Numerical Solutions To Differential Equations

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Numerical Methods for Ordinary Differential Equations Springer Science & Business Media
This new book updates the exceptionally popular Numerical Analysis of Ordinary Differential Equations. "This book is...an indispensible reference for any researcher."-American Mathematical Society on the First Edition. Features: * New exercises included in each chapter. * Author is widely regarded as the world expert on Runge-Kutta methods * Didactic aspects of the book have been enhanced by interspersing the text with exercises. * Updated Bibliography.
Introduction to the Numerical Solution of Differential Equations Academic Press
The analysis of singular perturbed differential equations began early in this century, when approximate solutions were constructed from asymptotic ex pansions. (Preliminary attempts appear in the nineteenth century [vD94].) This technique has flourished since the mid-1960s. Its principal ideas and methods are described in several textbooks. Nevertheless, asymptotic ex pansions may be impossible to construct or may fail to simplify the given problem; then numerical approximations are often the only option. The systematic study of numerical methods for singular perturbation problems started somewhat later - in the 1970s. While the research frontier has been steadily pushed back, the exposition of new developments in the analysis of numerical methods has been neglected. Perhaps the only example of a textbook that concentrates on this analysis is [DMS80], which collects various results for ordinary differential equations, but many methods and techniques that are relevant today (especially for partial differential equa tions) were developed after 1980.Thus contemporary researchers must comb the literature to acquaint themselves with earlier work. Our purposes in writing this introductory book are twofold. First, we aim to present a structured account of recent ideas in the numerical analysis of singularly perturbed differential equations. Second, this important area has many open problems and we hope that our book will stimulate further investigations.Our choice of topics is inevitably personal and reflects our own main interests.
Numerical Solution of Differential Equations Academic Press
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.
Numerical Methods for Differential Equations John Wiley & Sons
Designed for those people who want to gain a practical knowledge of modern techniques, this book contains all the material necessary for a course on the numerical solution of differential equations. Written by two of the field's leading authorities, it provides a unified presentation of initial value and boundary value problems in ODEs as well as differential-algebraic equations. The approach is aimed at a thorough understanding of the issues and methods for practical computation while avoiding an extensive theorem-proof type of exposition. It also addresses reasons why existing software succeeds or fails. This book is a practical and mathematically well-informed introduction that emphasizes basic methods and theory, issues in the use and development of mathematical software, and examples from scientific engineering applications. Topics requiring an extensive amount of mathematical development, such as symplectic methods for Hamiltonian systems, are introduced, motivated, and included in the exercises, but a complete and rigorous mathematical presentation is referenced rather than included.
A First Course in the Numerical Analysis of Differential Equations Springer Science & Business Media
This new work is an introduction to the numerical solution of the initial value problem for a system of ordinary differential equations. The first three chapters are general in nature, and chapters 4 through 8 derive the basic numerical methods, prove their convergence, study their stability and consider how to implement them effectively. The book focuses on the most important methods in practice and develops them fully, uses examples throughout, and emphasizes practical problem-solving methods.
NUMERICAL SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS USING FINITE DIFFERENCE METHOD AND MATHEMATICA CRC Press
This is the practical introduction to the analytical approach taken in Volume 2. Based upon courses in partial differential equations over the last two decades, the text covers the classic canonical equations, with the method of separation of variables introduced at an early stage. The characteristic method for first order equations acts as an introduction to the classification of second order quasi-linear problems by characteristics. Attention then moves to different co-ordinate systems, primarily those with cylindrical or spherical symmetry. Hence a discussion of special functions arises quite naturally, and in each case the major properties are derived. The next section deals with the use of integral transforms and extensive methods for inverting them, and concludes with links to the use of Fourier series.
Numerical Solution of Ordinary Differential Equations Cambridge University Press
The Numerical Solution of Ordinary and Partial Differential Equations is an introduction to the numerical solution of ordinary and partial differential equations. Finite difference methods for solving partial differential equations are mostly classical low order formulas, easy to program but not ideal for problems with poorly behaved solutions or (especially) for problems in irregular multidimensional regions. FORTRAN77 programs are used to implement many of the methods studied. Comprised of six chapters, this book begins with a review of direct methods for the solution of linear systems, with emphasis on the special features of the linear systems that arise when differential equations are solved. The next four chapters deal with the more commonly used finite difference methods for solving a variety of problems, including both ordinary differential equations and partial differential equations, and both initial value and boundary value problems. The final chapter is an overview of the basic ideas behind the finite element method and covers the Galerkin method for boundary value problems. Examples using piecewise linear trial functions, cubic hermite trial functions, and triangular elements are presented. This monograph is appropriate for senior-level undergraduate or first-year graduate students of mathematics.
Introduction to Numerical Methods for Time Dependent Differential Equations John Wiley & Sons
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.
Numerical Solution of Differential Equations CRC Press
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.
A First Course in Ordinary Differential Equations Elsevier
This book studies time-dependent partial differential equations and their numerical solution, developing the analytic and the numerical theory in parallel, and placing special emphasis on the discretization of boundary conditions. The theoretical results are then applied to Newtonian and non-Newtonian flows, two-phase flows and geophysical problems. This book will be a useful introduction to the field for applied mathematicians and graduate students.
Numerical Solutions of Partial Differential Equations Springer Science & Business Media
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.
The Numerical Solution of Ordinary and Partial Differential Equations John Wiley & Sons
A practical and concise guide to finite difference and finite element methods. Well-tested MATLAB ® codes are available online.
Differential-algebraic Equations European Mathematical Society
Partial differential equations (PDEs) play an important role in the natural sciences and technology, because they describe the way systems (natural and other) behave. The inherent suitability of PDEs to characterizing the nature, motion, and evolution of systems, has led to their wide-ranging use in numerical models that are developed in order to analyze systems that are not otherwise easily studied. Numerical Solutions for Partial Differential Equations contains all the details necessary for the reader to understand the principles and applications of advanced numerical methods for solving PDEs. In addition, it shows how the modern computer system algebra Mathematica ® can be used for the analytic investigation of such numerical properties as stability, approximation, and dispersion.
Numerical Solution of Stochastic Differential Equations John Wiley & Sons

The numerical approximation of solutions of differential equations has been, and continues to be, one of the principal concerns of numerical analysis and is an active area of research. The new generation of parallel computers have provoked a reconsideration of numerical methods. This book aims to generalize classical multistep methods for both initial and boundary value problems; to present a self-contained theory which embraces and generalizes the classical Dahlquist theory; to treat nonclassical problems, such as Hamiltonian problems and the mesh selection; and to select appropriate methods for a general purpose software capable of solving a wide range of problems efficiently, even on parallel computers.

Numerical Solutions of Boundary Value Problems of Non-linear Differential Equations Courier Corporation

Scientific Computing and Differential Equations: An Introduction to Numerical Methods, is an excellent complement to Introduction to Numerical Methods by Ortega and Poole. The book emphasizes the importance of solving differential equations on a computer, which comprises a large part of what has come to be called scientific computing. It reviews modern scientific computing, outlines its applications, and places the subject in a larger context. This book is appropriate for upper undergraduate courses in mathematics, electrical engineering, and computer science; it is also well-suited to serve as a textbook for numerical differential equations courses at the graduate level. An introductory chapter gives an overview of scientific computing, indicating its important role in solving differential equations, and placing the subject in the larger environment Contains an introduction to numerical methods for both ordinary and partial differential equations Concentrates on ordinary differential equations, especially boundary-value problems Contains most of the main topics for a first course in numerical methods, and can serve as a text for this course Uses material for junior/senior level undergraduate courses in math and computer science plus material for numerical differential equations courses for engineering/science students at the graduate level

Numerical Solution of Ordinary Differential Equations CRC Press

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.

Numerical Methods for Singularly Perturbed Differential Equations Springer Science & Business

In recent years the study of numerical methods for solving ordinary differential equations has seen many new developments. This second edition of the author's pioneering text is fully revised and updated to acknowledge many of these developments. It includes a complete treatment of linear multistep methods whilst maintaining its unique and comprehensive emphasis on Runge-Kutta methods and general linear methods. Although the specialist topics are taken to an advanced level, the entry point to the volume as a whole is not especially demanding. Early chapters provide a wide-ranging introduction to differential equations and difference equations together with a survey of numerical differential equation methods, based on the fundamental Euler method with more sophisticated methods presented as generalizations of Euler. Features of the book include Introductory work on differential and difference equations. A comprehensive introduction to the theory and practice of solving ordinary differential equations numerically. A detailed analysis of Runge-Kutta methods and of linear multistep methods. A complete study of general linear methods from both theoretical and practical points of view. The latest results on practical general linear methods and their implementation. A balance between informal discussion and rigorous mathematical style. Examples and exercises integrated into each chapter enhancing the suitability of the book as a course text or a self-study treatise. Written in a lucid style by one of the worlds leading authorities on numerical methods for ordinary differential equations and drawing upon his vast experience, this new edition provides an accessible and self-contained introduction, ideal for researchers and students following courses on numerical methods, engineering and other sciences.

Numerical Solutions for Partial Differential Equations Springer Science & Business Media

The numerical analysis of stochastic differential equations (SDEs) differs significantly from that of ordinary differential equations. This book provides an easily accessible introduction to SDEs, their applications and the numerical methods to solve such equations. From the reviews: "The authors draw upon their own research and experiences in obviously many disciplines... considerable time has obviously been spent writing this in the simplest language possible." --ZAMP

Numerical Solutions of Boundary Value Problems for Ordinary Differential Equations Springer Science & Business Media

Numerical Methods for Partial Differential Equations, Second Edition deals with the use of numerical methods to solve partial differential equations. In addition to numerical fluid mechanics, hopscotch and other explicit-implicit methods are also considered, along with Monte Carlo techniques, lines, fast Fourier transform, and fractional steps methods. Comprised of six chapters, this volume begins with an introduction to numerical calculation, paying particular attention to the classification of equations and physical problems, asymptotics, discrete methods, and dimensionless forms. Subsequent chapters focus on parabolic and hyperbolic equations, elliptic equations, and special topics ranging from singularities and shocks to Navier-Stokes equations and Monte Carlo methods. The final chapter discuss the general concepts of weighted residuals, with emphasis on orthogonal collocation and the Bubnov-Galerkin method. The latter procedure is used to introduce finite elements. This book should be a valuable resource for students and practitioners in the fields of computer science and applied mathematics.

Numerical Methods for Ordinary Differential Equations Cambridge University Press

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.