Ernst Hairer
Syvert P. Nørsett
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Solving Ordinary Differential Equations I

Nonstiff Problems

Second Revised Edition

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Solving Ordinary Differential Equations I Computational Mathematics Ser Vol 8

A. Iserles

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Solving Ordinary Differential Equations I Ernst Hairer,Syvert P. Nørsett,Gerhard Wanner,2008-04-03 This book deals with methods for solving nonstiff ordinary differential equations The first chapter describes the historical development of the classical theory and the second chapter includes a modern treatment of Runge Kutta and extrapolation methods Chapter three begins with the classical theory of multistep methods and concludes with the theory of general linear methods The reader will benefit from many illustrations a historical and didactic approach and computer programs which help him her learn to solve all kinds of ordinary differential equations This new edition has been rewritten and new material has been included **Acta Numerica 2008: Volume 17** A. Iserles,2008-06-12 A high impact prestigious annual publication containing invited surveys by subject leaders essential reading for all practitioners and researchers **Recent Advances in Computational and Applied Mathematics** Theodore E. Simos,2010-10-10 This multi author contributed proceedings volume contains recent advances in several areas of Computational and Applied Mathematics Each review is written by well known leaders of Computational and Applied Mathematics The book gives a comprehensive account of a variety of topics including Efficient Global Methods for the Numerical Solution of Nonlinear Systems of Two point Boundary Value Problems Advances on collocation based numerical methods for Ordinary Differential Equations and Volterra Integral Equations Basic Methods for Computing Special Functions Melt Spinning Optimal Control and Stability Issues Brief survey on the CP methods for the Schr dinger equation Symplectic Partitioned Runge Kutta methods for the numerical integration of periodic and oscillatory problems Recent Advances in Computational and Applied Mathematics is aimed at advanced undergraduates and researchers who are working in these fast moving fields **Computational Science and Its Applications - ICCSA 2008** Osvaldo Gervasi,Beniamino Murgante,Antonio Laganà,David Taniar,Youngsong Mun,2008-06-28 This two volume set is assembled following the 2008 International Conference on Computational Science and Its Applications ICCSA 2008 a premium int national event held in Perugia Italy from June 30 to July 3 2008 The collection of fully refereed high quality original works accepted as theme papers for presentation at ICCSA 2008 are published in this LNCS proceedings set This outstanding collection complements the volume of workshop papers traditionally published by IEEE Computer Society The continuous support of computational science researchers has helped ICCSA to become a rmly established forum in the area of scienti c computing and the conference itself become a recurring scienti c and professional meeting that cannot be given up The computational science eld based on fundamental disciplines such as mathematics physics and chemistry is nding new computational approaches to foster the human progress in heterogeneous and fundamental areas such as aerospace and automotive industries bioinformatics and nanotechnology studies networks and grid computing computational geometry and biometrics computer education virtual reality and art Due to the growing complexity of many ch lenges in computational science the use of sophisticated algorithms and eme ing technologies is inevitable Together these far reaching scienti c areas

help to shape this conference in the areas of state of the art computational science research and applications encompassing the facilitating theoretical foundations and the innovative applications of such results in other areas **An Introduction to Computational Stochastic PDEs** Gabriel J. Lord,Catherine E. Powell,Tony Shardlow,2014-08-11 This book gives a comprehensive introduction to numerical methods and analysis of stochastic processes random fields and stochastic differential equations and offers graduate students and researchers powerful tools for understanding uncertainty quantification for risk analysis Coverage includes traditional stochastic ODEs with white noise forcing strong and weak approximation and the multi level Monte Carlo method Later chapters apply the theory of random fields to the numerical solution of elliptic PDEs with correlated random data discuss the Monte Carlo method and introduce stochastic Galerkin finite element methods Finally stochastic parabolic PDEs are developed Assuming little previous exposure to probability and statistics theory is developed in tandem with state of the art computational methods through worked examples exercises theorems and proofs The set of MATLAB codes included and downloadable allows readers to perform computations themselves and solve the test problems discussed Practical examples are drawn from finance mathematical biology neuroscience fluid flow modelling and materials science *Discrete Mechanics, Geometric Integration and Lie–Butcher Series* Kurusch Ebrahimi-Fard,María Barbero Liñán,2018-11-05 This volume resulted from presentations given at the international Brainstorming Workshop on New Developments in Discrete Mechanics Geometric Integration and Lie Butcher Series that took place at the Instituto de Ciencias Matem ticas ICMAT in Madrid Spain It combines overview and research articles on recent and ongoing developments as well as new research directions Why geometric numerical integration In their article of the same title Arieh Iserles and Reinout Quispel two renowned experts in numerical analysis of differential equations provide a compelling answer to this question After this introductory chapter a collection of high quality research articles aim at exploring recent and ongoing developments as well as new research directions in the areas of geometric integration methods for differential equations nonlinear systems interconnections and discrete mechanics One of the highlights is the unfolding of modern algebraic and combinatorial structures common to those topics which give rise to fruitful interactions between theoretical as well as applied and computational perspectives The volume is aimed at researchers and graduate students interested in theoretical and computational problems in geometric integration theory nonlinear control theory and discrete mechanics *Solving Ordinary Differential Equations II* Ernst Hairer,Gerhard Wanner,2013-03-14 Whatever regrets may be we have done our best Sir Ernest Shackleton turning back on 9 January 1909 at 88 23 South Brahms struggled for 20 years to write his first symphony Compared to this the 10 years we have been working on these two volumes may even appear short This second volume treats stiff differential equations and differential alge braic equations It contains three chapters Chapter IV on one step Runge Kutta methods for stiff problems Chapter Von multistep methods for stiff problems and Chapter VI on singular perturbation and differential algebraic equations Each

chapter is divided into sections Usually the first sections of a chapter are of an introductory nature explain numerical phenomena and exhibit numerical results Investigations of a more theoretieal nature are presented in the later sections of each chapter As in Volume I the formulas theorems tables and figures are numbered consecutively in each section and indicate in addition the section num ber In cross references to other chapters the latin chapter number is put first References to the bibliography are again by author plus year in parentheses The bibliography again contains only those papers which are discussed in the text and is in no way meant to be complete **Numerical Analysis** Brian Sutton,2019-04-18 This textbook develops the fundamental skills of numerical analysis designing numerical methods implementing them in computer code and analyzing their accuracy and efficiency A number of mathematical problems interpolation integration linear systems zero finding and differential equations are considered and some of the most important methods for their solution are demonstrated and analyzed Notable features of this book include the development of Chebyshev methods alongside more classical ones a dual emphasis on theory and experimentation the use of linear algebra to solve problems from analysis which enables students to gain a greater appreciation for both subjects and many examples and exercises Numerical Analysis Theory and Experiments is designed to be the primary text for a junior or senior level undergraduate course in numerical analysis for mathematics majors Scientists and engineers interested in numerical methods particularly those seeking an accessible introduction to Chebyshev methods will also be interested in this book 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 *NIST Handbook of Mathematical Functions Hardback and CD-ROM* Frank W. J. Olver,2010-05-17 The new standard reference on mathematical functions replacing the classic but outdated handbook from Abramowitz and Stegun Includes PDF version *Nonlinear Wave Equations* Christopher W. Curtis,Anton Dzhamay,Willy A. Hereman,Barbara Prinari,2015-03-26 This volume contains the proceedings of the AMS Special Session on Nonlinear Waves and Integrable Systems held on April 13 14 2013 at the University of Colorado Boulder Colorado The field of nonlinear waves is an exciting area of modern mathematical research that also plays a major role in many application areas from physics and fluids The articles in this volume present a diverse cross section of topics from this field including work on the Inverse Scattering Transform scattering theory inverse problems numerical methods for dispersive wave equations and analytic and computational methods for free boundary problems Significant attention to applications is also given throughout the articles with an extensive presentation on new results in the free surface problem in fluids This volume will be useful to students and researchers interested in learning current techniques in studying nonlinear dispersive systems from both the integrable systems and computational points of view **High-Dimensional Partial Differential Equations in Science and Engineering** André D. Bandrauk,Michel C. Delfour,Claude Le Bris,2007 High dimensional spatio temporal partial differential

equations are a major challenge to scientific computing of the future Up to now deemed prohibitive they have recently become manageable by combining recent developments in numerical techniques appropriate computer implementations and the use of computers with parallel and even massively parallel architectures This opens new perspectives in many fields of applications Kinetic plasma physics equations the many body Schrodinger equation Dirac and Maxwell equations for molecular electronic structures and nuclear dynamic computations options pricing equations in mathematical finance as well as Fokker Planck and fluid dynamics equations for complex fluids are examples of equations that can now be handled The objective of this volume is to bring together contributions by experts of international stature in that broad spectrum of areas to confront their approaches and possibly bring out common problem formulations and research directions in the numerical solutions of high dimensional partial differential equations in various fields of science and engineering with special emphasis on chemistry and physics Information for our distributors Titles in this series are co published with the Centre de Recherches Mathematiques Numerical Computations with GPUs Volodymyr Kindratenko,2014-07-03 This book brings together research on numerical methods adapted for Graphics Processing Units GPUs It explains recent efforts to adapt classic numerical methods including solution of linear equations and FFT for massively parallel GPU architectures This volume consolidates recent research and adaptations covering widely used methods that are at the core of many scientific and engineering computations Each chapter is written by authors working on a specific group of methods these leading experts provide mathematical background parallel algorithms and implementation details leading to reusable adaptable and scalable code fragments This book also serves as a GPU implementation manual for many numerical algorithms sharing tips on GPUs that can increase application efficiency The valuable insights into parallelization strategies for GPUs are supplemented by ready to use code fragments Numerical Computations with GPUs targets professionals and researchers working in high performance computing and GPU programming Advanced level students focused on computer science and mathematics will also find this book useful as secondary text book or reference *Mathematical Aspects of Computer and Information Sciences* Johannes Blömer,Ilias S. Kotsireas,Temur Kutsia,Dimitris E. Simos,2017-12-20 This book constitutes the refereed proceedings of the 7th International Conference on Mathematical Aspects of Computer and Information Sciences MACIS 2017 held in Vienna Austria in November 2017 The 28 revised papers and 8 short papers presented were carefully reviewed and selected from 67 submissions The papers are organized in the following topical sections foundation of algorithms in mathematics engineering and scientific computation combinatorics and codes in computer science data modeling and analysis and mathematical aspects of information security and cryptography *Transactions on Engineering Technologies* Gi-Chul Yang,Sio-Iong Ao,Len Gelman,2014-04-26 This book contains revised and extended research articles written by prominent researchers participating in the international conference on Advances in Engineering Technologies and Physical Science London U K 3 5 July 2013 Topics covered include mechanical engineering bioengineering internet engineering image

engineering wireless networks knowledge engineering manufacturing engineering and industrial applications The book offers state of art of tremendous advances in engineering technologies and physical science and applications and also serves as an excellent reference work for researchers and graduate students working with on engineering technologies and physical science Formal Algorithmic Elimination for PDEs Daniel Robertz,2014-10-13 Investigating the correspondence between systems of partial differential equations and their analytic solutions using a formal approach this monograph presents algorithms to determine the set of analytic solutions of such a system and conversely to find differential equations whose set of solutions coincides with a given parametrized set of analytic functions After giving a detailed introduction to Janet bases and Thomas decomposition the problem of finding an implicit description of certain sets of analytic functions in terms of differential equations is addressed Effective methods of varying generality are developed to solve the differential elimination problems that arise in this context In particular it is demonstrated how the symbolic solution of partial differential equations profits from the study of the implicitization problem For instance certain families of exact solutions of the Navier Stokes equations can be computed **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 **Computer Algebra 2006** Ilias Kotsireas,Eugene Zima,2007 Written by world renowned experts the book is a collection of tutorial presentations and research papers catering to the latest advances in symbolic summation factorization symbolic numeric linear algebra and linear functional equations The papers were presented at a workshop celebrating the 60th birthday of Sergei Abramov Russia whose highly influential contributions to symbolic methods are adopted in many leading computer algebra systems **Computer Algebra 2006: Latest Advances In Symbolic Algorithms - Proceedings Of The Waterloo Workshop** Ilias S Kotsireas,Evgueni V Zima,2007-08-13 Written by world renowned experts the book is a collection of tutorial presentations and research papers catering to the latest advances in symbolic summation factorization symbolic numeric linear algebra and linear functional equations The papers were presented at a workshop celebrating the 60th birthday of Sergei Abramov Russia whose highly influential contributions to symbolic methods are adopted in many leading computer algebra systems *Proceedings, 2019, MaxEnt 2019* Udo von Toussaint,Roland Preuss,2020-03-19 This Proceedings book presents papers from the 39th International Workshop on Bayesian Inference and Maximum Entropy Methods in Science and Engineering MaxEnt 2019 The workshop took place at the Max Planck Institute for Plasma Physics in Garching near Munich Germany from 30 June to 5 July 2019 and invited

contributions on all aspects of probabilistic inference including novel techniques applications and work that sheds new light on the foundations of inference Addressed are inverse and uncertainty quantification UQ and problems arising from a large variety of applications such as earth science astrophysics material and plasma science imaging in geophysics and medicine nondestructive testing density estimation remote sensing Gaussian process GP regression optimal experimental design data assimilation and data mining

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