Scientific Computing, Validated Numerics, Interval Methods

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   Scientific Computing, Validated Numerics, Interval Methods Walter Krämer,Jürgen Wolff von Gudenberg,2013-04-17 Scan 2000 the GAMM IMACS International Symposium on Scientific Computing Computer Arithmetic and Validated Numerics and Interval 2000 the International Conference on Interval Methods in Science and Engineering were jointly held in Karlsruhe September 19 22 2000 The joint conference continued the series of 7 previous Scan symposia under the joint sponsorship of GAMM and IMACS These conferences have traditionally covered the numerical and algorithmic aspects of scientific computing with a strong emphasis on validation and verification of computed results as well as on arithmetic programming and algorithmic tools for this purpose The conference further continued the series of 4 former Interval conferences focusing on interval methods and their application in science and engineering The objectives are to propagate current applications and research as well as to promote a greater understanding and increased awareness of the subject matters The symposium was held in Karlsruhe the European cradle of interval arithmetic and self validating numerics and attracted 193 researchers from 33 countries 12 invited and 153 contributed talks were given But not only the quantity was overwhelming we were deeply impressed by the emerging maturity of our discipline There were many talks discussing a wide variety of serious applications stretching all parts of mathematical modelling New efficient publicly available or even commercial tools were proposed or presented and also foundations of the theory of intervals and reliable computations were considerably strengthened   *Validated Numerics* Warwick Tucker,2023-06-06 Validated Numerics contains introductory material on interval arithmetic and rigorous computations that is easily accessible to students with little background in mathematics and computer programming I am not aware of any other book like it The exercises and computer labs make it ideal for the classroom and the references offer a good starting point for readers trying to gain deeper knowledge in this area Zbigniew Galias AGH University of Science and Technology Krakw A significant contribution particularly since there are not many texts in this area Validated Numerics will be read by those interested in interval arithmetic numerical analysis and ways to make computer simulations more robust and less susceptible to errors It is well written and well organized A J Meir Auburn University   **Scientific Computing, Computer Arithmetic, and Validated Numerics** Marco Nehmeier,Jürgen Wolff von Gudenberg,Warwick Tucker,2016-04-08 This book constitutes the refereed post proceedings of the 16th International Symposium SCAN 2014 held in W rzburg Germany in September 2014 The 22 full papers presented were carefully reviewed and selected from 60 submissions The main concerns of research addressed by SCAN conferences are validation verification or reliable assertions of numerical computations Interval arithmetic and other treatments of uncertainty are developed as appropriate tools   **Large-Scale Scientific Computing** Ivan Lirkov,Svetozar D. Margenov,Jerzy Wasniewski,2009-03-26 Coverage in this proceedings volume includes robust multilevel and hierarchical preconditioning methods applications for large scale computations and optimization of coupled engineering problems and

applications of metaheuristics to large scale problems **Scientific Computing and Validated Numerics** G. Alefeld,Andreas Frommer,Bruno Lang,1996 The International Symposium on Scientific Computing Computer Arithmetic and Validated Numerics SCAN is held biannually the fourth conference took place in Wuppertal 1995 This volume contains contributions from outstanding research specialists based on their presentations at SCAN 95 It covers all aspects of scientific computing with validation starting with the latest developments in the design of floating point units together with algorithms for floating point operations and elementary function evaluations with maximum accuracy The book continues by treating scientific computing methods for many areas of applied mathematics such as numerical linear algebra nonlinear equations global optimization ordinary and partial differential equations and dynamical systems Some computer science aspects like complexity are also considered as are examples where validation methods have successfully be used in applications from the engineering sciences *Validated Numerics* Warwick Tucker,2011-07-05 A comprehensive self contained primer on validated numerics This textbook provides a comprehensive introduction to the theory and practice of validated numerics an emerging new field that combines the strengths of scientific computing and pure mathematics In numerous fields ranging from pharmaceutics and engineering to weather prediction and robotics fast and precise computations are essential Based on the theory of set valued analysis a new suite of numerical methods is developed producing efficient and reliable solvers for numerous problems in nonlinear analysis Validated numerics yields rigorous computations that can find all possible solutions to a problem while taking into account all possible sources of error fast and with guaranteed accuracy Validated Numerics offers a self contained primer on the subject guiding readers from the basics to more advanced concepts and techniques This book is an essential resource for those entering this fast developing field and it is also the ideal textbook for graduate students and advanced undergraduates needing an accessible introduction to the subject Validated Numerics features many examples exercises and computer labs using MATLAB C as well as detailed appendixes and an extensive bibliography for further reading Provides a comprehensive self contained introduction to validated numerics Requires no advanced mathematics or programming skills Features many examples exercises and computer labs Includes code snippets that illustrate implementation Suitable as a textbook for graduate students and advanced undergraduates **Parallel Processing and Applied Mathematics, Part II** Roman Wyrzykowski,Jack Dongarra,Konrad Karczewski,Jerzy Wasniewski,2010-07-12 This book constitutes the proceedings of the 8th International Conference on Parallel Processing and Applied Mathematics PPAM 2009 held in Wroclaw Poland in September 2009 *Numerical Validation in Current Hardware Architectures* Annie A.M. Cuyt,Walter Krämer,Wolfram Luther,Peter Markstein,2009-04-24 The major emphasis of the Dagstuhl Seminar on Numerical Validation in C rent Hardware Architectures lay on numerical validation in current hardware architecturesand softwareenvironments The generalidea wasto bring together experts who are concerned with computer arithmetic in systems with actual processor architectures and scientists who develop use and need techniques from veri ed

computation in their applications Topics of the seminar therefore included The ongoing revision of the IEEE 754 854 standard for oating point ari metic Feasible ways to implement multiple precision multiword arithmetic and to compute the actual precision at run time according to the needs of input data The achievement of a similar behavior of xed point oating point and terval arithmetic across language compliant implementations The design of robust and e cient numerical programsportable from diverse computers to those that adhere to the IEEE standard The development and propagation of validated special purpose software in di erent application areas Error analysis in several contexts Certi cation of numerical programs veri cation and validation assessment Computer arithmetic plays an important role at the hardware and software level when microprocessors embedded systems or grids are designed The re ability of numerical softwarestrongly depends on the compliance with the cor sponding oating point norms Standard CISC processors follow the 1985 IEEE norm 754 which is currently under revision but the new highly performing CELL processor is not fully IEEE compliant   *Numerical Methods and Applications* Ivan Dimov,Lirkov Ivan Dimov,Stefka Dimova,Natalia Kolkovska,2011-01-14 This book constitutes the thoroughly refereed post conference proceedings of the 7th International Conference on Numerical Methods and Applications NMA 2010 held in Borovets Bulgaria in August 2010 The 60 revised full papers presented together with 3 invited papers were carefully reviewed and selected from numerous submissions for inclusion in this book The papers are organized in topical sections on Monte Carlo and quasi Monte Carlo methods environmental modeling grid computing and applications metaheuristics for optimization problems and modeling and simulation of electrochemical processes

Granular, Fuzzy, and Soft Computing Tsau-Young Lin,Churn-Jung Liau,Janusz Kacprzyk,2023-03-29 The first edition of the Encyclopedia of Complexity and Systems Science ECSS 2009 presented a comprehensive overview of granular computing GrC broadly divided into several categories Granular computing from rough set theory Granular Computing in Database Theory Granular Computing in Social Networks Granular Computing and Fuzzy Set Theory Grid Cloud Computing as well as general issues in granular computing In 2011 the formal theory of GrC was established providing an adequate infrastructure to support revolutionary new approaches to computer data science including the challenges presented by so called big data For this volume of ECSS Second Edition many entries have been updated to capture these new developments together with new chapters on such topics as data clustering outliers in data mining qualitative fuzzy sets and information flow analysis for security applications Granulations can be seen as a natural and ancient methodology deeply rooted in the human mind Many daily things are routinely granulated into sub things The topography of earth is granulated into hills plateaus etc space and time are granulated into infinitesimal granules and a circle is granulated into polygons of infinitesimal sides Such granules led to the invention of calculus topology and non standard analysis Formalization of general granulation was difficult but as shown in this volume great progress has been made in combing discrete and continuous mathematics under one roof for a broad range of applications in data science   Interval Methods for Solving Nonlinear Constraint

<u>Satisfaction, Optimization and Similar Problems</u> Bartłomiej Jacek Kubica,2019-03-08 This book highlights recent research on interval methods for solving nonlinear constraint satisfaction optimization and similar problems Further it presents a comprehensive survey of applications in various branches of robotics artificial intelligence systems economics control theory dynamical systems theory and others Three appendices on the notation representation of numbers used as intervals endpoints and sample implementations of the interval data type in several programming languages round out the coverage

<u>Developments in Reliable Computing</u> Tibor Csendes,2013-04-17 The SCAN conference the International Symposium on Scientific Com puting Computer Arithmetic and Validated Numerics takes place bian nually under the joint auspices of GAMM Gesellschaft fiir Angewandte Mathematik und Mechanik and IMACS International Association for Mathematics and Computers in Simulation SCAN 98 attracted more than 100 participants from 21 countries all over the world During the four days from September 22 to 25 nine highlighted plenary lectures and over 70 contributed talks were given These figures indicate a large participation which was partly caused by the attraction of the organizing country Hungary but also the effec tive support system have contributed to the success The conference was substantially supported by the Hungarian Research Fund OTKA GAMM the National Technology Development Board OMFB and by the J6zsef Attila University Due to this funding it was possible to subsidize the participation of over 20 scientists mainly from Eastern European countries It is important that the possibly first participation of 6 young researchers was made possible due to the obtained support The number of East European participants was relatively high These results are especially valuable since in contrast to the usual 2 years period the present meeting was organized just one year after the last SCAN xx conference *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 quest for subjects of inves gation 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 **Numerical Methods and Applications** Todor Boyanov,Stefka Dimova,Krassimir Georgiev,Geno Nikolov,2007-05-15 This book constitutes the thoroughly refereed post proceedings of NMA 2006 held in Borovets Bulgaria Coverage in the 84 revised full papers includes

numerical methods for hyperbolic problems robust preconditioning solution methods metaheuristics for optimization problems uncertain control systems and reliable numerics interpolation and quadrature processes and large scale computations in environmental modeling   Rigorous Global Search: Continuous Problems R. Baker Kearfott,2013-03-09 This work grew out of several years of research graduate seminars and talks on the subject It was motivated by a desire to make the technology accessible to those who most needed it or could most use it It is meant to be a self contained introduction a reference for the techniques and a guide to the literature for the underlying theory It contains pointers to fertile areas for future research It also serves as introductory documentation for a Fortran 90 software package for nonlinear systems and global optimization The subject of the monograph is deterministic automatically verified or r orous methods In such methods directed rounding and computational fix point theory are combined with exhaustive search branch and bound te niques Completion of such an algorithm with a list of solutions constitutes a rigorous mathematical proof that all of the solutions within the original search region are within the output list The monograph is appropriate as an introduction to research and technology in the area as a desk reference or as a graduate level course reference Kno edge of calculus linear algebra and elementary numerical analysis is assumed   International Conference on Computing and Information Technologies George Antoniou,Dorothy Deremer,2001 This book is a balanced presentation of the latest techniques algorithms and applications in computer science and engineering The papers written by eminent researchers in their fields provide a vehicle for new research and development The proceedings have been selected for coverage in Index to Scientific Technical Proceedings ISTP CDROM version ISI Proceedings   **Computer Arithmetic and Validity** Ulrich Kulisch,2013-04-30 This is the revised and extended second edition of the successful basic book on computer arithmetic It is consistent with the newest recent standard developments in the field The book shows how the arithmetic and mathematical capability of the digital computer can be enhanced in a quite natural way The work is motivated by the desire and the need to improve the accuracy of numerical computing and to control the quality of the computed results validity The accuracy requirements for the elementary floating point operations are extended to the customary product spaces of computations including interval spaces The mathematical properties of these models are extracted into an axiomatic approach which leads to a general theory of computer arithmetic Detailed methods and circuits for the implementation of this advanced computer arithmetic on digital computers are developed in part two of the book Part three then illustrates by a number of sample applications how this extended computer arithmetic can be used to compute highly accurate and mathematically verified results The book can be used as a high level undergraduate textbook but also as reference work for research in computer arithmetic and applied mathematics   *Advances in the Theory of Control, Signals and Systems with Physical Modeling* Jean Levine,Philippe Müllhaupt,2010-09-30 In the 60 s control signals and systems had a common linear algebraic background and according to their evolution their respective backgrounds have now dramatically differed Recovering such a common

background especially in the nonlinear context is currently a fully open question The role played by physical models finite or infinite dimensional in this hypothetical convergence is extensively discussed in this book The discussion does not only take place on a theoretical basis but also in the light of two wide classes of applications among the most active in the current industrially oriented researches Electrical and Mechatronical systems Chemical Processes and systems appearing in Life Sciences In this perspective this book is a contribution to the enhancement of the dialogue between theoretical laboratories and more practically oriented ones and industries This book is a collection of articles that have been presented by leading international experts at a series of three workshops of a Bernoulli program entitled Advances in the Theory of Control Signals and Systems with Physical Modeling hosted by the Bernoulli Centre of EPFL during the first semester of 2009 It provides researchers engineers and graduate students with an unprecedented collection of topics and internationally acknowledged top quality works and surveys   **Accuracy and Reliability in Scientific Computing** Bo Einarsson,2005-01-01 Numerical software is used to test scientific theories design airplanes and bridges operate manufacturing lines control power plants and refineries analyze financial derivatives identify genomes and provide the understanding necessary to derive and analyze cancer treatments Because of the high stakes involved it is essential that results computed using software be accurate reliable and robust Unfortunately developing accurate and reliable scientific software is notoriously difficult This book investigates some of the difficulties related to scientific computing and provides insight into how to overcome them and obtain dependable results The tools to assess existing scientific applications are described and a variety of techniques that can improve the accuracy and reliability of newly developed applications is discussed Accuracy and Reliability in Scientific Computing can be considered a handbook for improving the quality of scientific computing It will help computer scientists address the problems that affect software in general as well as the particular challenges of numerical computation approximations occurring at all levels continuous functions replaced by discretized versions infinite processes replaced by finite ones and real numbers replaced by finite precision numbers Divided into three parts it starts by illustrating some of the difficulties in producing robust and reliable scientific software Well known cases of failure are reviewed and the what and why of numerical computations are considered The second section describes diagnostic tools that can be used to assess the accuracy and reliability of existing scientific applications In the last section the authors describe a variety of techniques that can be employed to improve the accuracy and reliability of newly developed scientific applications The authors of the individual chapters are international experts many of them members of the IFIP Working Group on Numerical Software

Perspectives on Enclosure Methods Ulrich Kulisch,Rudolf Lohner,Axel Facius,2012-12-06 Enclosure methods and their applications have been developed to a high standard during the last decades These methods guarantee the validity of the computed results This means they are of the same standard as the rest of mathematics The book deals with a wide variety of aspects of enclosure methods All contributions follow the common goal to push the limits of enclosure methods forward

Topics that are treated include basic questions of arithmetic proving conjectures bounds for Krylow type linear system solvers bounds for eigenvalues the wrapping effect algorithmic differencing differential equations finite element methods application in robotics and nonsmooth global optimization

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