NUMERICAL MATHEMATICS AND SCIENTIFIC COMPUTATION

## Parallel and Sequential Methods for Ordinary Differential Equations

KEVIN BURRAGE



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# **Parallel And Sequential Methods For Ordinary Differential Equations**

Uri M. Ascher, Linda R. Petzold

#### **Parallel And Sequential Methods For Ordinary Differential Equations:**

Parallel and Sequential Methods for Ordinary Differential Equations Kevin Burrage, 1995 **Parallel and Sequential** Methods for Ordinary Differential Equations Kevin Burrage, Professor in Computation Mathematics Department of Mathematics Kevin Burrage, 1995 This book presents an up to date exposition of the current state of the art of numerical methods for solving ordinary differential equations in a parallel computing environment Although the main focus is on problems of initial value type consideration will also be given to boundary valueproblems and partial differential equations Furthermore because linear algebra is an important component of the solution of differential equations a complete chapter is devoted to the parallel solution of linear systems of equations In addition to presenting an overview of parallel computing ingeneral two chapters are devoted to a summary of existing sequential differential equation methods The parallel techniques discussed include parallelism across the method parallelism across the step parallelism across the system and dynamic iteration The book concludes with a chapter on thebehaviour of a parallel code based on waveform relaxation This comprehensive book is unique in its content and provides a balance between theoretical and practical issues by providing general frameworks in which to study parallel methods **Computer Methods for Ordinary Differential Equations and** Differential-Algebraic Equations Uri M. Ascher, Linda R. Petzold, 1998-08-01 This book contains all the material necessary for a course on the numerical solution of differential equations High-Performance Computing and Networking Peter Sloot, Marian Bubak, Bob Hertzberger, 1998-04-15 Proceedings Parallel Computing **High Performance Computing in** Science and Engineering, Garching/Munich 2007 Siegfried Wagner, Matthias Steinmetz, Arndt Bode, Matthias Brehm, 2008-10-22 For the fourth time the Leibniz Supercomputing Centre LRZ and the Com tence Network for Technical Scienti c High Performance Computing in Bavaria KONWIHR publishes the results from scienti c projects conducted on the c puter systems HLRB I and II High Performance Computer in Bavaria This book reports the research carried out on the HLRB systems within the last three years and compiles the proceedings of the Third Joint HLRB and KONWIHR Result and Reviewing Workshop 3rd and 4th December 2007 in Garching In 2000 HLRB I was the rst system in Europe that was capable of performing more than one Tera op s or one billion oating point operations per second In 2006 it was replaced by HLRB II After a substantial upgrade it now achieves a peak performance of more than 62 Tera op s To install and operate this powerful system LRZ had to move to its new facilities in Garching However the situation regarding the need for more computation cycles has not changed much since 2000 The demand for higher performance is still present a trend that is likely to continue for the foreseeable future Other resources like memory and disk space are currently in suf cient abundance Proceedings of the Fourth SIAM Conference on Parallel Processing for Scientific Computing J. J. on this new system Dongarra, 1990-01-01 Proceedings Parallel Computing Advances in Numerical Methods Nikos Mastorakis, John Sakellaris, 2009-07-09 Recent Advances in Numerical Methods features contributions from distinguished researchers focused

on significant aspects of current numerical methods and computational mathematics The increasing necessity to present new computational methods that can solve complex scientific and engineering problems requires the preparation of this volume with actual new results and innovative methods that provide numerical solutions in effective computing times Each chapter will present new and advanced methods and modern variations on known techniques that can solve difficult scientific problems efficiently *Solving Differential Equations by Multistep Initial and Boundary Value Methods* L Brugnano,D Trigiante,1998-05-22 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

Time-parallel Methods for Accelerating the Solution of Structural Dynamics Problems Julien Remi Cortial, 2011 The classical approach for solving evolution Partial Differential Equations PDEs using a parallel computer consists in first partitioning the spatial domain and assigning each subdomain to a processor to achieve space parallelism then advancing the solution sequentially However enabling parallelism along the time dimension despite its intrinsic difficulty can be of paramount importance to fast computations when space parallelism is unfeasible cannot fully exploit a massively parallel machine or when near real time prediction is desired The aforementioned objective can be achieved by applying classical domain decomposition principles to the time axis The latter is first partitioned into time slices to be processed independently Starting with approximate seed information that provides a set of initial conditions the response is then advanced in parallel in each time slice using a standard time stepping integrator This decomposed solution exhibits discontinuities or jumps at the time slice boundaries if the initial guess is not accurate Applying a Newton like approach to the time dependent system a correction function is then computed to improve the accuracy of the seed values and the process is repeated until convergence is reached Methods based on the above concept have been successfully applied to various problems but none was found to be competitive for even for the simplest of second order hyperbolic PDEs a class of equations that covers the field of structural dynamics among others To overcome this difficulty a key idea is to improve the sequential propagator used for correcting the seed values observing that the original evolution problem and the derived corrective one are closely related The present work first demonstrates how this insight can be brought to fruition in the context of linear oscillators with numerical examples featuring structural models ranging from academic to more challenging large scale ones An extension of this method to nonlinear equations is then developed and its concrete application to geometrically nonlinear transient dynamics is presented Finally it is shown how the time reversibility property that characterizes some of the above

problems can be exploited to develop a new framework that provides an increased speed up factor **Numerical Methods** for Ordinary Differential Equations Alfredo Bellen, Charles W. Gear, Elvira Russo, 2006-11-14 Developments in numerical initial value ode methods were the focal topic of the meeting at L Aguila which explore the connections between the classical background and new research areas such as differental algebraic equations delay integral and integro differential equations stability properties continuous extensions interpolants for Runge Kutta methods and their applications effective stepsize control parallel algorithms for small and large scale parallel architectures The resulting proceedings address many of these topics in both research and survey papers Recent Trends in Numerical Analysis D. Trigiante, 2000 The contributions for this volume dedicated to honour the 65th birthday of Professor I Galligani have been numerous and cover a wide range of topics of the current Numerical Analysis and of its applications Multiple Shooting and Time Domain Decomposition Methods Thomas Carraro, Michael Geiger, Stefan Körkel, Rolf Rannacher, 2015-10-26 This book offers a comprehensive collection of the most advanced numerical techniques for the efficient and effective solution of simulation and optimization problems governed by systems of time dependent differential equations The contributions present various approaches to time domain decomposition focusing on multiple shooting and parareal algorithms The range of topics covers theoretical analysis of the methods as well as their algorithmic formulation and guidelines for practical implementation Selected examples show that the discussed approaches are mandatory for the solution of challenging practical problems The practicability and efficiency of the presented methods is illustrated by several case studies from fluid dynamics data compression image processing and computational biology giving rise to possible new research topics This volume resulting from the workshop Multiple Shooting and Time Domain Decomposition Methods held in Heidelberg in May 2013 will be of great interest to applied mathematicians computer scientists and all scientists using mathematical methods **Computational Science - ICCS** 2004 Marian Bubak, Geert D. van Albada, Peter M.A. Sloot, Jack J. Dongarra, 2004-05-13 The International Conference on Computational Science ICCS 2004 held in Krak ow Poland June 6 9 2004 was a follow up to the highly successful ICCS 2003 held at two locations in Melbourne Australia and St Petersburg Russia ICCS 2002 in Amsterdam The Netherlands and ICCS 2001 in San Francisco USA As computational science is still evolving in its guest for subjects of investigation and e cient methods ICCS 2004 was devised as a forum for scientists from mathematics and computer science as the basic computing disciplines and application areas interested in advanced computational methods for physics chemistry life sciences engineering arts and humanities as well as computer system vendors and software developers The main objective of this conference was to discuss problems and solutions in all areas to identify new issues to shape future directions of research and to help users apply various advanced computational techniques The event harvested recent developments in com tationalgridsandnextgenerationcomputingsystems tools advancednumerical methods data driven systems and novel application elds such as complex stems nance econo physics and population evolution Parallel Methods for the Numerical

Solution of Ordinary Differential Equations Hon Wah Tam, University of Illinois at Urbana-Champaign. Department of Computer Science, 1989 Based on this approach we derive new efficient parallel methods The proposed families of block methods have stability regions which do not change as the order increases These new methods have much better stability properties than the Adams PECE methods of the same order The above perfect power stability polynomial appraoch can also be extended to multi block methods Euro-Par 2007 Parallel Processing Anne-Marie Kermarrec, 2007-08-14 This book constitutes the refereed proceedings of the 13th International Conference on Parallel Computing Euro Par 2007 held in Dresden Rennes France August 28 31 2007 The 89 revised papers presented were carefully reviewed and selected from 333 submissions The papers are organized in topical sections on support tools and environments performance prediction and evaluation scheduling and load balancing compilers for high performance parallel and distributed databases grid and cluster computing peer to peer computing distributed systems and algorithms parallel and distributed programming parallel numerical algorithms distributed and high performance multimedia theory and algorithms for parallel computation high performance networks mobile and ubiquitous computing Mathematical Methods for the Magnetohydrodynamics of Liquid Metals Jean-Frédéric Gerbeau, Claude Le Bris, Tony Lelièvre, 2006-08-31 This comprehensive text focuses on mathematical and numerical techniques for the simulation of magnetohydrodynamic phenomena with an emphasis laid on the magnetohydrodynamics of liquid metals and on a prototypical industrial application Aimed at research mathematicians engineers and physicists as well as those working in industry and starting from a good understanding of the physics at play the approach is a highly mathematical one based on the rigorous analysis of the equations at hand and a solid numerical analysis to found the simulations At each stage of the exposition examples of numerical simulations are provided first on academic test cases to illustrate the approach next on benchmarks well documented in the professional literature and finally whenever possible on real industrial cases Large-Scale Scientific Computing Ivan Lirkov, Svetozar D. Margenov, Jerzy Wasniewski,2010-05-10 This book constitutes the thoroughly refereed post conference proceedings of the 7th International Conference on Large Scale Scientific Computations LSSC 2009 held in Sozopol Bulgaria in June 2009 The 93 revised full papers presented together with 5 plenary and invited papers were carefully reviewed and selected from numerous submissions for inclusion in the book The papers are organized in topical sections on multilevel and multiscale preconditioning methods multilevel and multiscale methods for industrial applications environmental modeling control and uncertain systems application of metaheuristics to large scale problems monte carlo methods applications distributed computing grid and scientific and engineering applications reliable numerical methods for differential equations novel applications of optimization ideas to the numerical Solution of PDEs and contributed talks **Parallel Computing Technologies** Victor Malyshkin, 2011-09-10 This book constitutes the proceedings of the 11th International Conference on Parallel Computing Technologies PaCT 2011 held in Kazan Russia on September 19 23 2011 The 44 full papers presented

together with 2 invited papers were carefully reviewed and selected from 68 submissions The papers are organized in topical sections on models and languages cellular automata parallel programming tools and support and applications Recent Progress in Computational Sciences and Engineering (2 vols) Theodore Simos, 2019-05-07 This volume brings together selected contributed papers presented at the International Conference of Computational Methods in Science and Engineering ICCMSE 2006 held in Chania Greece October 2006 The conference aims to bring together computational scientists from several disciplines in order to share methods and ideas The ICCMSE is unique in its kind It regroups original contributions from all fields of the traditional Sciences Mathematics Physics Chemistry Biology Medicine and all branches of Engineering It would be perhaps more appropriate to define the ICCMSE as a conference on computational science and its applications to science and engineering Topics of general interest are Computational Mathematics Theoretical Physics and Theoretical Chemistry Computational Engineering and Mechanics Computational Biology and Medicine Computational Geosciences and Meteorology Computational Economics and Finance Scientific Computation High Performance Computing Parallel and Distributed Computing Visualization Problem Solving Environments Numerical Algorithms Modelling and Simulation of Complex System Web based Simulation and Computing Grid based Simulation and Computing Fuzzy Logic Hybrid Computational Methods Data Mining Information Retrieval and Virtual Reality Reliable Computing Image Processing Computational Science and Education etc More than 800 extended abstracts have been submitted for consideration for presentation in ICCMSE 2005 From these 500 have been selected after international peer review by at least two independent Recent Advances in Parallel Virtual Machine and Message Passing Interface Beniamino Di Martino, Dieter reviewers Kranzlmüller, Jack Dongarra, 2005-10-03 This volume comprises 61 selected contributions presented at the 12th European PVM MPI Users Group Meeting which was held in Sorrento Italy September 18 21 2005

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