René Alt Andreas Frommer R. Baker Kearfott Wolfram Luther (Eds.)

# Numerical Software with Result Verification

International Dagstuhl Seminar Dagstuhl Castle, Germany, January 2003 Revised Papers



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# **Numerical Software With Result Verification**

Maria Christakis, Nadia Polikarpova, Parasara Sridhar Duggirala, Peter Schrammel

#### **Numerical Software With Result Verification:**

Numerical Software with Result Verification René Alt, Andreas Frommer, R. Baker Kearfott, Wolfram Luther, 2004-02-12 Reliable computing techniques are essential if the validity of the output of a merical algorithm is to be quaranteed 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 all 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 computer hardware operating systems compiler construction programming languages object oriented modeling parallel processing and software engineering are all essential Numerical Software Verification Alessandro Abate, Sylvie Boldo, 2017-07-11 This book constitutes the proceedings of the 10th International Workshop on Numerical Software Verification NSV 2017 held in Heidelberg Germany in July 2017 colocated with the International Workshop on Formal Methods for Rigorous Systems Engineering of Cyber Physical Systems RISE4CPS 2017 a one time invited only event The 3 full papers presented together with 3 short papers 2 keynote abstracts and 4 invited abstracts were carefully reviewed and selected from numerous submissions The NSV 2017 workshop is dedicated to the development of logical and mathematical techniques for the reasoning about programmability and reliability Numerical Software with Result Verification René Alt, Andreas Frommer, R. Baker Kearfott, 2014-01-15 Numerical Software Verification Majid Zamani, Damien Zufferey, 2019-08-02 This book constitutes the proceedings of the 12th International Workshop on Numerical Software Verification NSV 2019 held in New York City NY USA in July 2019 colocated with the International Conference on Computer Aided Verification CAV 2019 The 5 full papers presented together with 2 short papers 3 abstracts of invited talks and 2 tutorial papers were carefully reviewed and selected from numerous submissions The NSV 2017 workshop is dedicated to the development of logical and mathematical techniques for the reasoning about programmability and reliability **Numerical Validation in Current** Hardware Architectures Annie A.M. Cuyt, Walter Krämer, Wolfram Luther, Peter Markstein, 2009-04-28 This book constitutes the thoroughly referred post proceedings of the Dagstuhl Seminar 08021 on Numerical Validation in Current

Hardware Architectures held at Dagstuhl Castle Germany in January 2008 The 16 revised full papers presented were selected during two rounds of reviewing and improvements The papers are organized in topical sections on languages software systems and tools new verification techniques based on interval arithmetic applications in science and engineering and novel approaches to verification Quality of Numerical Software Ronald F. Boisvert, 2016-01-09 Numerical software is central to our computerized society It is used to control aeroplanes and bridges operate manufacturing lines control power plants and refineries and analyse financial markets Such software must be accurate reliable robust efficient easy to use maintainable and adaptable Quality assessment and control of numerical software is still not well understood Although measurement is a key element it remains difficult to assess many components of software quality and to evaluate the trade offs between them Fortunately as numerical software is built upon a long established foundation of mathematical and computational knowledge there is great potential for dramatic breakthroughs This volume will address enabling techniques and tools such as benchmarks testing methodologies quality standards metrics and accuracy control mechanisms and their application to software for differential equations linear algebra data analysis as well as the evaluation of integrals derivatives and elementary and special functions Software Verification Maria Christakis, Nadia Polikarpova, Parasara Sridhar Duggirala, Peter Schrammel, 2020-12-05 This book constitutes the refereed proceedings of the 12th International Conference on Verified Software VSTTE 2020 and the 13th International Workshop on Numerical Software Verification NSV 2020 held in Los Angeles CA USA in July 2020 Due to COVID 19 pandemic the conference was held virtually The 13 papers presented in this volume were carefully reviewed and selected from 21 submissions. The papers describe large scale verification efforts that involve collaboration theory unification tool integration and formalized domain knowledge as well as novel experiments and case studies evaluating verification techniques and technologies. The conference was co located with the 32nd International Conference on Computer Aided Verification CAV 2020 Modeling, Design, and Simulation of Systems with Uncertainties Andreas Rauh, Ekaterina Auer, 2011-06-06 To describe the true behavior of most real world systems with sufficient accuracy engineers have to overcome difficulties arising from their lack of knowledge about certain parts of a process or from the impossibility of characterizing it with absolute certainty Depending on the application at hand uncertainties in modeling and measurements can be represented in different ways For example bounded uncertainties can be described by intervals affine forms or general polynomial enclosures such as Taylor models whereas stochastic uncertainties can be characterized in the form of a distribution described for example by the mean value the standard deviation and higher order moments The goal of this Special Volume on Modeling Design and Simulation of Systems with Uncertainties is to cover modern methods for dealing with the challenges presented by imprecise or unavailable information All contributions tackle the topic from the point of view of control state and parameter estimation optimization and simulation Thematically this volume can be divided into two parts In the first we present works highlighting the theoretic background and current

research on algorithmic approaches in the field of uncertainty handling together with their reliable software implementation The second part is concerned with real life application scenarios from various areas including but not limited to mechatronics robotics and biomedical engineering 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 Guide to Software Verification with Frama-C Nikolai Kosmatov, Virgile Prevosto, Julien Signoles, 2024-07-09 Frama C is a popular open source toolset for analysis and verification of C programs largely used for teaching experimental research and industrial applications With the growing complexity and ubiquity of modern software there is increasing interest in code analysis tools at various levels of formalization to ensure safety and security of software products Acknowledging the fact that no single technique will ever be able to fit all software verification needs the Frama C platform features a wide set of plug ins that can be used or combined for solving specific verification tasks This guidebook presents a large panorama of basic usages research results and concrete applications of Frama C since the very first open source release of the platform in 2008 It covers the ACSL specification language core verification plug ins advanced analyses and their combinations key ingredients for developing new plug ins as well as successful industrial case studies in which Frama C has helped engineers verify crucial safety or security properties Topics and features Gentle example based introduction to software specification and verification Wide panorama of state of the art specification and analysis techniques Step by step guide to develop your own tailor made analysis on top of the platform Inspiring success stories of Frama C deployment on industrial code More than 15 years of R D on analysis and verification of C code This book is firmly rooted on the practice of software analysis with numerous examples exercises and application guidelines As such it is particularly well suited for software verification practitioners wishing to deploy verification on their code as well as for undergraduate students with little or no experience in code analysis techniques More advanced sections on the theoretical underpinnings of the analyzers will be of interest for graduate students and researchers Nikolai Kosmatov is a Senior Researcher at Thales Research Technology France Virgile Prevosto is

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