Shooting Methods For Numerical Solution Of Nonlinear File Type

The need for efficient and accurate methods for the solution of boundary value problems such as Poisson-type equations is well established. In numerical weather prediction where solutions to such equations are required in daily routine operations, it is paramount that the solution procedure be efficient. An efficient shooting method to meet such a need has been reported. The algebraic system resulting from the regular discretization of the Poisson equation on a sphere is, however, numerically unstable. Thus the direct application of this method is accurate only for relatively small systems. This limitation has now been successfully removed by two major improvements to the method. The inherent instability of the system due to a spectral radius larger than unity is alleviated by the use of a multiple shooting technique, while the instability due to the convergence of meridians on a sphere is overcome by a specially designed flexible grid. Numerical examples are provided to demonstrate the effectiveness of the improved method.

Numerical Solutions of Boundary Value Problems with So-Called Shooting Method

In this thesis, we consider shooting methods for computing approximate solutions of control problems constrained by linear or nonlinear hyperbolic partial differential equations. Optimal control problems and exact controllability problems are both studied, with the latter being approximated by the former with appropriate choices of parameters in the cost functional. The types of equations include linear wave equations, semilinear wave equations, and first order linear hyperbolic equations. The controls considered are either distributed in part of the time-space domain or of the Dirichlet type on the boundary. Each optimal control problem is reformulated as a system of equations that consists of an initial value problem (IVP) for the state equations and a terminal value problem for the adjoint equations. The optimality systems are regarded as a system of an IVP for the state equation and an IVP for the adjoint equations with unknown initial conditions. Then the optimality system is solved by shooting methods, i.e. we attempt to find adjoint initial values such that the adjoint terminal conditions are met. The shooting methods are implemented iteratively and Newton's method is employed to update the adjoint initial values. The convergence of the algorithms are theoretically discussed and numerically verified. Computational experiments are performed extensively for a variety of settings: different types of constraint equations in 1-D or 2-D, distributed or boundary controls, optimal control or exact controllability.

In this work, Parviz Moin introduces numerical methods and shows how to develop, analyse, and use them. A thorough and practical text, it is intended as a first course in numerical analysis.

Numerical Methods and Applications

Numerical Methods, 4th

Extrapolation of Difference Methods in Option Valuation, Rounding Error in Numerical Solution of Stochastic Differential Equations, and Shooting Methods for Stochastic Boundary-value Problems

Proceedings of an International Workshop, Vancouver, Canada, July 10–13, 1984

Nonlinear Ordinary Differential Equations

Analytical Approximation and Numerical Methods

NUMERICAL METHODS, Fourth Edition emphasizes the intelligent application of approximation techniques to the type of problems that commonly occur in engineering and the physical sciences. Readers learn why the numerical methods work, what kinds of errors to expect, and when an application might lead to difficulties. The authors also provide information about the availability of high-quality software for numerical approximation routines. The techniques are the same as those covered in the authors' top-selling Numerical Analysis text, but this text provides an overview for students who need to know the methods without having to perform the analysis. This concise approach still includes mathematical justifications, but only when they are necessary to understand the methods. The emphasis is placed on describing each technique from an implementation standpoint, and on convincing the reader that the method is reasonable both mathematically and computationally. Important Notice: Media content referenced within the product description or the product text may not be available in the ebook version.

Most of the equations governing the problems related to science and engineering are nonlinear in nature. As a result, they are inherently difficult to solve. Analytical solutions are available only for some special cases. For other cases, one has no easy means but to solve the problem must depend on numerical solutions. Fluid Flow, Heat and Mass Transfer at Bodies of Different Shapes: Numerical Solutions presents the current theoretical developments of boundary layer theory, a branch of transport phenomena. Also, the book addresses the theoretical developments in the area and presents a number of physical problems that have been solved by analytical or numerical method. It is focused particularly on fluid flow problems governed by nonlinear differential equations. The book is intended for researchers in applied mathematics, physics, mechanics and engineering. Addresses basic concepts to understand the theoretical framework for the method Provides examples of nonlinear problems that have been solved through the use of numerical method Focuses on fluid flow problems governed by nonlinear equations

There are many books on the use of numerical methods for solving engineering problems and for modeling of engineering artifacts. In addition there are many styles of such presentations ranging from books with a major emphasis on theory to books with an emphasis on applications. The purpose of this book is hopefully to present a somewhat different approach to the use of numerical methods for - gineering applications. Engineering models are in general nonlinear models where the response of some appropriate engineering variable depends in a nonlinear manner on the - plication of some independent parameter. It is certainly true that for many types of engineering models it is sufficient to approximate the real physical world by some linear model. However, when engineering environments are pushed to - treme conditions, nonlinear effects are always encountered. It is also such - treme conditions that are of major importance in determining the reliability or failure limits of engineering systems. Hence it is essential than engineers have a toolbox of modeling techniques that can be used to model nonlinear engineering systems. Such a set of basic numerical methods is the topic of this book. For each subject area treated, nonlinear models are incorporated into the discussion from the very beginning and linear models are simply treated as special cases of more general nonlinear models. This is a basic and fundamental difference in this book from most books on numerical methods.

This is the first comprehensive textbook that provides a systematic and detailed analysis of initial and boundary value problems for differential-algebraic equations. The analysis is developed from the theory of linear constant coefficient systems via linear variable coefficient systems to general nonlinear systems. Further sections on control problems, generalized inverses of differential algebraic operators, generalized solutions, and differential equations on manifolds complement the theoretical treatment of initial value problems.

Numerical Analysis

Fundamentals of Engineering Numerical Analysis

Shooting Method to Some Problems of Fluid Mechanics

A Guide for Engineers and Scientists

Numerical Solutions of Boundary Value Problems for Ordinary Differential Equations

Numerical Methods for Nonlinear Engineering Models

Numerical Solutions of Boundary Value Problems for Ordinary Differential Equations covers the proceedings of the 1974 Symposium by the same title, held at the University of Maryland, Baltimore Country Campus. This symposium aims to bring together a number of numerical analysis involved in research in both theoretical and practical aspects of this field. This text is organized into three parts encompassing 15 chapters. Part I reviews the initial and boundary value problems. Part II explores a large number of important results of both theoretical and practical nature of the field, including discussions of the smooth and local interpolant with small K-th derivative, the occurrence and solution of boundary value reaction systems, the posteriori error estimates, and boundary problem solvers for first order systems based on deferred corrections. Part III highlights the practical applications of the boundary value problems, specifically a high-order finite-difference method for the solution of two-point boundary-value problems on a uniform mesh. This book will prove useful to mathematicians, engineers, and physicists.

Python Programming and Numerical Methods: A Guide for Engineers and Scientists introduces programming tools and numerical methods to engineering and science students, with the goal of helping the students to develop good computational problem-solving techniques through the use of numerical methods and the Python programming language. Part One introduces fundamental programming concepts, using simple examples to put new concepts quickly into practice. Part Two covers the fundamentals of algorithms and numerical analysis at a level that allows students to quickly apply results in practical settings. Includes tips, warnings and "try this" features within each chapter to help the reader develop good programming practice Summaries at the end of each chapter allow for quick access to important information Includes code in Jupyter notebook format that can be directly run online

Praise for the First Edition ". . . outstandingly appealing with regard to its style, contents, considerations of requirements of practice, choice of examples, and exercises." —Zentrablatt Math ". . . carefully structured with many detailed worked examples . . ." —The Mathematical Gazette ". . . an up-to-date and user-friendly account . . ." —Mathematika An Introduction to Numerical Methods and Analysis addresses the mathematics underlying approximation and scientific computing and successfully explains where approximation methods come from, why they sometimes work (or don't work), and when to use one of the many techniques that are available. Written in a style that emphasizes readability and usefulness for the numerical methods novice, the book begins with basic, elementary material and gradually builds up to more advanced topics. A selection of concepts required for the study of computational mathematics is introduced, and simple approximations using Taylor's Theorem are also treated in some depth. The text includes exercises that run the gamut from simple hand computations, to challenging derivations and minor proofs, to programming exercises. A greater emphasis on applied exercises as well as the cause and effect associated with numerical mathematics is featured throughout the book. An Introduction to Numerical Methods and Analysis is the ideal text for students in advanced undergraduate mathematics and engineering courses who are interested in gaining an understanding of numerical methods and numerical analysis.

This book shows how to derive, test and analyze numerical methods for solving differential equations, including both ordinary and partial differential equations. The objective is that students learn to solve differential equations numerically and understand the mathematical and computational issues that arise when this is done. Includes an extensive collection of exercises, which develop both the analytical and computational aspects of the material. In addition to more than 100 illustrations, the book includes a large collection of supplemental material: exercise sets, MATLAB computer codes for both student and instructor, lecture slides and movies.

A MATLAB Approach, Third Edition

Fluid Flow, Heat and Mass Transfer at Bodies of Different Shapes

Introduction to Numerical Analysis

A Shooting Method for the Solution of a Discrete Poisson Equation on the Surface of a Sphere

Numerical Boundary Value ODEs

International Conference, ICICA 2010, Tangshan, China, October 15-18, 2010. Proceedings

Elementary yet rigorous, this concise treatment is directed toward students with a knowledge of advanced calculus, basic numerical analysis, and some background in ordinary differential equations and linear algebra. 1968 edition.

A concise introduction to numerical methodsand the mathematicalframework neededto understand their performance Numerical Solution of Ordinary Differential Equationspresents a complete and easy-to-follow introduction to classicaltopics in the numerical solution of ordinary differentialequations. The book's approach not only explains the presentedmathematics, but also helps readers understand how these numericalmethods are used to solve real-world problems. Unifying perspectives are provided throughout the text, bringingtogether and categorizing different types of problems in order tohelp readers comprehend the applications of ordinary differentialequations. In addition, the authors' collective academic experienceensures a coherent and accessible discussion of key topics,including: Euler's method Taylor and Runge-Kutta methods General error analysis for multi-step methods Stiff differential equations Differential algebraic equations Two-point boundary value problems Volterra integral equations Each chapter features problem sets that enable readers to testand build their knowledge of the presented methods, and a relatedWeb site features MATLAB® programs that facilitate theexploration of numerical methods in greater depth. Detailedreferences outline additional literature on both analytical andnumerical aspects of ordinary differential equations for furtherexploration of individual topics. Numerical Solution of Ordinary Differential Equations isan excellent textbook for courses on the numerical solution ofdifferential equations at the upper-undergraduate and beginninggraduate levels. It also serves as a valuable reference forresearchers in the fields of mathematics and engineering.

Nearly 20 years ago we produced a treatise (of about the same length as this book) entitled Computing methods for scientists and engineers. It was stated that most computation is performed by workers whose mathematical training stopped somewhere short of the 'professional' level, and that some books are therefore needed which use quite simple mathematics but which nevertheless communicate the essence of the 'numerical sense' which is exhibited by the real computing experts and which is surely needed, at least to some extent, by all who use modern computers and modern numerical software. In that book we treated, at no great length, a variety of computational problems in which the material on ordinary differential equations occupied about 50 pages. At that time it was quite common to find books on numerical analysis, with a little on each topic ofthat field, whereas today we are more likely to see similarly-sized books on each major topic: for example on numerical linear algebra, numerical approximation, numerical solution ofordinary differential equations, numerical solution of partial differential equations, and so on. These are needed because our numerical education and software have improved and because our relevant problems exhibit more variety and more difficulty. Ordinary differential equa tions are obvious candidates for such treatment, and the current book is written in this sense.

Highly recommended by CHOICE, previous editions of this popular textbook offered an accessible and practical introduction to numerical analysis. An Introduction to Numerical Methods: A MATLAB Approach, Third Edition continues to present a wide range of useful and important algorithms for scientific and engineering applications. The authors use MATL

Solving ODEs with MATLAB

An Efficient, Accurate Numerical Method for the Solution of a Poisson Equation on a Sphere

Numerical Methods for Two-Point Boundary-Value Problems

A First Course in Ordinary Differential Equations

Numerical Solutions of Boundary Value Problems with So-Called Shooting Method

Numerical Solution of Ordinary Differential Equations

This excellent text for advanced undergraduate and graduate students covers norms, numerical solutions of linear systems and matrix factoring, eigenvalues and eigenvectors, polynomial approximation, and more. Many examples and problems. 1966 edition.

The first MATLAB-based numerical methods textbook for bioengineers that uniquely integrates modelling concepts with statistical analysis, while maintaining a focus on enabling the user to report the error or uncertainty in their result. Between traditional numerical method topics of linear modelling concepts, nonlinear root finding, and numerical integration, chapters on hypothesis testing, data regression and probability are interweaved. A unique feature of the book is the inclusion of examples from clinical trials and bioinformatics, which are not found in other numerical methods textbooks for engineers. With a wealth of biomedical engineering examples, case studies on topical biomedical research, and the inclusion of end of chapter problems, this is a perfect core text for a one-semester undergraduate course.

This volume presents papers delivered at the First International Conference on Difference Equations (FICDE) held at Trinity University in San Antonio, Texas, USA. During the course of this meeting, 66 papers were presented by participants from across the United States and more than 20 other countries. Topics of papers include chaotic dynamics, mathematical biology, robust control theory, stochastic differential systems, dynamics of satellite and rocket systems, theory of orthogonal polynomials, and epidemiological modelling. Many current expository papers will be of value to students and researchers in the mathematical and physical sciences.

This book constitutes the thoroughly refereed post-conference proceedings of the 8th International Conference on Numerical Methods and Applications, NMA 2014, held in Borovets, Bulgaria, in August 2014. The 34 revised full papers presented were carefully reviewed and selected from 56 submissions for inclusion in this book. The papers are organized in the following topical sections: Monte Carlo and quasi-Monte Carlo methods; metaheuristics for optimization problems; advanced numerical methods for scientific computing; advanced numerical techniques for PDEs and applications; solving large engineering and scientific problems with advanced mathematical models; numerical simulations and back analysis in civil and mechanical engineering.

A MATLAB Approach, Second Edition

Numerical Solution of Nonlinear Boundary Value Problems with Applications

Analytical and Numerical Methods

An Introduction to Numerical Methods

Two-point Boundary Value Problems: Shooting Methods

Numerical Solutions

The solution of the Poisson equation plays an important role in problems such as air pollution and numerical weather prediction in geophysics and in problems such as fission in reactor physics. In the case of numerical weather prediction where solutions to the Poisson equation are required in daily routine operations, it is paramount that the solution procedure be efficient. An efficient shooting method is presented for the numerical solution of a discrete Poisson equation on the surface of the sphere. The solution is computed via two-dimensional shooting in the physical domain while the 'missing initial conditions' needed to start the shooting are obtained in a one-dimensional setting in the Fourier domain.

Please note that the content of this book primarily consists of articles available from Wikipedia or other free sources online. Pages: 114. Chapters: Discrete element method, Finite difference, Shooting method, Finite-difference time-domain method, Finite element method, MUSCL scheme, Constraint algorithm, Verlet integration, Runge-Kutta methods, Linear multistep method, Stiff equation, Particle-in-cell, Crank-Nicolson method, Finite element method in structural mechanics, Numerical ordinary differential equations, Direct stiffness method, Flux limiter, Smoothed-particle hydrodynamics, Cea's lemma, Finite difference method, Spectral method, Euler method, Transmission line matrix method, List of Runge-Kutta methods, Discrete Laplace operator, Finite pointset method, Eigenvalues and eigenvectors of the second derivative, Finite volume method, Moving particle semi-implicit method, Discrete Poisson equation, Modal analysis using FEM, Boundary element method, Shock capturing methods, Parallel mesh generation, Galerkin method, Cell lists, Godunov's theorem, Five-point stencil, Vorticity confinement, Symplectic integrator, Split-step method, Perfectly matched layer, Weak formulation, Finite difference coefficient, Finite difference methods for option pricing, Energy drift, Meshfree methods, Geometric integrator, Direct multiple shooting method, Kronecker sum of discrete Laplacians, Image-based meshing, Adaptive stepsize, Numerov's method, Method of lines, Semi-implicit Euler method, Upwind scheme, Trefftz method, Interval boundary element method, Beeman's algorithm, AUSM, Rayleigh-Ritz method, Adaptive mesh refinement, Compact stencil, Godunov's scheme, Partial element equivalent circuit, Alternating direction implicit method, History of numerical solution of differential equations using computers, Variational integrator, Dormand-Prince method, Extended finite element method, Fast multipole method, Midpoint method, Explicit and implicit methods, Immersed...

On the occasion of this new edition, the text was enlarged by several new sections. Two sections on B-splines and their computation were added to the chapter on spline functions: Due to their special properties, their flexibility, and the availability of well-tested programs for their computation, B-splines play an important role in many applications. Also, the authors followed suggestions by many readers to supplement the chapter on elimination methods with a section dealing with the solution of large sparse systems of linear equations. Even though such systems are usually solved by iterative methods, the realm of elimination methods has been widely extended due to powerful techniques for handling sparse matrices. We will explain some of these techniques in connection with the Cholesky algorithm for solving positive definite linear systems. The chapter on eigenvalue problems was enlarged by a section on the Lanczos algorithm; the sections on the LR and QR algorithm were rewritten and now contain a description of implicit shift techniques. In order to some extent take into account the progress in the area of ordinary differential equations, a new section on implicit differential equa tions and differential-algebraic systems was added, and the section on stiff differential equations was updated by describing further methods to solve such equations.

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.

Applied Numerical Methods with MATLAB for Engineers and Scientists

Applications in MATLAB

Numerical Differential Equations

Computer Oriented Numerical Analysis

Shooting Methods for Numerical Solutions of Control Problems Constrained by Linear and Nonlinear Hyperbolic Partial Differential Equations

Lectures on a unified theory of and practical procedures for the numerical solution of very general classes of linear and nonlinear two point boundary-value problems.

Electronic computers have opened up vast fields in the world of science and Engineering. In many Engineering designs where only guessed solutions could be tested till now, it has become possible to optimize the designs by testing the various permutations and combinations of loads, strengths and configurations. Problems which could not possibly be touched so far due to prohibitive computational time involved are now amenable to solution. The widespread use of digital computers has revolutionized numerical analysis. The classical method of polynomial interpolation is replaced by computer oriented numerical methods. The methods of solving algebraic and transcendental equations have been modified so as to provide facilities for computation in digital computers. Some of the well known problems of fluid mechanics have been subjected to modern methods with the view to examine (i) the convergence of the new methods, (ii) whether the solution is improved in accuracy etc. The purpose of this book is to discuss how to apply computer oriented numerical approach to solve this unsolved problems.

The book discusses the solutions to nonlinear ordinary differential equations (ODEs) using analytical and numerical approximation methods. Recently, analytical approximation methods have been largely used in solving linear and nonlinear lower-order ODEs. It also discusses using these *methods to solve some strong nonlinear ODEs. There are two chapters devoted to solving nonlinear ODEs using numerical methods, as in practice high-dimensional systems of nonlinear ODEs that cannot be solved by analytical approximate methods are common. Moreover, it studies analytical and numerical techniques for the treatment of parameter-depending ODEs. The book explains various methods for solving nonlinear-oscillator and structural-system problems, including the energy balance method, harmonic balance method, amplitude frequency formulation, variational iteration method, homotopy perturbation method, iteration perturbation method, homotopy analysis method, simple and multiple shooting method, and the nonlinear stabilized march method. This book comprehensively investigates various new analytical and numerical approximation techniques that are used in solving nonlinear-oscillator and structural-system problems. Students often rely on the finite element method to such an extent that on graduation they have little or no knowledge of alternative methods of solving problems. To rectify this, the book introduces several new approximation techniques.*

Numerical methods are a mainstay of researchers and professionals across the many mathematics, scientific, and engineering disciplines. The importance of these methods combined with the power and availability of today's computers virtually demand that students in these fields be well versed not only in the numerical techniques, but also in the use

Numerical Solution of Boundary Value Problems for Ordinary Differential Equations

Python Programming and Numerical Methods

Introduction To Numerical Computation, An (Second Edition)

Analysis of Numerical Methods

An Introduction to Numerical Methods and Analysis

Numerical Solution of Two Point Boundary Value Problems

This book serves as a set of lecture notes for a senior undergraduate level course on the introduction to numerical computation, which was developed through 4 semesters of teaching the course over 10 years. The book requires minimum background knowledge from the students, including only a three-semester of calculus, and a bit on matrices.The book covers many of the introductory topics for a first course in numerical computation, which fits in the short time frame of a semester course. Topics range from polynomial approximations and interpolation, to numerical methods for ODEs and PDEs. Emphasis was made more on algorithm development, basic mathematical ideas behind the algorithms, and the implementation in Matlab.The book is supplemented by two sets of videos, available through the author's YouTube channel. Homework problem sets are provided for each chapter, and complete answer sets are available for instructors upon request.The second edition contains a set of selected advanced topics, written in a self-contained manner, suitable for self-learning or as additional material for an honored version of the course. Videos are also available for these added topics.

Learn to write programs to solve ordinary and partial differential equations The Second Edition of this popular text provides an insightful introduction to the use of finite difference and finite element methods for the computational solution of ordinary and partial differential equations. Readers gain a thorough understanding of the theory underlying themethods presented in the text. The author emphasizes the practical steps involved in implementing the methods, culminating in readers learning how to write programs using FORTRAN90 and MATLAB(r) to solve ordinary and partial differential equations. The book begins with a review of direct methods for the solution of linear systems, with an emphasis on the special features of the linear systems that arise when differential equations are solved. The following four chapters introduce and analyze the more commonly used finite difference methods for solving a variety of problems, including ordinary and partial differential equations and initial value and boundary value problems. The techniques presented in these chapters, with the aid of carefully developed exercises and numerical examples, can be easilymastered by readers. The final chapter of the text presents the basic theory underlying the finite element method. Following the guidance offered in this chapter, readers gain a solid understanding of the method and discover how to use it to solve many problems. A special feature of the Second Edition is Appendix A, which describes a finite element program, PDE2D, developed by the author. Readers discover how PDE2D can be used to solve difficult partial differential equation problems, including nonlinear time-dependent and steady-state systems, and linear eigenvalue systems in 1D intervals, general 2D regions, and a wide range of simple 3D regions. The software itself is available to instructors who adopt the text to share with their students.

"This book presents in comprehensive detail numerical solutions to boundary value problems of a number of differential equations using the so-called Shooting Method. 4th order Runge-Kutta method, Newton's forward difference interpolation method and bisection method for root finding have been employed in this regard. Programs in Mathematica 6.0 were written to obtain the numerical solutions. This monograph on Shooting Method is the only available detailed resource of the topic"--

This well-respected text gives an introduction to the theory and application of modern numerical approximation techniques for students taking a one- or two-semester course in numerical analysis. With an accessible treatment that only requires a calculus prerequisite, Burden and Faires explain how, why, and when approximation techniques can be expected to work, and why, in some situations, they fail. A wealth of examples and exercises develop students' intuition, and demonstrate the subject's practical applications to important everyday problems in math, computing, engineering, and physical science disciplines. The first book of its kind built from the ground up to serve a diverse undergraduate audience, three decades later Burden and Faires remains the definitive introduction to a vital and practical subject. Important Notice: Media content referenced within the product description or the product text may not be available in the ebook version.

Information Computing and Applications, Part II

Numerical and Statistical Methods for Bioengineering

Differential-algebraic Equations

Proceedings of the First International Conference on Difference Equations

Analysis and Numerical Solution

Introduction to Numerical Methods in Differential Equations

This book, first published in 2003, provides a concise but sound treatment of ODEs, including IVPs, BVPs, and DDEs.

Steven Chapra's second edition, Applied Numerical Methods with MATLAB for Engineers and Scientists, is written for engineers and scientists who want to learn numerical problem solving. This text focuses on problem-solving (applications) rather than theory, using MATLAB, and is intended for Numerical Methods users; hence theory is included only to inform key concepts. The second edition feature new material such as Numerical Differentiation and ODE's: Boundary-Value Problems. For those who require a more theoretical approach, see Chapra's best-selling Numerical Methods for Engineers, 5/e (2006), also by McGraw-Hill.

This volume contains the proceedings of the International Conference on Inf- mation Computing and Applications (ICICA 2010), which was held in Tangshan, China, October 15-18, 2010. As future-generation information technology, information computing and applications become specialized, information computing and applications - cluding hardware, software, communications and networks are growing with ever-increasing scale and heterogeneity and becoming overly complex. The c- plexity is getting more critical along with the growing applications. To cope with the growing and computing complexity, information computing and applications focus on intelligent, selfmanageable, scalable computing systems and applications to the maximum extent possible without human intervention or guidance. With the rapid development of information science and technology, infor- tion computing has become the third approach of science research. Information computing and applications is the ?eld of study concerned with constructing - telligent computing, mathematical models, numerical solution techniques and using computers to analyze and solve natural scienti?c, social scienti?c and engineering problems. In practical use, it is typically the application of c- puter simulation, intelligent computing, internet computing, pervasive comp- ing, scalable computing, trusted computing, autonomy-oriented computing, evolutionary computing, mobile computing, computational statistics, engine- ing computing, multimedia networking and computing, applications and other forms of computation problems in various scienti?c disciplines and engine- ing. Information computing and applications is an important underpinning for techniques used in information and computational science and there are many unresolved problems that address worth studying.

This book presents a modern introduction to analytical and numerical techniques for solving ordinary differential equations (ODEs). Contrary to the traditional format—the theorem-and-proof format—the book is focusing on analytical and numerical methods. The book supplies a variety of problems and examples, ranging from the elementary to the advanced level, to introduce and study the mathematics of ODEs. The analytical part of the book deals with solution techniques for scalar first-order and second-order linear ODEs, and systems of linear ODEs—with a special focus on the Laplace transform, operator techniques and power series solutions. In the numerical part, theoretical and practical aspects of Runge-Kutta methods for solving initial-value problems and shooting methods for linear two-point boundary-value problems are considered. The book is intended as a primary text for courses on the theory of ODEs and numerical treatment of ODEs for advanced undergraduate and early graduate students. It is assumed that the reader has a basic grasp of elementary calculus, in particular methods of integration, and of numerical analysis. Physicists, chemists, biologists, computer scientists and engineers whose work involves solving ODEs will also find the book useful as a reference work and tool for independent study. The book has been prepared within the framework of a German–Iranian research project on mathematical methods for ODEs, which was started in early 2012.

The Numerical Solution of Ordinary and Partial Differential Equations

8th International Conference, NMA 2014, Borovets, Bulgaria, August 20-24, 2014, Revised Selected Papers

Discrete Element Method, Finite Difference, Shooting Method, Finite-Difference Time-Domain Method, Finite Element Me

Fast Numerical Methods for Mixed-Integer Nonlinear Model-Predictive Control

A survey of the development, analysis, and application of numerical techniques in solving nonlinear boundary value problems, this text presents numerical analysis as a working tool for physicists and engineers. Starting with a survey of accomplishments in the field, it explores initial and boundary value problems for ordinary differential equations, linear boundary value problems, and the numerical realization of parametric studies in nonlinear boundary value problems. The authors--Milan Kubicek, Professor at the Prague Institute of Chemical Technology, and Vladimir Hlavacek, Professor at the University of Buffalo--emphasize the description and straightforward application of numerical techniques rather than underlying theory. This approach reflects their extensive experience with the application of diverse numerical algorithms.

In the past few years, knowledge about methods for the numerical solution of two-point boundary value problems has increased significantly. Important theoretical and practical advances have been made in a number or fronts, although they are not adequately described in any tt'xt currently available. With this in mind, we organized an international workshop, devoted solely to this topic. Tht' workshop took place in Vancouver, B.C., Canada, in July 1()"13, 1984. This volume contains the refereed proceedings of the workshop. Contributions to the workshop were in two formats. There were a small number of invited talks (ten of which are presented in this proceedings); the other contributions were in the rorm or poster sessions, for which there was no parallel activity in the workshop. We had attemptt'd to cover a number of topics and objectives in the talks. As a result, the general review papt'rs of O'Malley and Russell are intended to take a broader perspective, while the other papers are more specific. The contributions in this volume are divided (somewhat arbitrarily) into five groups. The first group concerns fundamental issues like conditioning and decoupling, which have only rect'ntly gained a proper appreciation of their centrality. Understanding of certain aspects or shooting methods ties in with these fundamental concepts. The papers of Russell, dt' Hoog and Mattheij all deal with these issues.

Christian Kirches develops a fast numerical algorithm of wide applicability that efficiently solves mixed-integer nonlinear optimal control problems. He uses convexification and relaxation techniques to obtain computationally tractable reformulations for which feasibility and optimality certificates can be given even after discretization and rounding.