

*Commenced Publication in 1973*

Founding and Former Series Editors:

Gerhard Goos, Juris Hartmanis, and Jan van Leeuwen

Editorial Board

David Hutchison

*Lancaster University, UK*

Takeo Kanade

*Carnegie Mellon University, Pittsburgh, PA, USA*

Josef Kittler

*University of Surrey, Guildford, UK*

Jon M. Kleinberg

*Cornell University, Ithaca, NY, USA*

Friedemann Mattern

*ETH Zurich, Switzerland*

John C. Mitchell

*Stanford University, CA, USA*

Moni Naor

*Weizmann Institute of Science, Rehovot, Israel*

Oscar Nierstrasz

*University of Bern, Switzerland*

C. Pandu Rangan

*Indian Institute of Technology, Madras, India*

Bernhard Steffen

*University of Dortmund, Germany*

Madhu Sudan

*Massachusetts Institute of Technology, MA, USA*

Demetri Terzopoulos

*University of California, Los Angeles, CA, USA*

Doug Tygar

*University of California, Berkeley, CA, USA*

Moshe Y. Vardi

*Rice University, Houston, TX, USA*

Gerhard Weikum

*Max-Planck Institute of Computer Science, Saarbruecken, Germany*

Victor G. Ganzha Ernst W. Mayr  
Evgenii V. Vorozhtsov (Eds.)

# Computer Algebra in Scientific Computing

10th International Workshop, CASC 2007  
Bonn, Germany, September 16-20, 2007  
Proceedings

Volume Editors

Victor G. Ganzha  
Ernst W. Mayr  
Technische Universität München  
Institut für Informatik  
Garching, Germany  
E-mail: {ganzha,mayr}@in.tum.de

Evgenii V. Vorozhtsov  
Russian Academy of Sciences  
Institute of Theoretical and Applied Mechanics  
Novosibirsk, Russia  
E-mail: vorozh@itam.nsc.ru

Library of Congress Control Number: 2007934978

CR Subject Classification (1998): I.2, F.2.1-2, G.1, I.3.5, I.2

LNCS Sublibrary: SL 1 – Theoretical Computer Science and General Issues

ISSN 0302-9743  
ISBN-10 3-540-75186-6 Springer Berlin Heidelberg New York  
ISBN-13 978-3-540-75186-1 Springer Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer. Violations are liable to prosecution under the German Copyright Law.

Springer is a part of Springer Science+Business Media

[springer.com](http://springer.com)

© Springer-Verlag Berlin Heidelberg 2007  
Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India  
Printed on acid-free paper SPIN: 12163083 06/3180 5 4 3 2 1 0

Dedicated to  
Prof. Vladimir P. Gerdt  
on the occasion of his 60th birthday



# Preface

The outstanding feature of this CASC Workshop is that this is the tenth workshop in the series started in 1998. The general idea of this workshop was to bring together people working in the areas of computer algebra systems (CASs), computer algebra methods and algorithms, and various CA applications in natural sciences and engineering.

The nine earlier CASC conferences, CASC 1998, CASC 1999, CASC 2000, CASC 2001, CASC 2002, CASC 2003, CASC 2004, CASC 2005, and CASC 2006, were held, respectively, in St. Petersburg, Russia, in Munich, Germany, in Samarkand, Uzbekistan, in Konstanz, Germany, in Crimea, Ukraine, in Passau, Germany, in St. Petersburg, Russia, in Kalamata, Greece, and in Chişinău, Moldova, and they proved to be successful.

Since 1998, the topics of papers published in the CASC proceedings accounted both for the development of new excellent computer algebra systems and for expanding the scopes of application of CA methods and techniques. The present volume of the proceedings of CASC 2007 continues this tradition. Among the traditional topics, there are studies in polynomial and matrix algebra, quantifier elimination, and Gröbner bases.

One of the fruitful areas of the application of CA methods and systems is the derivation of new analytic solutions to differential equations, and several papers deal with this topic.

The application of CASs to stability investigation of both differential equations and difference methods for them is also the subject of a number of papers.

Several papers are devoted to the application of computer algebra methods and algorithms to the derivation of new mathematical models in biology and in mathematical physics.

In addition to the accepted submissions, this volume also includes two invited papers. The paper by F. Winkler and E. Shemyakova (RISC, Linz) addresses the theme of extending the range of analytically solvable PDEs with the aid of symbolic and algebraic methods. The key technique used here is the factorization of a differential operator. The authors have introduced the notion of *obstacle* for the factorization of a differential operator, i.e., conditions preventing a given operator from being factorizable.

The other invited lecture, by S. Fritzsche (Max-Planck Institute for Nuclear Physics, Heidelberg), is devoted to the problem of exploring decoherence and entanglement phenomena in quantum information theory. The author presents his Maple-based FEYNMAN program, which was developed recently to support the investigation of the above phenomena. One of the applications presented is the atomic photoionization, where the author shows how the polarization can be transferred from the incoming photons to the emitted photoelectrons, giving

rise to a (spin-spin) entanglement between the photoelectron and the remaining (photo-)ion.

All the papers contained in this volume were accepted by the Program Committee after a thorough reviewing process.

The CASC 2007 workshop was supported financially by a generous grant from the Deutsche Forschungsgemeinschaft (DFG). Our particular thanks are due to the members of the CASC 2007 Local Organizing Committee at the University of Bonn: Andreas Weber (Computer Science Department) and Joachim von zur Gathen (B-IT), who ably handled local arrangements in Bonn. We are grateful to W. Meixner for his technical help in the preparation of the camera-ready manuscript for this volume.

July 2007

V.G. Ganzha  
E.W. Mayr  
E.V. Vorozhtsov

# Organization

CASC 2007 was organized jointly by the Department of Informatics at the Technische Universität München, Germany, the Department of Computer Security at the Bonn-Aachen International Center for Information Technology, Bonn, Germany and the Department of Computer Science, Universität Bonn, Germany.

## Workshop General Chairs

Vladimir Gerdt (JINR, Dubna)

Ernst W. Mayr (TU München)

## Program Committee

Alkis Akritas (Volos)

Gerd Baumann (Cairo)

Hans-Joachim Bungartz (Munich)

Andreas Dolzmann (Passau)

Victor Edneral (Moscow)

M'hammed El Kahoui (Marrakech)

Ioannis Emiris (Athens)

Victor Ganzha (Munich, Co-chair)

Evgenii Grebenikov (Moscow)

Jaime Gutierrez (Santander)

Robert Kragler (Weingarten)

Richard Liska (Prague)

Bernard Mourrain (Sophia Antipolis)

Eugenio Roanes-Lozano (Madrid)

Yosuke Sato (Tokyo)

Werner Seiler (Kassel)

Doru Stefanescu (Bucharest)

Stanly Steinberg (Albuquerque)

Serguei Tsarev (Krasnoyarsk)

Evgenii Vorozhtsov (Novosibirsk,  
Co-chair)

Andreas Weber (Bonn)

Song Yan (Coventry)

## Local Organizing Committee

Andreas Weber (Bonn)

Joachim von zur Gathen (Bonn)

## General Organizing Committee

Werner Meixner (Munich, Chair)

Annelies Schmidt (Munich, Secretary)

## Electronic Address

WWW site: <http://wwwmayr.in.tum.de/CASC2007>

# Table of Contents

Analytic Solutions of Linear Difference Equations, Formal Series, and Bottom Summation . . . . .	1
<i>S.A. Abramov and M. Petkovšek</i>	
Computations in Modules over Commutative Domains . . . . .	11
<i>Alkiviadis G. Akritas and Gennadi I. Malaschonok</i>	
Advances on the Continued Fractions Method Using Better Estimations of Positive Root Bounds . . . . .	24
<i>Alkiviadis G. Akritas, Adam W. Strzeboński, and Panagiotis S. Vigklas</i>	
An Efficient LLL Gram Using Buffered Transformations . . . . .	31
<i>Werner Backes and Susanne Wetzel</i>	
On the Computation of $A_\infty$ -Maps . . . . .	45
<i>Ainhoa Berciano, María José Jiménez, and Pedro Real</i>	
Algebraic Visualization of Relations Using RELVIEW . . . . .	58
<i>Rudolf Berghammer and Gunther Schmidt</i>	
Comprehensive Triangular Decomposition . . . . .	73
<i>Changbo Chen, Oleg Golubitsky, François Lemaire, Marc Moreno Maza, and Wei Pan</i>	
Stability Investigation of a Difference Scheme for Incompressible Navier-Stokes Equations . . . . .	102
<i>Dmytro Chibisov, Victor Ganzha, Ernst W. Mayr, and Evgenii V. Vorozhtsov</i>	
A Symbolic-Numerical Algorithm for Solving the Eigenvalue Problem for a Hydrogen Atom in the Magnetic Field: Cylindrical Coordinates . . . . .	118
<i>Ochbadrakh Chuluunbaatar, Alexander Gusev, Vladimir Gerdt, Michail Kaschiev, Vitaly Rostovtsev, Valentin Samoylov, Tatyana Tupikova, and Sergue Vinitzky</i>	
An Algorithm for Construction of Normal Forms . . . . .	134
<i>Victor F. Edneral</i>	
Computer Algebra: A ‘Classical’ Path to Explore Decoherence and Entanglement Phenomena in Quantum Information Theory (Abstract) . . . . .	143
<i>Stephan Fritzsche</i>	



Deducing the Constraints in the Light-Cone $SU(3)$ Yang-Mills Mechanics Via Gröbner Bases .....	145
<i>Vladimir Gerdt, Arsen Khvedelidze, and Yuri Paliı</i>	
On the Weight Spectra of Conway Matrices Related to the Non-transitive Head-or-Tail Game.....	160
<i>Nikita Gogin and Aleksandr Mylläri</i>	
Properties of the Liapunov Stability Zones of the Lagrange Triangle ....	169
<i>E.A. Grebenikov, D. Kozak-Skoworodkin, and N.I. Zemtsova</i>	
Studying the Stability of the Second Order Non-autonomous Hamiltonian System.....	181
<i>Evgenii A. Grebenikov, Ersain V. Ikhsanov, and Alexander N. Prokopenya</i>	
On the Peculiar Properties of Families of Invariant Manifolds of Conservative Systems.....	195
<i>Valentin Irtegov and Tatyana Titorenko</i>	
A Unified Algorithm for Multivariate Analytic Factorization.....	211
<i>Maki Iwami</i>	
On the Computation of the Defining Polynomial of the Algebraic Riccati Equation .....	224
<i>Takuya Kitamoto and Tetsu Yamaguchi</i>	
Symmetries and Dynamics of Discrete Systems .....	236
<i>Vladimir V. Korniyak</i>	
Exact Solutions of Completely Integrable Systems and Linear ODE's Having Elliptic Function Coefficients .....	252
<i>N.A. Kostov and Z.T. Kostova</i>	
Dynamics of Nonlinear Parabolic Equations with Cosymmetry .....	265
<i>Ekaterina S. Kovaleva, Vyacheslav G. Tsybulin, and Kurt Frischmuth</i>	
Weak Integer Quantifier Elimination Beyond the Linear Case.....	275
<i>Aless Lasaruk and Thomas Sturm</i>	
Polynomial Division Using Dynamic Arrays, Heaps, and Packed Exponent Vectors .....	295
<i>Michael Monagan and Roman Pearce</i>	
Ruppert Matrix as Subresultant Mapping .....	316
<i>Kosaku Nagasaka</i>	
Construction of Computer System for Microobjects Recognition Based on Neural Networks .....	328
<i>Ulugbek Kh. Narzullaev, Akmal R. Akhatov, and Olim I. Jumanov</i>	

Analytical Solution for Transient Flow of a Generalized Bingham Fluid with Memory in a Movable Tube Using Computer Algebra . . . . .	339
<i>Juan Ospina and Mario Velez</i>	
Some Elimination Problems for Matrices . . . . .	350
<i>Wilhelm Plesken and Daniel Robertz</i>	
A Full System of Invariants for Third-Order Linear Partial Differential Operators in General Form . . . . .	360
<i>Ekaterina Shemyakova and Franz Winkler</i>	
Automatic Stability Analysis for a Diffusion Equation with Memories Using Maple . . . . .	370
<i>Daniel Esteban Sierra Sosa</i>	
Bounds for Real Roots and Applications to Orthogonal Polynomials . . . .	377
<i>Doru Ștefănescu</i>	
Distance Computation from an Ellipsoid to a Linear or a Quadric Surface in $\mathbb{R}^n$ . . . . .	392
<i>Alexei Yu. Uteshev and Marina V. Yashina</i>	
Robust Stability for Parametric Linear ODEs . . . . .	402
<i>Volker Weispfenning</i>	
Symbolic and Algebraic Methods for Linear Partial Differential Operators (Abstract) . . . . .	423
<i>Franz Winkler and Ekaterina Shemyakova</i>	
A New Scheme for Deniable/Repudiable Authentication . . . . .	424
<i>Song Y. Yan, Carsten Maple, and Glyn James</i>	
An Algebraic-Numeric Algorithm for the Model Selection in Kinetic Networks . . . . .	433
<i>Hiroshi Yoshida, Koji Nakagawa, Hirokazu Anai, and Katsuhisa Horimoto</i>	
On the Representation of the Differential Operator in Bases of Periodic Coiflets and It's Application . . . . .	448
<i>Anna Deytseva</i>	
<b>Author Index</b> . . . . .	459