Numerical Toolbox For Verified Computing I Basic Numerical Problems Theory Algorithms And Pasca

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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.
Numerical Validation in Current Hardware Architectures - Annie A.M.

Cuyt 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 for Singularly Perturbed Differential Equations - Hans-G. Roos 1996-03-14

The analysis of singular perturbed differential equations began early in this century, when approximate solutions were constructed from asymptotic ex pansions. (Preliminary attempts appear in the nineteenth century [vD94].) This technique has flourished since the mid-1960s. Its principal ideas and methods are described in several textbooks. Nevertheless, asymptotic ex pansions may be impossible to construct or may fail to simplify the given problem; then numerical approximations are often the only option. The systematic study of numerical methods for singular perturbation problems started somewhat later - in the 1970s. While the research frontier has been steadily pushed back, the exposition of new developments in the analysis of numerical methods has been neglected. Perhaps the only example of a textbook that concentrates on this analysis is [DMS80], which collects various results for ordinary differential equations, but many methods and techniques that are relevant today (especially for partial differential equa tions) were developed after 1980.Thus contemporary researchers must comb the literature to acquaint themselves with earlier work. Our purposes in writing this introductory book are twofold. First, we aim to present a structured account of recent ideas in the numerical analysis of singularly perturbed differential equations. Second, this important area has many open problems and we hope that our book will stimulate further investigations.Our choice of topics is inevitably personal and reflects our own main interests.

Scientific Computing, Computer Arithmetic, and Validated Numerics - Marco Nehmeier 2016-04-08

This book constitutes the refereed post proceedings of the 16th International Symposium, SCAN 2014, held in Würzburg, 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.

Developments in Reliable Computing - 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.

Applications of Interval Computations - R. Baker Kearfott 2013-12-01

Primary Audience for the Book • Specialists in numerical computations who are interested in algorithms with automatic result verification. • Engineers, scientists, and practitioners who desire results with automatic verification and who would therefore benefit from the experience of suc cessful applications. • Students in applied mathematics and computer science who want to learn these methods. Goal Of the Book This book contains surveys of applications of interval computations, i. e. , appli

cations of numerical methods with automatic result verification, that were pre sented at an international workshop on the subject in EI Paso, Texas, February 23-25, 1995. The purpose of this book is to disseminate detailed and surveyed information about existing and potential applications of this new growing field. Brief Description of the Papers At the most fundamental level, interval arithmetic operations work with sets: The result of a single arithmetic operation is the set of all possible results as the operands range over the domain. For example, [0. 9,1. 1] + [2. 9,3. 1] = [3. 8,4. 2], where [3. 8,4. 2] = {x + ylx E [0. 9,1. 1] and y E [3. 8,4. 2]}. The power of interval arithmetic comes from the fact that (i) the elementary operations and standard functions can be computed for intervals with formulas and subroutines; and (ii) directed roundings can be used, so that the images of these operations (e. g.

The Palgrave Handbook of Operations Research - Saïd Salhi 2022-07-07
Operations Research (OR) is a fast-evolving field, which is having a significant impact on its neighbouring disciplines of Business Analytics and Data Science, and on contemporary business and management practices. This handbook provides a comprehensive and cutting edge collection of studies in the area. Views differ on what should be included within the scope of OR. The editors of this volume have taken the view that an inclusive stance is the most helpful, both for theory and practice. Real-world problems often require consideration from both 'softer' and 'harder' perspectives and need consideration of both predictive and prescriptive problems. In accordance with this inclusive approach to OR, the book is divided into six parts, covering Discrete Optimization, Continuous Optimization, Heuristic Search Optimization, Forecasting, Simulation and Prediction, Problem Structuring and Behavioural OR, and finally some recent OR Applications. This wide-ranging handbook includes a culturally diverse collection of authors, with different perspectives and backgrounds around Operations Research. It will be of tremendous value to researchers, students and practitioners in the field of OR

Uncertainty Quantification in Scientific Computing - Andrew Dienstfrey 2012-08-11

This book constitutes the refereed post-proceedings of the 10th IFIP WG 2.5 Working Conference on Uncertainty Quantification in Scientific Computing, WoCoUQ 2011, held in Boulder, CO, USA, in August 2011. The 24 revised papers were carefully reviewed and selected from numerous submissions. They are organized in the following topical sections: UQ need: risk, policy, and decision making, UQ theory, UQ tools, UQ practice, and hot topics. The papers are followed by the records of the discussions between the participants and the speaker.

Interval Analysis - Günter Mayer 2017-04-10
This self-contained text is a step-by-step introduction and a complete overview of interval computation and result verification, a subject whose importance has steadily increased over the past many years. The author, an expert in the field, gently presents the theory of interval analysis through many examples and exercises, and guides the reader from the basics of the theory to current research topics in the mathematics of computation. Contents Preliminaries Real intervals Interval vectors, interval matrices Expressions, P-contraction, ε-inflation Linear systems of equations Nonlinear systems of equations Eigenvalue problems Automatic differentiation Complex intervals

C++ Toolbox for Verified Computing I - Rolf Hammer 2012-12-06
Our aim in writing this book was to provide an extensive set of C++ programs for solving basic numerical problems with verification of the results. This C++ Toolbox for Verified Computing I is the C++ edition of the Numerical Toolbox for Verified Computing l. The programs of the original edition were written in PASCAL-XSC, a PASCAL eXtension for Scientific Computation. Since we published the first edition we have received many requests from readers and users of our tools for a version in C++. We take the view that C++ is growing in importance in the field of numeri cal computing. C++ includes C, but as a typed language and due to its modern concepts, it is superior to C. To obtain the degree of efficiency that PASCAL-XSC provides, we used the C-XSC library. C-XSC is a C++ class library for eXtended Scientific Computing. C++ and the C-XSC library are an adequate alternative to special XSC-Ianguages such as PASCAL-XSC or ACRITH-XSC. A shareware version of the C-XSC

library and the sources of the toolbox programs are freely available via anonymous ftp or can be ordered against reimbursement of expenses. The programs of this book do not require a great deal of insight into the features of C++. Particularly, object oriented programming techniques are not required.

Introduction to Interval Analysis - Ramon E. Moore 2009-04-16 An introduction to interval analysis for scientists and engineers interested in scientific computation, especially using INTLAB/MATLAB®.

Perspectives on Enclosure Methods - Ulrich Kulisch 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.

Accuracy and Stability of Numerical Algorithms - Nicholas J. Higham 2002-08-01 Accuracy and Stability of Numerical Algorithms gives a thorough, up-to-date treatment of the behavior of numerical algorithms in finite precision arithmetic. It combines algorithmic derivations, perturbation theory, and rounding error analysis, all enlivened by historical perspective and informative quotations. This second edition expands and updates the coverage of the first edition (1996) and includes numerous improvements to the original material. Two new chapters treat symmetric indefinite systems and skew-symmetric systems, and nonlinear systems and Newton's method. Twelve new sections include coverage of additional error bounds for Gaussian elimination, rank revealing LU factorizations, weighted and constrained least squares problems, and the fused multiply-add operation found on some modern computer architectures.

High Performance Computing for Computational Science --

VECPAR 2010 - José M. Laginha M. Palma 2011-02-18 This book constitutes the thoroughly refereed post-conference proceedings of the 9th International Conference on High Performance Computing for Computational Science, VECPAR 2010, held in Berkeley, CA, USA, in June 2010. The 34 revised full papers presented together with five invited contributions were carefully selected during two rounds of reviewing and revision. The papers are organized in topical sections on linear algebra and solvers on emerging architectures, large-scale simulations, parallel and distributed computing, numerical algorithms.

Developments in Global Optimization - Immanuel Bomze 1997-01-31 In recent years global optimization has found applications in many interesting areas of science and technology including molecular biology, chemical equilibrium problems, medical imaging and networks. The collection of papers in this book indicates the diverse applicability of global optimization. Furthermore, various algorithmic, theoretical developments and computational studies are presented. Audience: All researchers and students working in mathematical programming.

Numerical Toolbox for Verified Computing II - W. Krämer 2009-12-01 Dieses Lehrbuch gibt dem Studenten einen Überblick über alle wichtigen Lebensräume des Meeres: von den Küstengebieten bis hin zur Tiefsee und dem Meeresboden, von den Packeiszonen bis zu den Korallenriffen. Es setzt den Schwerpunkt auf diejenigen Lebensräume im Meer, die die großen Flächen der Erdoberfläche ausmachen und eine entsprechend große Bedeutung für die Biosphäre der Erde haben - z.B. bei der aktuellen Diskussion darüber, wieviel Kohlendioxid die Weltmeere aufnehmen können.

Numerical Analysis and Its Applications - Lubin Vulkov 1997-02-26 This book constitutes the refereed proceedings of the First International Workshop on Numerical Analysis and Its Applications, WNAA'96, held in Rousse, Bulgaria, in June 1996. The 57 revised full papers presented were carefully selected and reviewed for inclusion in the volume; also included are 14 invited presentations. All in all, the book offers a wealth of new results and methods of numerical analysis applicable in

computational science, particularly in computational physics and chemistry. The volume reflects that the cooperation of computer scientists, mathematicians and scientists provides new numerical tools for computational scientists and, at the same time, stimulates numerical analysis.

Numerical Verification Methods and Computer-Assisted Proofs for Partial Differential Equations - Mitsuhiro T. Nakao 2019-11-11
In the last decades, various mathematical problems have been solved by computer-assisted proofs, among them the Kepler conjecture, the existence of chaos, the existence of the Lorenz attractor, the famous four-color problem, and more. In many cases, computer-assisted proofs have the remarkable advantage (compared with a "theoretical" proof) of additionally providing accurate quantitative information. The authors have been working more than a quarter century to establish methods for the verified computation of solutions for partial differential equations, mainly for nonlinear elliptic problems of the form $-\Delta u = f(x, u, \nabla u)$ with Dirichlet boundary conditions. Here, by "verified computation" is meant a computer-assisted numerical approach for proving the existence of a solution in a close and explicit neighborhood of an approximate solution. The quantitative information provided by these techniques is also significant from the viewpoint of a posteriori error estimates for approximate solutions of the concerned partial differential equations in a mathematically rigorous sense. In this monograph, the authors give a detailed description of the verified computations and computer-assisted proofs for partial differential equations that they developed. In Part I, the methods mainly studied by the authors Nakao and Watanabe are presented. These methods are based on a finite dimensional projection and constructive a priori error estimates for finite element approximations of the Poisson equation. In Part II, the computer-assisted approaches via eigenvalue bounds developed by the author Plum are explained in detail. The main task of this method consists of establishing eigenvalue bounds for the linearization of the corresponding nonlinear problem at the computed approximate solution. Some brief remarks on other approaches are also given in Part III. Each method in Parts I and II is accompanied by appropriate numerical examples that confirm the actual usefulness of the authors' methods. Also in some examples practical computer algorithms are supplied so that readers can easily implement the verification programs by themselves.

Numerical Toolbox for Verified Computing I - Rolf Hammer 1993-12-20
As suggested by the title of this book Numerical Toolbox for Verified Computing, we present an extensive set of sophisticated tools to solve basic numerical problems with a verification of the results. We use the features of the scientific computer language PASCAL-XSC to offer modules that can be combined by the reader to his/her individual needs. Our overriding concern is reliability - the automatic verification of the result a computer returns for a given problem. All algorithms we present are influenced by this central concern. We must point out that there is no relationship between our methods of numerical result verification and the methods of program verification to prove the correctness of an imple~entation for a given algorithm. This book is the first to offer a general discussion on • arithmetic and computational reliability, • analytical mathematics and verification techniques, • algorithms, and • (most importantly) actual implementations in the form of working computer routines. Our task has been to find the right balance among these ingredients for each topic. For some topics, we have placed a little more emphasis on the algorithms. For other topics, where the mathematical prerequisites are universally held, we have tended towards more in-depth discussion of the nature of the computational algorithms, or towards practical questions of implementation. For all topics, we present exam ples, exercises, and numerical results demonstrating the application of the routines presented.

Scientific Computing, Validated Numerics, Interval Methods - Walter Krämer 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.

Advanced Arithmetic for the Digital Computer - Ulrich W. Kulisch 2012-09-07
The number one requirement for computer arithmetic has always been speed. It is the main force that drives the technology. With increased speed larger problems can be attempted. To gain speed, advanced processors and pro gramming languages offer, for instance, compound arithmetic operations like matmul and dotproduct. But there is another side to the computational coin - the accuracy and reliability of the computed result. Progress on this side is very important, if not essential. Compound arithmetic operations, for instance, should always deliver a correct result. The user should not be obliged to perform an error analysis every time a compound arithmetic operation, implemented by the hardware manufacturer or in the programming language, is employed. This treatise deals with computer arithmetic in a more general sense than usual. Advanced computer arithmetic extends the accuracy of the elementary floating-point operations, for instance, as defined by the IEEE arithmetic standard, to all operations in the usual product spaces of computation: the complex numbers, the real and complex intervals, and the real and complex vectors and matrices and their interval counterparts. The implementation of advanced computer arithmetic by fast hardware is examined in this book. Arithmetic units for its elementary components are described. It is shown that the requirements for speed and for reliability do not conflict with each other. Advanced computer arithmetic is superior to other arithmetic with respect to accuracy, costs, and speed.

Cable-Driven Parallel Robots - Andreas Pott 2018-03-27
Cable-driven parallel robots are a new kind of lightweight manipulators with excellent scalability in terms of size, payload, and dynamics capacities. For the first time, a comprehensive compendium is presented of the field of cable-driven parallel robots. A thorough theory of cable robots is setup leading the reader from first principles to the latest results in research. The main topics covered in the book are classification, terminology, and fields of application for cable-driven parallel robots. The geometric foundation of the standard cable model is introduced followed by statics, force distribution, and stiffness. Inverse and forward kinematics are addressed by elaborating efficient algorithms. Furthermore, the workspace is introduced and different algorithms are detailed. The book contains the dynamic equations as well as simulation models with applicable parameters. Advanced cable models are described taking into account pulleys, elastic cables, and sagging cables. For practitioner, a descriptive design method is stated including methodology, parameter synthesis, construction design, component selection, and calibration. Rich examples are presented by means of simulation results from sample robots as well as experimental validation on reference demonstrators. The book contains a representative overview of reference demonstrator system. Tables with physical parameters for geometry, cable properties, and robot parameterizations support case studies and are valuable references for building custom

cable robots. For scientist, the book provides the starting point to address new scientific challenges as open problems are named and a commented review of the literature on cable robot with more than 500 references are given.

Parallel Processing and Applied Mathematics, Part II - Roman Wyrzykowski 2010-07-12
The LNCS series reports State-of-the-art results in computer science research, development, and education, at a high level and in both printed and electronic form. Enjoying tight cooperation with the R&D community, with numerous individuals, as well as with prestigious organizations and societies, LNCS has grown into the most comprehensive computer science research forum available. The scope of LNCS, including its subseries LNAI and LNBI, spans the whole range of computer science and information technology including interdisciplinary topics in a variety of application fields. More recently, several color-cover sublines have been added featuring, beyond a collection of papers, various added-value components In parallel to the printed book, each new volume is published electronically in LNCS Online

Applied Parallel and Scientific Computing - Kristján Jónasson 2012-02-04
The two volume set LNCS 7133 and LNCS 7134 constitutes the thoroughly refereed post-conference proceedings of the 10th International Conference on Applied Parallel and Scientific Computing, PARA 2010, held in Reykjavík, Iceland, in June 2010. These volumes contain three keynote lectures, 29 revised papers and 45 minisymposia presentations arranged on the following topics: cloud computing, HPC algorithms, HPC programming tools, HPC in meteorology, parallel numerical algorithms, parallel computing in physics, scientific computing tools, HPC software engineering, simulations of atomic scale systems, tools and environments for accelerator based computational biomedicine, GPU computing, high performance computing interval methods, real-time access and processing of large data sets, linear algebra algorithms and software for multicore and hybrid architectures in honor of Fred Gustavson on his 75th birthday, memory and multicore issues in

scientific computing - theory and praxis, multicore algorithms and implementations for application problems, fast PDE solvers and a posteriori error estimates, and scalable tools for high performance computing.

Proceedings of the International Workshop, Special Functions - Charles F. Dunkl 2000
Special functions and q-series are currently very active areas of research which overlap with many other areas of mathematics, such as representation theory, classical and quantum groups, affine Lie algebras, number theory, harmonic analysis, and mathematical physics. This book presents the state-of-the-art of the subject and its applications.

Numerical Analysis - Walter Gautschi 2011-12-07
Revised and updated, this second edition of Walter Gautschi's successful Numerical Analysis explores computational methods for problems arising in the areas of classical analysis, approximation theory, and ordinary differential equations, among others. Topics included in the book are presented with a view toward stressing basic principles and maintaining simplicity and teachability as far as possible, while subjects requiring a higher level of technicality are referenced in detailed bibliographic notes at the end of each chapter. Readers are thus given the guidance and opportunity to pursue advanced modern topics in more depth. Along with updated references, new biographical notes, and enhanced notational clarity, this second edition includes the expansion of an already large collection of exercises and assignments, both the kind that deal with theoretical and practical aspects of the subject and those requiring machine computation and the use of mathematical software. Perhaps most notably, the edition also comes with a complete solutions manual, carefully developed and polished by the author, which will serve as an exceptionally valuable resource for instructors.

Parallel Processing and Applied Mathematics - Roman Wyrzykowski 2004-04-26
This book constitutes the thoroughly refereed post-proceedings of the 5th International Conference on Parallel Processing and Applied Mathematics, PPAM 2003, held in Czestochowa, Poland, in September

2003. The 149 papers presented were carefully selected and improved during two rounds of reviewing and revision. The papers are organized in topical sections on parallel and distributed architectures, scheduling and load balancing, performance analysis and prediction, parallel and distributed non-numerical algorithms, parallel and distributed programming, tools and environments, applications, evolutionary computing, soft computing data and knowledge management, numerical methods and their applications, multi-dimensional systems, grid computing, heterogeneous platforms, high performance numerical computation, large-scale scientific computation, and bioinformatics applications.

The Linearization Method for Constrained Optimization - Boris N. Pshenichnyj 2012-12-06
Techniques of optimization are applied in many problems in economics, automatic control, engineering, etc. and a wealth of literature is devoted to this subject. The first computer applications involved linear programming problems with simp- le structure and comparatively uncomplicated nonlinear pro- blems: These could be solved readily with the computational power of existing machines, more than 20 years ago. Problems of increasing size and nonlinear complexity made it necessa- ry to develop a complete new arsenal of methods for obtai- ning numerical results in a reasonable time. The lineariza- tion method is one of the fruits of this research of the last 20 years. It is closely related to Newton's method for solving systems of linear equations, to penalty function me- thods and to methods of nondifferentiable optimization. It requires the efficient solution of quadratic programming problems and this leads to a connection with conjugate gra- dient methods and variable metrics. This book, written by one of the leading specialists of optimization theory, sets out to provide - for a wide readership including engineers, economists and optimization specialists, from graduate student level on - a brief yet quite complete exposition of this most effective method of solution of optimization problems.

From Sperner's Lemma to Differential Equations in Banach Spaces : An Introduction to Fixed Point Theorems and their Applications - Schaefer,

Uwe 2014-12-03

C++ Toolbox for Verified Computing I - Rolf Hammer 2011-12-14
Our aim in writing this book was to provide an extensive set of C++ programs for solving basic numerical problems with verification of the results. This C++ Toolbox for Verified Computing I is the C++ edition of the Numerical Toolbox for Verified Computing l. The programs of the original edition were written in PASCAL-XSC, a PASCAL eXtension for Scientific Computation. Since we published the first edition we have received many requests from readers and users of our tools for a version in C++. We take the view that C++ is growing in importance in the field of numeri cal computing. C++ includes C, but as a typed language and due to its modern concepts, it is superior to C. To obtain the degree of efficiency that PASCAL-XSC provides, we used the C-XSC library. C-XSC is a C++ class library for eXtended Scientific Computing. C++ and the C-XSC library are an adequate alternative to special XSC-Ianguages such as PASCAL-XSC or ACRITH-XSC. A shareware version of the C-XSC library and the sources of the toolbox programs are freely available via anonymous ftp or can be ordered against reimbursement of expenses. The programs of this book do not require a great deal of insight into the features of C++. Particularly, object oriented programming techniques are not required.

Informatics in Control, Automation and Robotics - Joaquim Filipe 2008-09-27
The present book includes a set of selected papers from the fourth "International Conference on Informatics in Control Automation and Robotics" (ICINCO 2007), held at the University of Angers, France, from 9 to 12 May 2007. The conference was organized in three simultaneous tracks: "Intelligent Control Systems and Optimization", "Robotics and Automation" and "Systems Modeling, Signal Processing and Control". The book is based on the same structure. ICINCO 2007 received 435 paper submissions, from more than 50 different countries in all continents. From these, after a blind review process, only 52 where accepted as full papers, of which 22 were selected for inclusion in this

book, based on the classifications provided by the Program Committee. The selected papers reflect the interdisciplinary nature of the conference. The diversity of topics is an important feature of this conference, enabling an overall perception of several important scientific and technological trends. These high quality standards will be maintained and reinforced at ICINCO 2008, to be held in Funchal, Madeira - Portugal, and in future editions of this conference. Furthermore, ICINCO 2007 included 3 plenary keynote lectures given by Dimitar Filev (Ford Motor Company), Patrick Millot (Université de Valenciennes) and Mark W. Spong (University of Illinois at Urbana-Champaign).

Mathematical Modeling and Optimization - Tony Hürlimann 2013-03-14

Computer-based mathematical modeling - the technique of representing and managing models in machine-readable form - is still in its infancy despite the many powerful mathematical software packages already available which can solve astonishingly complex and large models. On the one hand, using mathematical and logical notation, we can formulate models which cannot be solved by any computer in reasonable time - or which cannot even be solved by any method. On the other hand, we can solve certain classes of much larger models than we can practically handle and manipulate without heavy programming. This is especially true in operations research where it is common to solve models with many thousands of variables. Even today, there are no general modeling tools that accompany the whole modeling process from start to finish, that is to say, from model creation to report writing. This book proposes a framework for computer-based modeling. More precisely, it puts forward a modeling language as a kernel representation for mathematical models. It presents a general specification for modeling tools. The book does not expose any solution methods or algorithms which may be useful in solving models, neither is it a treatise on how to build them. No help is intended here for the modeler by giving practical modeling exercises, although several models will be presented in order to illustrate the framework. Nevertheless, a short introduction to the

modeling process is given in order to expound the necessary background for the proposed modeling framework.

Beyond Traditional Probabilistic Data Processing Techniques: Interval, Fuzzy etc. Methods and Their Applications - Olga Kosheleva 2020-02-28
Data processing has become essential to modern civilization. The original data for this processing comes from measurements or from experts, and both sources are subject to uncertainty. Traditionally, probabilistic methods have been used to process uncertainty. However, in many practical situations, we do not know the corresponding probabilities: in measurements, we often only know the upper bound on the measurement errors; this is known as interval uncertainty. In turn, expert estimates often include imprecise (fuzzy) words from natural language such as "small"; this is known as fuzzy uncertainty. In this book, leading specialists on interval, fuzzy, probabilistic uncertainty and their combination describe state-of-the-art developments in their research areas. Accordingly, the book offers a valuable guide for researchers and practitioners interested in data processing under uncertainty, and an introduction to the latest trends and techniques in this area, suitable for graduate students.

Applied Parallel Computing - Bo Kagström 2007-09-22
This book constitutes the thoroughly refereed post-proceedings of the 8th International Workshop on Applied Parallel Computing, PARA 2006. It covers partial differential equations, parallel scientific computing algorithms, linear algebra, simulation environments, algorithms and applications for blue gene/L, scientific computing tools and applications, parallel search algorithms, peer-to-peer computing, mobility and security, algorithms for single-chip multiprocessors.

C++ Toolbox for Verified Computing I - Rolf Hammer 2012-12-06
Our aim in writing this book was to provide an extensive set of C++ programs for solving basic numerical problems with verification of the results. This C++ Toolbox for Verified Computing I is the C++ edition of the Numerical Toolbox for Verified Computing l. The programs of the original edition were written in PASCAL-XSC, a PASCAL eXtension for Scientific Computation. Since we published the first edition we have

received many requests from readers and users of our tools for a version in C++. We take the view that C++ is growing in importance in the field of numeri cal computing. C++ includes C, but as a typed language and due to its modern concepts, it is superior to C. To obtain the degree of efficiency that PASCAL-XSC provides, we used the C-XSC library. C-XSC is a C++ class library for eXtended Scientific Computing. C++ and the C-XSC library are an adequate alternative to special XSC-Ianguages such as PASCAL-XSC or ACRITH-XSC. A shareware version of the C-XSC library and the sources of the toolbox programs are freely available via anonymous ftp or can be ordered against reimbursement of expenses. The programs of this book do not require a great deal of insight into the features of C++. Particularly, object oriented programming techniques are not required.

Differential and Difference Equations with Applications - Sandra Pinelas 2018-05-08
This book gathers papers from the International Conference on Differential & Difference Equations and Applications 2017 (ICDDEA 2017), held in Lisbon, Portugal on June 5-9, 2017. The editors have compiled the strongest research presented at the conference, providing readers with valuable insights into new trends in the field, as well as applications and high-level survey results. The goal of the ICDDEA was to promote fruitful collaborations between researchers in the fields of differential and difference equations. All areas of differential and difference equations are represented, with a special emphasis on applications.

Reliable Implementation of Real Number Algorithms: Theory and Practice - Peter Hertling 2008-08-06
A large amount of the capacity of today's computers is used for computations that can be described as computations involving real numbers. In this book, the focus is on a problem arising particularly in real number computations: the problem of veri?edor reliablecomputations. Since real numbersare objects c- taining an in?nite amount of information, they cannot be represented precisely on a computer. This leads to the well-known problems caused by unveri?ed -

plementations of real number algorithms using ?nite precision. While this is t- ditionally seen to be a problem in numerical mathematics, there are also several scienti?c communities in computer science that are dealing with this problem. This book is a follow-up of the Dagstuhl Seminar 06021 on "Reliable Imp- mentation of Real Number Algorithms: Theory and Practice," which took place January 8–13, 2006. It was intended to stimulate an exchange of ideas between the di?erent communities that deal with the problem of reliable implementation of real number algorithms either from a theoretical or from a practical point of view. Forty-eight researchers from many di?erent countries and many di?erent disciplines gathered in the castle of Dagstuhl to exchange views and ideas, in a relaxed atmosphere. The program consisted of 35 talks of 30 minutes each, and of three evening sessions with additional presentations and discussions. There were also lively discussions about di?erent theoretical models and practical - proaches for reliable real number computations.

Numerical Toolbox for Verified Computing I - Rolf Hammer 2012-12-06
As suggested by the title of this book Numerical Toolbox for Verified Computing, we present an extensive set of sophisticated tools to solve basic numerical problems with a verification of the results. We use the features of the scientific computer language PASCAL-XSC to offer modules that can be combined by the reader to his/her individual needs. Our overriding concern is reliability - the automatic verification of the result a computer returns for a given problem. All algorithms we present are influenced by this central concern. We must point out that there is no relationship between our methods of numerical result verification and the methods of program verification to prove the correctness of an imple~entation for a given algorithm. This book is the first to offer a general discussion on • arithmetic and computational reliability, • analytical mathematics and verification techniques, • algorithms, and • (most importantly) actual implementations in the form of working computer routines. Our task has been to find the right balance among these ingredients for each topic. For some topics, we have placed a little

more emphasis on the algorithms. For other topics, where the mathematical prerequisites are universally held, we have tended towards more in-depth discussion of the nature of the computational algorithms, or towards practical questions of implementation. For all topics, we present exam ples, exercises, and numerical results demonstrating the application of the routines presented.

Analysis of Charge Transport - Joseph W. Jerome 2012-12-06
This book addresses the mathematical aspects of semiconductor modeling, with particular attention focused on the drift-diffusion model. The aim is to provide a rigorous basis for those models which are actually employed in practice, and to analyze the approximation properties of discretization procedures. The book is intended for applied and computational mathematicians, and for mathematically literate engineers, who wish to gain an understanding of the mathematical framework that is pertinent to device modeling. The latter audience will welcome the introduction of hydrodynamic and energy transport models in Chap. 3. Solutions of the nonlinear steady-state systems are analyzed as the fixed points of a mapping T, or better, a family of such mappings, distinguished by system decoupling. Significant attention is paid to questions related to the mathematical properties of this mapping, termed the Gummel map. Compu tational aspects of this fixed point mapping for analysis of discretizations are discussed as well. We present a novel nonlinear approximation theory, termed the Kras nosel'skii operator calculus, which we develop in Chap. 6 as an appropriate extension of the Babuska-Aziz inf-sup linear saddle point theory. It is shown in Chap. 5 how this applies to the semiconductor model. We also present in Chap. 4 a thorough study of various realizations of the Gummel map, which includes non-uniformly elliptic systems and variational inequalities. In Chap.

Numerical Software with Result Verification - René Alt 2004-02-12
Reliable computing techniques are essential if the validity of the output of a - merical algorithm is to be guaranteed to be correct. Our society relies more and more on computer systems. Usually, our systems appear to work successfully, but there are sometimes serious, and often minor, errors. Validated computing is one essential technology to achieve increased software reliability. Formal - gor in the de?nition of data types, the computer arithmetic, in algorithm design, and in program execution allows us to guarantee that the stated problem has (or does not have) a solution in an enclosing interval we compute. If the enclosure is narrow, we are certain that the result can be used. Otherwise, we have a clear warning that the uncertainty of input values might be large and the algorithm and the model have to be improved. The use of interval data types and al- rithms with controlled rounding and result veri?cation capture uncertainty in modeling and problem formulation, in model parameter estimation, in algorithm truncation, in operation round-o?, and in model interpretation. The techniques of validated computing have proven their merits in many scienti?c and engineering applications. They are based on solid and interesting theoretical studies in mathematics and computer science. Contributions from ?elds including real, complex and functional analysis, semigroups, probability, statistics,fuzzyintervalanalysis,fuzzylogic,automaticdi?erentiation,comput er hardware, operating systems, compiler construction, programming languages, object-oriented modeling, parallel processing, and software engineering are all essential.