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High Order Difference Methods for Time Dependent PDE Springer Science & Business Media This book covers high order finite difference methods for time dependent PDE. It gives an overview of the basic theory and construction principles by using model examples. The book also contains a general presentation of the techniques and results for well-posedness and stability, with inclusion of the three fundamental methods of analysis both for PDE in its original and discretized form: the Fourier transform, the eneregy method and the Laplace transform. Finite Difference Methods for Ordinary and Partial Differential Equations Steady-State and Time-Dependent Problems SIAM 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. Spectral and High Order Methods for Partial Differential Equations ICOSAHOM 2014 Selected papers from the ICOSAHOM conference, June 23-27, 2014, Salt Lake City, Utah, USA Springer The book contains a selection of high quality papers, chosen among the best presentations during the International Conference on Spectral and High-Order Methods (2014), and provides an overview of the depth and breadth of the activities within this important research area. The carefully reviewed selection of papers will provide the reader with a snapshot of the state-of-the-art and help initiate new research directions through the extensive biography. Time-Dependent Problems and Difference Methods John Wiley & Sons Praise for the First Edition ". . . fills a considerable gap in the numerical analysisliterature by providing a self-contained treatment . . . this is animportant work written in a clear style . . . warmly recommended toany graduate student or researcher in the field of the numericalsolution of partial differential equations." —SIAM Review Time-Dependent Problems and Difference Methods, SecondEdition continues to provide guidance for the analysis ofdifference methods for computing approximate solutions to partialdifferential equations for time-dependent problems. The book treatsdifferential equations and difference methods with a paralleldevelopment, thus achieving a more useful analysis of numericalmethods. The Second Edition presents hyperbolic equations in greatdetail as well as new coverage on second-order systems of waveequations including acoustic waves, elastic waves, and Einsteinequations. Compared to first-order hyperbolic systems,initial-boundary value problems for such systems contain newproperties that must be taken into account when analyzingstability. Featuring the latest material in partial differentialequations with new theorems, examples, andillustrations,Time-Dependent Problems and Difference Methods,Second Edition also includes: High order methods on staggered grids Extended treatment of Summation By Parts operators and theirapplication to second-order derivatives Simplified presentation of certain parts and proofs Time-Dependent Problems and Difference Methods, SecondEdition is an ideal reference for physical scientists,engineers, numerical analysts, and mathematical modelers who usenumerical experiments to test designs and to predict andinvestigate physical phenomena. The book is also excellent forgraduate-level courses in applied mathematics and scientificcomputations. Advances in Applied Mathematics, Modeling, and Computational Science Springer Science & Business Media The volume presents a selection of in-depth studies and state-of-the-art surveys of several challenging topics that are at the forefront of modern applied mathematics, mathematical modeling, and computational science. These three areas represent the foundation upon which the methodology of mathematical modeling and computational experiment is built as a ubiquitous tool in all areas of mathematical applications. This book covers both fundamental and applied research, ranging from studies of elliptic curves over finite fields with their applications to cryptography, to dynamic blocking problems, to random matrix theory with its innovative applications. The book provides the reader with state-of-the-art achievements in the development and application of new theories at the interface of applied mathematics, modeling, and computational science. This book aims at fostering interdisciplinary collaborations required to meet the modern challenges of applied mathematics, modeling, and computational science. At the same time, the contributions combine rigorous mathematical and computational procedures and examples from applications ranging from engineering to life sciences, providing a rich ground for graduate student projects. Computational Partial Differential Equations Using MATLAB CRC Press 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. The Numerical Solution of Ordinary and Partial Differential Equations World Scientific This book presents methods for the computational solution of differential equations, both ordinary and partial, time-dependent and steady-state. Finite difference methods are introduced and analyzed in the first four chapters, and finite element methods are studied in chapter five. A very general-purpose and widely-used finite element program, PDE2D, which implements many of the methods studied in the earlier chapters, is presented and documented in Appendix A. The book contains the relevant theory and error analysis for most of the methods studied, but also emphasizes the practical aspects involved in implementing the methods. Students using this book will actually see and write programs (FORTRAN or MATLAB) for solving ordinary and partial differential equations, using both finite differences and finite elements. In addition, they will be able to solve very difficult partial differential equations using the software PDE2D, presented in Appendix A. PDE2D solves very general steady-state, time-dependent and eigenvalue PDE systems, in 1D intervals, general 2D regions, and a wide range of simple 3D regions. Contents:Direct Solution of Linear SystemsInitial Value Ordinary Differential EquationsThe Initial Value Diffusion ProblemThe Initial Value Transport and Wave ProblemsBoundary Value ProblemsThe Finite Element MethodsAppendix A — Solving PDEs with PDE2DAppendix B — The Fourier Stability MethodAppendix C — MATLAB ProgramsAppendix D — Answers to Selected Exercises Readership: Undergraduate, graduate students and researchers. Key Features:The discussion of stability, absolute stability and stiffness in Chapter 1 is clearer than in other textsStudents will actually learn to write programs solving a range of simple PDEs using the finite element method in chapter 5In Appendix A, students will be able to solve quite difficult PDEs, using the author's software package, PDE2D. (a free version is available which solves small to moderate sized problems)Keywords:Differential Equations;Partial Differential Equations;Finite Element Method;Finite Difference Method;Computational Science;Numerical AnalysisReviews: "This book is very well written and it is relatively easy to read. The presentation is clear and straightforward but quite rigorous. This book is suitable for a course on the numerical solution of ODEs and PDEs problems, designed for senior level undergraduate or beginning level graduate students. The numerical techniques for solving problems presented in the book may also be useful for experienced researchers and practitioners both from universities or industry." Andrzej Icha Pomeranian Academy in Słupsk Poland Spectral and High Order Methods for Partial Differential Equations ICOSAHOM 2016 Selected Papers from the ICOSAHOM conference, June 27-July 1, 2016, Rio de Janeiro, Brazil Springer This book features a selection of high-quality papers chosen from the best presentations at the International Conference on Spectral and High-Order Methods (2016), offering an overview of the depth and breadth of the activities within this important research area. The carefully reviewed papers provide a snapshot of the state of the art, while the extensive bibliography helps initiate new research directions. The Numerical Method of Lines Integration of Partial Differential Equations Elsevier This is the first book on the numerical method of lines, a relatively new method for solving partial differential equations. The Numerical Method of Lines is also the first book to accommodate all major classes of partial differential equations. This is essentially an applications book for computer scientists. The author will separately offer a disk of FORTRAN 77 programs with 250 specific applications, ranging from "Shuttle Launch Simulation" to "Temperature Control of a Nuclear Fuel Rod." Scientific Computing An Introductory Survey, Revised Second Edition SIAM This book differs from traditional numerical analysis texts in that it focuses on the motivation and ideas behind the algorithms presented rather than on detailed analyses of them. It presents a broad overview of methods and software for solving mathematical problems arising in computational modeling and data analysis, including proper problem formulation, selection of effective solution algorithms, and interpretation of results. In the 20 years since its original publication, the modern, fundamental perspective of this book has aged well, and it continues to be used in the classroom. This Classics edition has been updated to include pointers to Python software and the Chebfun package, expansions on barycentric formulation for Lagrange polynomial interpretation and stochastic methods, and the availability of about 100 interactive educational modules that dynamically illustrate the concepts and algorithms in the book. Scientific Computing: An Introductory Survey, Second Edition is intended as both a textbook and a reference for computationally oriented disciplines that need to solve mathematical problems. Introduction to Numerical Methods for Time Dependent Differential Equations John Wiley & Sons Introduces both the fundamentals of time dependent differential equations and their numerical solutions Introduction to Numerical Methods for Time Dependent Differential Equations delves into the underlying mathematical theory needed to solve time dependent differential equations numerically. Written as a self-contained introduction, the book is divided into two parts to emphasize both ordinary differential equations (ODEs) and partial differential equations (PDEs). Beginning with ODEs and their approximations, the authors provide a crucial presentation of fundamental notions, such as the theory of scalar equations, finite difference approximations, and the Explicit Euler method. Next, a discussion on higher order approximations, implicit methods, multistep methods, Fourier interpolation, PDEs in one space dimension as well as their related systems is provided. Introduction to Numerical Methods for Time Dependent Differential Equations features: A step-by-step discussion of the procedures needed to prove the stability of difference approximations Multiple exercises throughout with select answers, providing readers with a practical guide to understanding the approximations of differential equations A simplified approach in a one space dimension Analytical theory for difference approximations that is particularly useful to clarify procedures Introduction to Numerical Methods for Time Dependent Differential Equations is an excellent textbook for upper-undergraduate courses in applied mathematics, engineering, and physics as well as a useful reference for physical scientists, engineers, numerical analysts, and mathematical modelers who use numerical experiments to test designs or predict and investigate phenomena from many disciplines. Numerical Methods for Engineers and Scientists, Second Edition, CRC Press Emphasizing the finite difference approach for solving differential equations, the second edition of Numerical Methods for Engineers and Scientists presents a methodology for systematically constructing individual computer programs. Providing easy access to accurate solutions to complex scientific and engineering problems, each chapter begins with objectives, a discussion of a representative application, and an outline of special features, summing up with a list of tasks students should be able to complete after reading the chapter- perfect for use as a study guide or for review. The AIAA Journal calls the book "...a good, solid instructional text on the basic tools of numerical analysis." Partial Differential Equations of Applied Mathematics John Wiley & Sons This new edition features the latest tools for modeling, characterizing, and solving partial differential equations The Third Edition of this

classic text offers a comprehensive guide to modeling, characterizing, and solving partial differential equations (PDEs). The author provides all the theory and tools necessary to solve problems via exact, approximate, and numerical methods. The Third Edition retains all the hallmarks of its previous editions, including an emphasis on practical applications, clear writing style and logical organization, and extensive use of real-world examples. Among the new and revised material, the book features: * A new section at the end of each original chapter, exhibiting the use of specially constructed Maple procedures that solve PDEs via many of the methods presented in the chapters. The results can be evaluated numerically or displayed graphically. * Two new chapters that present finite difference and finite element methods for the solution of PDEs. Newly constructed Maple procedures are provided and used to carry out each of these methods. All the numerical results can be displayed graphically. * A related FTP site that includes all the Maple code used in the text. * New exercises in each chapter, and answers to many of the exercises are provided via the FTP site. A supplementary Instructor's Solutions Manual is available. The book begins with a demonstration of how the three basic types of equations-parabolic, hyperbolic, and elliptic-can be derived from random walk models. It then covers an exceptionally broad range of topics, including questions of stability, analysis of singularities, transform methods, Green's functions, and perturbation and asymptotic treatments. Approximation methods for simplifying complicated problems and solutions are described, and linear and nonlinear problems not easily solved by standard methods are examined in depth. Examples from the fields of engineering and physical sciences are used liberally throughout the text to help illustrate how theory and techniques are applied to actual problems. With its extensive use of examples and exercises, this text is recommended for advanced undergraduates and graduate students in engineering, science, and applied mathematics, as well as professionals in any of these fields. It is possible to use the text, as in the past, without use of the new Maple material. Computer-Aided Analysis of Difference Schemes for Partial Differential Equations John Wiley & Sons Advances in computer technology have conveniently coincided withtrends in numerical analysis toward increased complexity ofcomputational algorithms based on finite difference methods. It isno longer feasible to perform stability investigation of thesemethods manually--and no longer necessary. As this book shows,modern computer algebra tools can be combined with methods fromnumerical analysis to generate programs that will do the jobautomatically. Comprehensive, timely, and accessible--this is the definitivereference on the application of computerized symbolic manipulationsfor analyzing the stability of a wide range of difference schemes.In particular, it deals with those schemes that are used to solvecomplex physical problems in areas such as gas dynamics, heat andmass transfer, catastrophe theory, elasticity, shallow watertheory, and more. Introducing many new applications, methods, and concepts,Computer-Aided Analysis of Difference Schemes for PartialDifferential Equations * Shows how computational algebra expedites the task of stabilityanalysis--whatever the approach to stability investigation * Covers ten different approaches for each stability method * Deals with the specific characteristics of each method and itsapplication to problems commonly encountered by numerical modelers * Describes all basic mathematical formulas that are necessary toimplement each algorithm * Provides each formula in several global algebraic symboliclanguages, such as MAPLE, MATHEMATICA, and REDUCE * Includes numerous illustrations and thought-provoking examplesthroughout the text For mathematicians, physicists, and engineers, as well as forpostgraduate students, and for anyone involved with numericsolutions for real-world physical problems, this book provides avaluable resource, a helpful guide, and a head start ondevelopments for the twenty-first century. Trends and Perspectives in Applied Mathematics Springer Science & Business Media This marks the 100th volume to appear in the Applied Mathematical Sci ences series. Partial Differential Equations, by Fritz John, the first volume of the series, appeared in 1971. One year prior to its appearance, the then mathematics editor of Springer-Verlag, Klaus Peters, organized a meeting to look into the possibility of starting a series slanted toward applications. The meeting took place in New Rochelle, at the home of Fritz and Char lotte John. K.O. Friedrichs, Peter Lax, Monroe Donsker, Joe Keller, and others from the Courant Institute (previously, the Institute for Mathemat ical Sciences) were present as were Joe LaSalle and myself, the two of us having traveled down from Providence for the meeting. The John home, a large, comfortable house, especially lent itself to the informal, relaxed, and wide-ranging discussion that ensued. What emerged was a consensus that mathematical applications appeared to be poised for a period of growth and that there was a clear need for a series committed to applied mathematics. The first paragraph ofthe editorial statement written at that time reads as follows: The mathematization of all sciences, the fading of traditional scientific boundaries, the impact of computer technology, the growing importance of mathematical-computer modeling and the necessity of scientific planning all create the need both in education and research for books that are introductory to and abreast of these developments. Continuum Theory and Modeling of Thermoelectric Elements John Wiley & Sons This volume presents the latest research results in the thermodynamics and design of thermoelectric devices, providing a solid foundation for thermoelectric element and module design in the technical development process, and a valuable tool for any application development. Polynomial Chaos Methods for Hyperbolic Partial Differential Equations Numerical Techniques for Fluid Dynamics Problems in the Presence of Uncertainties Springer This monograph presents computational techniques and numerical analysis to study conservation laws under uncertainty using the stochastic Galerkin formulation. With the continual growth of computer power, these methods are becoming increasingly popular as an alternative to more classical sampling-based techniques. The text takes advantage of stochastic Galerkin projections applied to the original conservation laws to produce a large system of modified partial differential equations, the solutions to which directly provide a full statistical characterization of the effect of uncertainties. Polynomial Chaos Methods of Hyperbolic Partial Differential Equations focuses on the analysis of stochastic Galerkin systems obtained for linear and non-linear convection-diffusion equations and for a systems of conservation laws; a detailed well-posedness and accuracy analysis is presented to enable the design of robust and stable numerical methods. The exposition is restricted to one spatial dimension and one uncertain parameter as its extension is conceptually straightforward. The numerical methods designed guarantee that the solutions to the uncertainty quantification systems will converge as the mesh size goes to zero. Examples from computational fluid dynamics are presented together with numerical methods suitable for the problem at hand: stable high-order finite-difference methods based on summation-by-parts operators for smooth problems, and robust shock-capturing methods for highly nonlinear problems. Academics and graduate students interested in computational fluid dynamics and uncertainty quantification will find this book of interest. Readers are expected to be familiar with the fundamentals of numerical analysis. Some background in stochastic methods is useful but notnecessary. Partial Differential Equations for Scientists and Engineers Courier Corporation Practical text shows how to formulate and solve partial differential equations. Coverage of diffusion-type problems, hyperbolic-type problems, elliptic-type problems, numerical and approximate methods. Solution guide available upon request. 1982 edition. New Trends in Differential and Difference Equations and Applications MDPI This Special Issue aims to be a compilation of new results in the areas of differential and difference Equations, covering boundary value problems, systems of differential and difference equations, as well as analytical and numerical methods. The objective is to provide an overview of techniques used in these different areas and to emphasize their applicability to real-life phenomena, by the inclusion of examples. These examples not only clarify the theoretical results presented, but also provide insight on how to apply, for future works, the techniques used. Partial Differential Equations Modeling, Analysis, Computation SIAM Partial differential equations (PDEs) are used to describe a large variety of physical phenomena, from fluid flow to electromagnetic fields, and are indispensable to such disparate fields as aircraft simulation and computer graphics. While most existing texts on PDEs deal with either analytical or numerical aspects of PDEs, this innovative and comprehensive textbook features a unique approach that integrates analysis and numerical solution methods and includes a third component - modeling - to address real-life problems. The authors believe that modeling can be learned only by doing; hence a separate chapter containing 16 user-friendly case studies of elliptic, parabolic, and hyperbolic equations is included and numerous exercises are included in all other chapters. Numerical Solution of Partial Differential Equations in Science and Engineering John Wiley & Sons "This book was written to provide a text for graduate and undergraduate students who took our courses in numerical methods. It incorporates the essential elements of all the numerical methods currently used extensively in the solution of partial differential equations encountered regularly in science and engineering. Because our courses were typically populated by students from varied backgrounds and with diverse interests, we attempted to eliminate jargon or nomenclature that would render the work unintelligible to any student. Moreover, in response to student needs, we incorporated not only classical (and not so classical) finite-difference methods but also finite-element, collocation, and boundary-element procedures. After an introduction to the various numerical schemes, each equation type--parabolic, elliptic, and hyperbolic--is allocated a separate chapter. Within each of these chapters the material is presented by numerical method. Thus one can read the book either by equation-type or numerical approach."--Preface, page [v]. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB Scientific and Engineering Applications Springer Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB shows the reader how to exploit a fuller array of numerical methods for the analysis of complex scientific and engineering systems than is conventionally employed. The book is dedicated to numerical simulation of distributed parameter systems described by mixed systems of algebraic equations, ordinary differential equations (ODEs) and partial differential equations (PDEs). Special attention is paid to the numerical method of lines (MOL), a popular approach to the solution of time-dependent PDEs, which proceeds in two basic steps: spatial discretization and time integration. Besides conventional finite-difference and element techniques, more advanced spatial-approximation methods are examined in some detail, including nonoscillatory schemes and adaptive-grid approaches. A MOL toolbox has been developed within MATLAB®/OCTAVE/SCILAB. In addition to a set of spatial approximations and time integrators, this toolbox includes a collection of application examples, in specific areas, which can serve as templates for developing new programs. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB provides a practical introduction to some advanced computational techniques for dynamic system simulation, supported by many worked examples in the text, and a collection of codes available for download from the book’s page at www.springer.com. This text is suitable for self-study by practicing scientists and engineers and as a final-year undergraduate course or at the graduate level. Derivatives, Risk Management & Value World Scientific 19.1. Numerical analysis and simulation techniques : an introduction to finite difference methods. 19.2. Application to European options on non-dividend paying stocks. 19.3. Valuation of American options with a composite volatility. 19.4. Simulation methods : Monte-Carlo method. ch. 20. Numerical methods and partial differential equations for European and American derivatives with complete and incomplete information. 20.1. Valuation of American calls on dividend-paying stocks. 20.2. American puts on dividend-paying stocks. 20.3. Numerical procedures in the presence of information costs : applications. 20.4. Convertible bonds. 20.5. Two-factor interest rate models and bond pricing within information uncertainty. 20.6. CBs pricing within information uncertainty -- pt. VIII. Exotic derivatives. ch. 21. Risk management : exotics and second-generation options. 21.1. Exchange options. 21.2. Forward-start options. 21.3. Pay-later options. 21.4. Simple chooser options. 21.5. Complex choosers. 21.6. Compound options. 21.7. Options on the maximum (minimum). 21.8. Extendible options. 21.9. Equity-linked foreign exchange options and quantos. 21.10. Binary barrier options. 21.11. Lookback options. ch. 22. Value at risk, credit risk, and credit derivatives. 22.1. VaR and riskmetrics : definitions and basic concepts. 22.2. Statistical and probability foundation of VaR. 22.3. A more advanced approach to VaR. 22.4. Credit valuation and the creditmetrics approach. 22.5. Default and credit-quality migration in the creditmetrics approach. 22.6. Credit-quality correlations. 22.7. Portfolio management of default risk in the Kealhofer, McQuown and Vasicek (KMV) approach. 22.8. Credit derivatives : definitions and main concepts. 22.9. The rating agencies models and the proprietary models. Computational Partial Differential Equations Numerical Methods and Diffpack Programming Springer Science & Business Media 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. Methods for the Approximate Solution of Time Dependent Problems "The theoretical analysis of numerical methods presented in this monograph will fill the need for systematic treatments in formulating finite-difference methods for geophysical fluid dynamics problems" - forward. Nonlinear Analysis in Chemical Engineering Bruce Alan Finlayson Numerical Methods in Computational

Finance A Partial Differential Equation (PDE/FDM) Approach John Wiley & Sons This book is a detailed and step-by-step introduction to the mathematical foundations of ordinary and partial differential equations, their approximation by the finite difference method and applications to computational finance. The book is structured so that it can be read by beginners, novices and expert users. Part A Mathematical Foundation for One-Factor Problems Chapters 1 to 7 introduce the mathematical and numerical analysis concepts that are needed to understand the finite difference method and its application to computational finance. Part B Mathematical Foundation for Two-Factor Problems Chapters 8 to 13 discuss a number of rigorous mathematical techniques relating to elliptic and parabolic partial differential equations in two space variables. In particular, we develop strategies to preprocess and modify a PDE before we approximate it by the finite difference method, thus avoiding ad-hoc and heuristic tricks. Part C The Foundations of the Finite Difference Method (FDM) Chapters 14 to 17 introduce the mathematical background to the finite difference method for initial boundary value problems for parabolic PDEs. It encapsulates all the background information to construct stable and accurate finite difference schemes. Part D Advanced Finite Difference Schemes for Two-Factor Problems Chapters 18 to 22 introduce a number of modern finite difference methods to approximate the solution of two factor partial differential equations. This is the only book we know of that discusses these methods in any detail. Part E Test Cases in Computational Finance Chapters 23 to 26 are concerned with applications based on previous chapters. We discuss finite difference schemes for a wide range of one-factor and two-factor problems. This book is suitable as an entry-level introduction as well as a detailed treatment of modern methods as used by industry quants and MSc/MFE students in finance. The topics have applications to numerical analysis, science and engineering. More on computational finance and the author's online courses, see www.datasim.nl. The Closest Point Method for Time-dependent Processes on Surfaces This thesis concerns the numerical solution of time-dependent partial differential equations (PDEs) on general surfaces using a recent technique known as the Closest Point Method. The Closest Point Method represents surfaces with a closest point representation which leads to great flexibility with respect to surface geometry, among other advantages. The computation itself alternates between two steps: first, an explicit time step is performed using standard finite difference techniques on a narrow band of grid points surrounding the surface embedded in a higher dimension; second, a closest point extension is used to maintain consistency with the original surface PDE. The Closest Point Method is applied to the important problem of interface motion on surfaces by using level set equations posed on surfaces. New weighted essentially non-oscillatory (WENO) interpolation schemes are derived to perform the necessary closest point extensions. This approach, in combination with standard Hamilton--Jacobi WENO finite difference schemes and explicit time stepping, gives high-order results (up to fifth-order) on a variety of test problems. Example computations are performed on a sphere, torus, triangulated human hand and Klein bottle to demonstrate the flexibility of the method. A new implicit Closest Point Method is presented for surface PDEs which are stiff, for example, because of diffusion terms. The method uses implicit time-stepping schemes to allow large steps but retains the flexibility with respect to surface geometry of the original explicit Closest Point Method. Numerical convergence studies on the heat equation and a fourth-order biharmonic problem demonstrate the accuracy of the method and a variety of example computations demonstrate its effectiveness. These include an image processing example of blurring on triangulated surfaces, heat diffusion on a surface consisting of multiple components connected by a thin filament and Turing pattern formation on surfaces using implicit--explicit (IMEX) time stepping. A class of time-stepping methods known as diagonally split Runge--Kutta (DSRK) methods is investigated. These methods appear promising because they offer both high-order convergence and unconditional contractivity (a nonlinear stability property). However, numerical computations and analysis of stage-order demonstrates that unconditionally contractive DSRK methods suffer from order reduction which severely limits their practical application. Computational Methods in Solid Mechanics Springer Science & Business Media 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. Fundamentals of Engineering Numerical Analysis Cambridge University Press Engineers need hands-on experience in solving complex engineering problems with computers. This text introduces numerical methods and shows how to develop, analyze, and use them. A thorough and practical book, it is is intended as a first course in numerical analysis, primarily for beginning 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. They will learn what factors affect accuracy, stability, and convergence. A special feature is the numerous examples and exercises that are included to give students first-hand experience. Numerical Methods for Evolutionary Differential Equations SIAM Methods for the numerical simulation of dynamic mathematical models have been the focus of intensive research for well over 60 years, and the demand for better and more efficient methods has grown as the range of applications has increased. Mathematical models involving evolutionary partial differential equations (PDEs) as well as ordinary differential equations (ODEs) arise in diverse applications such as fluid flow, image processing and computer vision, physics-based animation, mechanical systems, relativity, earth sciences, and mathematical finance. This textbook develops, analyzes, and applies numerical methods for evolutionary, or time-dependent, differential problems. Both PDEs and ODEs are discussed from a unified viewpoint. The author emphasizes finite difference and finite volume methods, specifically their principled derivation, stability, accuracy, efficient implementation, and practical performance in various fields of science and engineering. Smooth and nonsmooth solutions for hyperbolic PDEs, parabolic-type PDEs, and initial value ODEs are treated, and a practical introduction to geometric integration methods is included as well. Audience: suitable for researchers and graduate students from a variety of fields including computer science, applied mathematics, physics, earth and ocean sciences, and various engineering disciplines. Researchers who simulate processes that are modeled by evolutionary differential equations will find material on the principles underlying the appropriate method to use and the pitfalls that accompany each method. Numerical Methods John Wiley & Sons This series of five volumes proposes an integrated description ofphysical processes modeling used by scientific disciplines frommeteorology to coastal morphodynamics. Volume 1 describes thephysical processes and identifies the main measurement devices usedto measure the main parameters that are indispensable to implementall these simulation tools. Volume 2 presents the differenttheories in an integrated approach: mathematical models as well asconceptual models, used by all disciplines to represent theseprocesses. Volume 3 identifies the main numerical methods used inall these scientific fields to translate mathematical models intonumerical tools. Volume 4 is composed of a series of case studies,dedicated to practical applications of these tools in engineeringproblems. To complete this presentation, volume 5 identifies anddescribes the modeling software in each discipline. Recent Developments in the Numerics of Nonlinear Hyperbolic Conservation Laws Lectures Presented at a Workshop at the Mathematical Research Institute Oberwolfach, Germany, Jan 15 – 21, 2012 Springer Science & Business Media In January 2012 an Oberwolfach workshop took place on the topic of recent developments in the numerics of partial differential equations. Focus was laid on methods of high order and on applications in Computational Fluid Dynamics. The book covers most of the talks presented at this workshop. The Numerical Solution of Ordinary and Partial Differential Equations John Wiley & Sons Proper Orthogonal Decomposition Methods for Partial Differential Equations Academic Press Proper Orthogonal Decomposition Methods for Partial Differential Equations evaluates the potential applications of POD reduced-order numerical methods in increasing computational efficiency, decreasing calculating load and alleviating the accumulation of truncation error in the computational process. Introduces the foundations of finite-differences, finite-elements and finite-volume-elements. Models of time-dependent PDEs are presented, with detailed numerical procedures, implementation and error analysis. Output numerical data are plotted in graphics and compared using standard traditional methods. These models contain parabolic, hyperbolic and nonlinear systems of PDEs, suitable for the user to learn and adapt methods to their own R&D problems. Explains ways to reduce order for PDEs by means of the POD method so that reduced-order models have few unknowns Helps readers speed up computation and reduce computation load and memory requirements while numerically capturing system characteristics Enables readers to apply and adapt the methods to solve similar problems for PDEs of hyperbolic, parabolic and nonlinear types Solving Partial Differential Equation Applications with PDE2D John Wiley & Sons Solve engineering and scientific partial differential equation applications using the PDE2D software developed by the author Solving Partial Differential Equation Applications with PDE2D derives and solves a range of ordinary and partial differential equation (PDE) applications. This book describes an easy-to-use, general purpose, and time-tested PDE solver developed by the author that can be applied to a wide variety of science and engineering problems. The equations studied include many time-dependent, steady-state and eigenvalue applications such as diffusion, heat conduction and convection, image processing, math finance, fluid flow, and elasticity and quantum mechanics, in one, two, and three space dimensions. The author begins with some simple "0D" problems that give the reader an opportunity to become familiar with PDE2D before proceeding to more difficult problems. The book ends with the solution of a very difficult nonlinear problem, which requires a moving adaptive grid because the solution has sharp, moving peaks. This important book: Describes a finite-element program, PDE2D, developed by the author over the course of 40 years Derives the ordinary and partial differential equations, with appropriate initial and boundary conditions, for a wide variety of applications Offers free access to the Windows version of the PDE2D software through the author's website at www.pde2d.com Offers free access to the Linux and MacOSX versions of the PDE2D software also, for instructors who adopt the book for their course and contact the author at www.pde2d.com Written for graduate applied mathematics or computational science classes, Solving Partial Differential Equation Applications with PDE2D offers students the opportunity to actually solve interesting engineering and scientific applications using the accessible PDE2D. Computational Methods in Chemical Engineering with Maple Springer Science & Business Media This book presents Maple solutions to a wide range of problems relevant to chemical engineers and others. Many of these solutions use Maple's symbolic capability to help bridge the gap between analytical and numerical solutions. The readers are strongly encouraged to refer to the references included in the book for a better understanding of the physics involved, and for the mathematical analysis. This book was written for a senior undergraduate or a first year graduate student course in chemical engineering. Most of the examples in this book were done in Maple 10. However, the codes should run in the most recent version of Maple. We strongly encourage the readers to use the classic worksheet (*. mws) option in Maple as we believe it is more user-friendly and robust. In chapter one you will find an introduction to Maple which includes simple basics as a convenience for the reader such as plotting, solving linear and nonlinear equations, Laplace transformations, matrix operations, 'do loop,' and 'while loop. ' Chapter two presents linear ordinary differential equations in section 1 to include homogeneous and nonhomogeneous ODEs, solving systems of ODEs using the matrix exponential and Laplace transform method. In section two of chapter two, nonlinear ordinary differential equations are presented and include simultaneous series reactions, solving nonlinear ODEs with Maple's 'dsolve' command, stop conditions, differential algebraic equations, and steady state solutions. Chapter three addresses boundary value problems. Introduction to Chemical Engineering Computing John Wiley & Sons Applied Mechanics Reviews Trends in Industrial and Applied Mathematics Springer Science & Business Media This book contains current results of research on numerical solutions of Schrodinger-type problems, sampling theorems, numerical methods for large-scale non-convex quadratic programming, derivative-free algorithms, free material optimization, Moreau's sweeping process and a perspective on industrial mathematics work in recent years. The book also includes wavelet-based digital watermarking techniques and computer simulation of meteorological parameters. One chapter of the book is also devoted to the importance of strange attractors for industrial mathematics. Audience: Academic researchers, as well as researchers working in industry.