S. S. Artemiev, T. A. Averina

NUMERICAL ANALYSIS OF SYSTEMS OF ORDINARY AND STOCHASTIC DIFFERENTIAL EQUATIONS

Numerical Analysis Of Systems Of Ordinary And Stochastic Differential Equations

Michael Brown

Numerical Analysis Of Systems Of Ordinary And Stochastic Differential Equations:

   Numerical Analysis of Systems of Ordinary and Stochastic Differential Equations S. S. Artemiev,T. A. Averina,2011-02-11 No detailed description available for Numerical Analysis of Systems of Ordinary and Stochastic Differential Equations   **Random Ordinary Differential Equations and Their Numerical Solution** Xiaoying Han,Peter E. Kloeden,2017-10-25 This book is intended to make recent results on the derivation of higher order numerical schemes for random ordinary differential equations RODEs available to a broader readership and to familiarize readers with RODEs themselves as well as the closely associated theory of random dynamical systems In addition it demonstrates how RODEs are being used in the biological sciences where non Gaussian and bounded noise are often more realistic than the Gaussian white noise in stochastic differential equations SODEs RODEs are used in many important applications and play a fundamental role in the theory of random dynamical systems They can be analyzed pathwise with deterministic calculus but require further treatment beyond that of classical ODE theory due to the lack of smoothness in their time variable Although classical numerical schemes for ODEs can be used pathwise for RODEs they rarely attain their traditional order since the solutions of RODEs do not have sufficient smoothness to have Taylor expansions in the usual sense However Taylor like expansions can be derived for RODEs using an iterated application of the appropriate chain rule in integral form and represent the starting point for the systematic derivation of consistent higher order numerical schemes for RODEs The book is directed at a wide range of readers in applied and computational mathematics and related areas as well as readers who are interested in the applications of mathematical models involving random effects in particular in the biological sciences The level of this book is suitable for graduate students in applied mathematics and related areas computational sciences and systems biology A basic knowledge of ordinary differential equations and numerical analysis is required   **Numerical Methods for Ordinary Differential Equations** David F. Griffiths,Desmond J. Higham,2010-11-11 Numerical Methods for Ordinary Differential Equations is a self contained introduction to a fundamental field of numerical analysis and scientific computation Written for undergraduate students with a mathematical background this book focuses on the analysis of numerical methods without losing sight of the practical nature of the subject It covers the topics traditionally treated in a first course but also highlights new and emerging themes Chapters are broken down into lecture sized pieces motivated and illustrated by numerous theoretical and computational examples Over 200 exercises are provided and these are starred according to their degree of difficulty Solutions to all exercises are available to authorized instructors The book covers key foundation topics o Taylor series methods o Runge Kutta methods o Linear multistep methods o Convergence o Stability and a range of modern themes o Adaptive stepsize selection o Long term dynamics o Modified equations o Geometric integration o Stochastic differential equations The prerequisite of a basic university level calculus class is assumed although appropriate background results are also summarized in appendices A dedicated website for the book containing extra information can be found via www springer

com **Numerical Solution of Stochastic Differential Equations** Peter E. Kloeden,Eckhard Platen,2013-04-17 The aim of this book is to provide an accessible introduction to stochastic differ ential equations and their applications together with a systematic presentation of methods available for their numerical solution During the past decade there has been an accelerating interest in the de velopment of numerical methods for stochastic differential equations SDEs This activity has been as strong in the engineering and physical sciences as it has in mathematics resulting inevitably in some duplication of effort due to an unfamiliarity with the developments in other disciplines Much of the reported work has been motivated by the need to solve particular types of problems for which even more so than in the deterministic context specific methods are required The treatment has often been heuristic and ad hoc in character Nevertheless there are underlying principles present in many of the papers an understanding of which will enable one to develop or apply appropriate numerical schemes for particular problems or classes of problems **Numerical Solution of Stochastic Differential Equations with Jumps in Finance** Eckhard Platen,Nicola Bruti-Liberati,2010-07-23 In financial and actuarial modeling and other areas of application stochastic differential equations with jumps have been employed to describe the dynamics of various state variables The numerical solution of such equations is more complex than that of those only driven by Wiener processes described in Kloeden Platen Numerical Solution of Stochastic Differential Equations 1992 The present monograph builds on the above mentioned work and provides an introduction to stochastic differential equations with jumps in both theory and application emphasizing the numerical methods needed to solve such equations It presents many new results on higher order methods for scenario and Monte Carlo simulation including implicit predictor corrector extrapolation Markov chain and variance reduction methods stressing the importance of their numerical stability Furthermore it includes chapters on exact simulation estimation and filtering Besides serving as a basic text on quantitative methods it offers ready access to a large number of potential research problems in an area that is widely applicable and rapidly expanding Finance is chosen as the area of application because much of the recent research on stochastic numerical methods has been driven by challenges in quantitative finance Moreover the volume introduces readers to the modern benchmark approach that provides a general framework for modeling in finance and insurance beyond the standard risk neutral approach It requires undergraduate background in mathematical or quantitative methods is accessible to a broad readership including those who are only seeking numerical recipes and includes exercises that help the reader develop a deeper understanding of the underlying mathematics *Handbook of Stochastic Analysis and Applications* D. Kannan,V. Lakshmikantham,2001-10-23 An introduction to general theories of stochastic processes and modern martingale theory The volume focuses on consistency stability and contractivity under geometric invariance in numerical analysis and discusses problems related to implementation simulation variable step size algorithms and random number generation **Ordinary Differential Equations and Integral Equations** C.T.H. Baker,G. Monegato,G. vanden Berghe,2001-06-20 homepage sac cam na2000

index html7 Volume Set now available at special set price This volume contains contributions in the area of differential equations and integral equations Many numerical methods have arisen in response to the need to solve real life problems in applied mathematics in particular problems that do not have a closed form solution Contributions on both initial value problems and boundary value problems in ordinary differential equations appear in this volume Numerical methods for initial value problems in ordinary differential equations fall naturally into two classes those which use one starting value at each step one step methods and those which are based on several values of the solution multistep methods John Butcher has supplied an expert s perspective of the development of numerical methods for ordinary differential equations in the 20th century Rob Corless and Lawrence Shampine talk about established technology namely software for initial value problems using Runge Kutta and Rosenbrock methods with interpolants to fill in the solution between mesh points but the slant is new based on the question How should such software integrate into the current generation of Problem Solving Environments Natalia Borovykh and Marc Spijker study the problem of establishing upper bounds for the norm of the nth power of square matrices The dynamical system viewpoint has been of great benefit to ODE theory and numerical methods Related is the study of chaotic behaviour Willy Govaerts discusses the numerical methods for the computation and continuation of equilibria and bifurcation points of equilibria of dynamical systems Arieh Iserles and Antonella Zanna survey the construction of Runge Kutta methods which preserve algebraic invariant functions Valeria Antohe and Ian Gladwell present numerical experiments on solving a Hamiltonian system of H non and Heiles with a symplectic and a nonsymplectic method with a variety of precisions and initial conditions Stiff differential equations first became recognized as special during the 1950s In 1963 two seminal publications laid to the foundations for later development Dahlquist s paper on A stable multistep methods and Butcher s first paper on implicit Runge Kutta methods Ernst Hairer and Gerhard Wanner deliver a survey which retraces the discovery of the order stars as well as the principal achievements obtained by that theory Guido Vanden Berghe Hans De Meyer Marnix Van Daele and Tanja Van Hecke construct exponentially fitted Runge Kutta methods with s stages Differential algebraic equations arise in control in modelling of mechanical systems and in many other fields Jeff Cash describes a fairly recent class of formulae for the numerical solution of initial value problems for stiff and differential algebraic systems Shengtai Li and Linda Petzold describe methods and software for sensitivity analysis of solutions of DAE initial value problems Again in the area of differential algebraic systems Neil Biehn John Betts Stephen Campbell and William Huffman present current work on mesh adaptation for DAE two point boundary value problems Contrasting approaches to the question of how good an approximation is as a solution of a given equation involve i attempting to estimate the actual error i e the difference between the true and the approximate solutions and ii attempting to estimate the defect the amount by which the approximation fails to satisfy the given equation and any side conditions The paper by Wayne Enright on defect control relates to carefully analyzed techniques that have been proposed both for ordinary differential equations and for

delay differential equations in which an attempt is made to control an estimate of the size of the defect Many phenomena incorporate noise and the numerical solution of **Symplectic Integration of Stochastic Hamiltonian Systems** Jialin Hong,Liying Sun,2023-02-21 This book provides an accessible overview concerning the stochastic numerical methods inheriting long time dynamical behaviours of finite and infinite dimensional stochastic Hamiltonian systems The long time dynamical behaviours under study involve symplectic structure invariants ergodicity and invariant measure The emphasis is placed on the systematic construction and the probabilistic superiority of stochastic symplectic methods which preserve the geometric structure of the stochastic flow of stochastic Hamiltonian systems The problems considered in this book are related to several fascinating research hotspots numerical analysis stochastic analysis ergodic theory stochastic ordinary and partial differential equations and rough path theory This book will appeal to researchers who are interested in these topics

Numerical Analysis of Ordinary and Delay Differential Equations Taketomo Mitsui,Guang-Da Hu,2023-05-23 This book serves as a concise textbook for students in an advanced undergraduate or first year graduate course in various disciplines such as applied mathematics control and engineering who want to understand the modern standard of numerical methods of ordinary and delay differential equations Experts in the same fields can also learn about the recent developments in numerical analysis of such differential systems Ordinary differential equations ODEs provide a strong mathematical tool to express a wide variety of phenomena in science and engineering Along with its own significance one of the powerful directions toward which ODEs extend is to incorporate an unknown function with delayed argument This is called delay differential equations DDEs which often appear in mathematical modelling of biology demography epidemiology and control theory In some cases the solution of a differential equation can be obtained by algebraic combinations of known mathematical functions In many practical cases however such a solution is quite difficult or unavailable and numerical approximations are called for Modern development of computers accelerates the situation and moreover launches more possibilities of numerical means Henceforth the knowledge and expertise of the numerical solution of differential equations becomes a requirement in broad areas of science and engineering One might think that a well organized software package such as MATLAB serves much the same solution In a sense this is true but it must be kept in mind that blind employment of software packages misleads the user The gist of numerical solution of differential equations still must be learned The present book is intended to provide the essence of numerical solutions of ordinary differential equations as well as of delay differential equations Particularly the authors noted that there are still few concise textbooks of delay differential equations and then they set about filling the gap through descriptions as transparent as possible Major algorithms of numerical solution are clearly described in this book The stability of solutions of ODEs and DDEs is crucial as well The book introduces the asymptotic stability of analytical and numerical solutions and provides a practical way to analyze their stability by employing a theory of complex functions Applied Mathematics and Computational Mechanics for Smart Applications Lakhmi C.

Jain,Margarita N. Favorskaya,Ilia S. Nikitin,Dmitry L. Reviznikov,2021-03-14 This book presents best selected research papers presented at the Thirteenth International Conference on Applied Mathematics and Mechanics in the Aerospace Industry AMMAI 2020 held from September 6 to September 13 2020 at the Alushta Health and Educational Center The Republic of Crimea The book is dedicated to solving actual problems of applied mechanics using modern computer technology including smart paradigms Physical and mathematical models numerical methods computational algorithms and software complexes are discussed which allow to carry out high precision mathematical modeling in fluid gas and plasma mechanics in general mechanics deformable solid mechanics in strength destruction and safety of structures etc Technologies and software systems that provide effective solutions to the problems at various multi scale levels are considered Special attention is paid to the training of highly qualified specialists for the aviation and space industry The book is recommended for specialists in the field of applied mathematics and mechanics mathematical modeling information technologies and developers of modern applied software systems **Stochastic Differential Equations and Processes** Mounir Zili,Darya V. Filatova,2011-09-24 Selected papers submitted by participants of the international Conference Stochastic Analysis and Applied Probability 2010 www saap2010 org make up the basis of this volume The SAAP 2010 was held in Tunisia from 7 9 October 2010 and was organized by the Applied Mathematics Mathematical Physics research unit of the preparatory institute to the military academies of Sousse Tunisia chaired by Mounir Zili The papers cover theoretical numerical and applied aspects of stochastic processes and stochastic differential equations The study of such topic is motivated in part by the need to model understand forecast and control the behavior of many natural phenomena that evolve in time in a random way Such phenomena appear in the fields of finance telecommunications economics biology geology demography physics chemistry signal processing and modern control theory to mention just a few As this book emphasizes the importance of numerical and theoretical studies of the stochastic differential equations and stochastic processes it will be useful for a wide spectrum of researchers in applied probability stochastic numerical and theoretical analysis and statistics as well as for graduate students To make it more complete and accessible for graduate students practitioners and researchers the editors Mounir Zili and Daria Filatova have included a survey dedicated to the basic concepts of numerical analysis of the stochastic differential equations written by Henri Schurz **Modelling with Ordinary Differential Equations** Alfio Borzì,2022-06 Modelling with Ordinary Differential Equations A Comprehensive Approach aims to provide a broad and self contained introduction to the mathematical tools necessary to investigate and apply ODE models The book starts by establishing the existence of solutions in various settings and analysing their stability properties The next step is to illustrate modelling issues arising in the calculus of variation and optimal control theory that are of interest in many applications This discussion is continued with an introduction to inverse problems governed by ODE models and to differential games The book is completed with an illustration of stochastic differential equations and the development of neural networks to solve ODE

systems Many numerical methods are presented to solve the classes of problems discussed in this book Features Provides insight into rigorous mathematical issues concerning various topics while discussing many different models of interest in different disciplines biology chemistry economics medicine physics social sciences etc Suitable for undergraduate and graduate students and as an introduction for researchers in engineering and the sciences Accompanied by codes which allow the reader to apply the numerical methods discussed in this book in those cases where analytical solutions are not available

Using the Mathematics Literature Kristine K. Fowler,2004-05-25 This reference serves as a reader friendly guide to every basic tool and skill required in the mathematical library and helps mathematicians find resources in any format in the mathematics literature It lists a wide range of standard texts journals review articles newsgroups and Internet and database tools for every major subfield in mathematics and details methods of access to primary literature sources of new research applications results and techniques Using the Mathematics Literature is the most comprehensive and up to date resource on mathematics literature in both print and electronic formats presenting time saving strategies for retrieval of the latest information **Dynamical Systems** Mahmut Reyhanoglu,2017-03-15 There has been a considerable progress made during the recent past on mathematical techniques for studying dynamical systems that arise in science and engineering This progress has been to a large extent due to our increasing ability to mathematically model physical processes and to analyze and solve them both analytically and numerically With its eleven chapters this book brings together important contributions from renowned international researchers to provide an excellent survey of recent advances in dynamical systems theory and applications The first section consists of seven chapters that focus on analytical techniques while the next section is composed of four chapters that center on computational techniques *Applied Mechanics Reviews* ,1978 **Acta Numerica 1999: Volume 8** Arieh Iserles,1999-07-22 Numerical analysis is the subject of applied mathematics concerned mainly with using computers in evaluating or approximating mathematical models As such it is crucial to all applications of mathematics in science and engineering as well as being an important discipline on its own Acta Numerica surveys annually the most important developments in numerical analysis and scientific computing The subjects and authors of the substantive survey articles are chosen by a distinguished international editorial board so as to report the most important developments in the subject in a manner accessible to the wider community of professionals with an interest in scientific computing

Advances in Mathematical Methods and High Performance Computing Vinai K. Singh,David Gao,Andreas Fischer,2019-02-14 This special volume of the conference will be of immense use to the researchers and academicians In this conference academicians technocrats and researchers will get an opportunity to interact with eminent persons in the field of Applied Mathematics and Scientific Computing The topics to be covered in this International Conference are comprehensive and will be adequate for developing and understanding about new developments and emerging trends in this area High Performance Computing HPC systems have gone through many changes during the past two decades in their architectural

design to satisfy the increasingly large scale scientific computing demand Accurate fast and scalable performance models and simulation tools are essential for evaluating alternative architecture design decisions for the massive scale computing systems This conference recounts some of the influential work in modeling and simulation for HPC systems and applications identifies some of the major challenges and outlines future research directions which we believe are critical to the HPC modeling and simulation community   **Stochastic Calculus and Brownian Motion** Tejas Thakur,2025-02-20 Stochastic Calculus and Brownian Motion is a comprehensive guide crafted for students and professionals in mathematical sciences focusing on stochastic processes and their real world applications in finance physics and engineering We explore key concepts and mathematical foundations of random movements and their practical implications At its core the book delves into Brownian motion the random movement of particles suspended in a fluid as described by Robert Brown in the 19th century This phenomenon forms a cornerstone of modern probability theory and serves as a model for randomness in physical systems and financial models describing stock market behaviors We also cover martingales mathematical sequences where future values depend on present values akin to a fair game in gambling The book demonstrates how martingales are used to model stochastic processes and their calibration in real world scenarios Stochastic calculus extends these ideas into continuous time integrating calculus with random processes Our guide provides the tools to understand and apply It calculus crucial for advanced financial models like pricing derivatives and managing risks Written clearly and systematically the book includes examples and exercises to reinforce concepts and showcase their real world applications It serves as an invaluable resource for students educators and professionals globally   Modeling Languages in Mathematical Optimization Josef Kallrath,2013-12-01 This volume presents a unique combination of modeling and solving real world optimization problems It is the only book which treats systematically the major modeling languages and systems used to solve mathematical optimization problems and it also provides a useful overview and orientation of today s modeling languages in mathematical optimization It demonstrates the strengths and characteristic features of such languages and provides a bridge for researchers practitioners and students into a new world solving real optimization problems with the most advances modeling systems   Soviet Journal of Numerical Analysis and Mathematical Modelling ,1988

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