It is appropriate for a course on numerical methods for partial differential equations.

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.

This is the 2005 second edition of a highly successful and well-respected textbook on the numerical techniques used to solve partial differential equations arising from mathematical models in science, engineering and other fields. The authors maintain an emphasis on finite difference methods for simple but representative examples of parabolic, hyperbolic and elliptic equations from the first edition. However this is augmented by new sections on finite volume methods, modified equation analysis, symplectic integration schemes, convection-diffusion problems, multigrid, and conjugate gradient methods; and several sections, including that on the energy method of analysis, have been extensively rewritten to reflect modern developments. Already an excellent choice for students and teachers in mathematics, engineering and computer science departments, the revised text includes more latest theoretical and industrial developments.

Numerical Methods for Partial Differential Equations: Finite Difference and Finite Volume Methods focuses on two popular deterministic methods for solving partial differential equations (PDEs), namely finite difference and finite volume methods. The solution of PDEs can be very challenging, depending on the type of equation, the number of independent variables, the boundary, and initial conditions, and other factors. These two methods have been traditionally used to solve problems involving fluid flow. For practical reasons, the finite element method, used more often for solving problems in solid mechanics, and covered extensively in various other texts, has been excluded. The book is intended for beginning graduate students and early career professionals, although advanced undergraduate students may find it equally useful. The material is meant to serve as a prerequisite for students who might go on to take additional courses in computational mechanics, computational fluid dynamics, or computational electromagnetics. The notations, language, and technical jargon used in the book can be easily understood by scientists and engineers who may not have had graduate-level applied mathematics or computer science courses. Presents one of the few available resources that comprehensively describes and demonstrates the finite volume method for unstructured mesh used frequently by practicing code developers in industry Includes step-by-step algorithms and code snippets in each chapter that enables the reader to make the transition from equations on the page to working codes Includes 51 worked out examples that comprehensively demonstrate important mathematical steps, algorithms, and coding practices required to numerically solve PDEs, as well as how to interpret the results from both physical and mathematic perspectives

The Finite Element Method: Theory, Implementation, and Applications

The Immersed Interface Method

The FEniCS Tutorial I

Adaptive Numerical Solution of PDEs

Solving PDEs in Python

An Introduction

Finite Difference Computing with PDEsA Modern Software ApproachSpringer

This text provides a very simple, initial introduction to the complete scientific computing pipeline: models, discretization, algorithms, programming, verification, and visualization. The pedagogical strategy is to use one case study – an ordinary differential equation describing exponential decay processes – to illustrate fundamental concepts in mathematics and computer science. The book is easy to read and only requires a command of one-variable calculus and some very basic knowledge about computer programming. Contrary to similar texts on numerical methods and programming, this text has a much stronger focus on implementation and teaches testing and software engineering in particular.

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.

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Advanced Topics in Computational Partial Differential Equations

Partial Differential Equations: Modeling, Analysis and Numerical Approximation

Numerical Methods for Partial Differential Equations

Computational Partial Differential Equations

Introduction to Finite Difference and Finite Element Methods

The Portable, Extensible Toolkit for Scientific Computation (PETSc) is an open-source library of advanced data structures and methods for solving linear and nonlinear equations and for managing discretizations. This book uses these modern numerical tools to demonstrate how to solve nonlinear partial differential equations (PDEs) in parallel. It starts from key mathematical concepts, such as Krylov space methods, preconditioning, multigrid, and Newton's method. In PETSc these components are composed at run time into fast solvers. Discretizations are introduced from the beginning, with an emphasis on finite difference and finite element methodologies. The example C programs of the first 12 chapters, listed on the inside front cover, solve (mostly) elliptic and parabolic PDE problems. Discretization leads to large, sparse, and generally nonlinear systems of algebraic equations. For such problems, mathematical solver concepts are explained and illustrated through the examples, with sufficient context to speed further development. PETSc for Partial Differential Equations addresses both discretizations and fast solvers for PDEs, emphasizing practice more than theory. Well-structured examples lead to run-time choices that result in high solver performance and parallel scalability. The last two chapters build on the reader's understanding of fast solver concepts when applying the Firedrake Python finite element solver library. This textbook, the first to cover PETSc programming for nonlinear PDEs, provides an on-ramp for graduate students and researchers to a major area of high-performance computing for science and engineering. It is suitable as a supplement for courses in scientific computing or numerical methods for differential equations.

This book presents computer programming as a key method for solving mathematical problems. There are two versions of the book, one for MATLAB and one for Python. The book was inspired by the Springer book TCSE 6: A Primer on Scientific Programming with Python (by Langtangen), but the style is more accessible and concise, in keeping with the needs of engineering students. The book outlines the shortest possible path from no previous experience with programming to a set of skills that allows the students to write simple programs for solving common mathematical problems with numerical methods in engineering and science courses. The emphasis is on generic algorithms, clean design of programs, use of functions, and automatic tests for verification.

In this popular text for an Numerical Analysis course, the authors introduce several major methods of solving various partial differential equations (PDEs) including elliptic, parabolic, and hyperbolic equations. It covers traditional techniques including the classic finite difference method, finite element method, and state-of-the-art numercial methods.The text uniquely emphasizes both theoretical numerical analysis and practical implementation of the algorithms in MATLAB. This new edition includes a new chapter, Finite Value Method, the presentation has been tightened, new exercises and applications are included, and the text refers now to the latest release of MATLAB. Key Selling Points: A successful textbook for an undergraduate text on numerical analysis or methods taught in mathematics and computer engineering. This course is taught in every university throughout the world with an engineering department or school. Competitive advantage broader numerical methods (including finite difference, finite element, meshless method, and finite volume method), provides the MATLAB source code for most popular PDEs with detailed explanation about the implementation and theoretical analysis. No other existing textbook in the market offers a good combination of theoretical depth and practical source codes.

In this book, we study theoretical and practical aspects of computing methods for mathematical modelling of nonlinear systems. A number of computing techniques are considered, such as methods of operator approximation with any given accuracy; operator interpolation techniques including a non-Lagrange interpolation; methods of system representation subject to constraints associated with concepts of causality, memory and stationarity; methods of system representation with an accuracy that is the best within a given class of models; methods of covariance matrix estimation; methods for low-rank matrix approximations; hybrid methods based on a combination of iterative procedures and best operator approximation; and methods for information compression and filtering under condition that a filter model should satisfy restrictions associated with causality and different types of memory. As a result, the book represents a blend of new methods in general computational analysis, and specific, but also generic, techniques for study of systems theory ant its particular branches, such as optimal filtering and information compression. - Best operator approximation, - Non-Lagrange interpolation, - Generic Karhunen-Loeve transform - Generalised low-rank matrix approximation - Optimal data compression - Optimal nonlinear filtering

Finite Difference Computing with Pdes

Numerical Analysis of Partial Differential Equations Using Maple and MATLAB

Introductory Finite Difference Methods for PDEs

Numerical Methods and Diffpack Programming

Numerical Methods in a Unified Object-Oriented Approach, Second Edition