Shooting Methods For Numerical Solution Of Nonlinear

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Numerical Methods, 4th Springer Science & Business Media
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 Solution of Two Point Boundary Value Problems European Mathematical Society
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.

Fast Numerical Methods for Mixed-Integer Nonlinear Model-Predictive Control Springer Science & Business
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.

Introduction to Numerical Analysis Elsevier Publishing Company
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...

The Numerical Solution of Ordinary and Partial Differential Equations Academic Press

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.

A Guide for Engineers and Scientists Numerical Solutions of Boundary Value Problems with So-Called Shooting MethodThis 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.Numerical Methods for Two-Point Boundary-Value Problems 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.

Numerical Solution of Two Point Boundary Value Problems Cengage Learning

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.

Numerical and Statistical Methods for Bioengineering McGraw-Hill

"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"--

with MATLAB Solutions SIAM

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.

Differential-algebraic Equations Springer Science & Business Media

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.

Applications in MATLAB John Wiley & Sons

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.

An Efficient, Accurate Numerical Method for the Solution of a Poisson Equation on a Sphere Springer Science & Business Media

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 Nonlinear Boundary Value Problems with Applications John Wiley & Sons

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.

CRC Press

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.

Python Programming and Numerical Methods SIAM

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 Two-Point Boundary-Value Problems Springer Science & Business Media

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.

Principles and Perspectives in Cosmochemistry SIAM

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.

Analytical Approximation and Numerical Methods Springer

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.

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

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.

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

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.