Lecture Notes in Computer Science 6885

Commenced Publication in 1973
Founding and Former Series Editors:
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Computer Algebra in Scientific Computing

13th International Workshop, CASC 2011
Kassel, Germany, September 5-9, 2011
Proceedings

Springer

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ISSN 0302-9743 e-ISSN 1611-3349
ISBN 978-3-642-23567-2 e-ISBN 978-3-642-23568-9
DOI 10.1007/978-3-642-23568-9
Springer Heidelberg Dordrecht London New York

Library of Congress Control Number: 2011934868

CR Subject Classification (1998): I.1, G.2, I.3.5, F.2, G.1, F.2.2

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

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

It is hard to imagine the present-day progress in computer algebra and its applications to scientific computing without the numerous contributions of the German specialists in this area. In particular, research in the area of computer algebra and its applications has been actively conducted at the Institute of Mathematics of the University of Kassel (www.mathematik.uni-kassel.de) during the past 20 years. Thus, the educational use of computer algebra systems has been promoted via two book series for a calculus course by Wolfram Koepf and for a course on "Mathematics for Engineers" by Walter Strampp in the 1990s. Research topics vary from power series and summation (Wolfram Koepf), cryptography (Hans-Georg Rück), PDEs and commutative algebra (Werner Seiler), to integrable systems and symmetry (Walter Strampp). Numerous PhD and habilitation theses in the areas of non-commutative polynomial algorithms, algebraic algorithms for q-special functions, Fourier series, PDEs, differential Galois theory, polycyclic groups, number fields, and Tamagawa numbers have been developed by the Computational Mathematics group.

As spokesperson of the German computer algebra working group Fachgruppe Computeralgebra (www.fachgruppe-computeralgebra.de), Wolfram Koepf has organized several conferences in Kassel to give young academics the opportunity to present their research. The *Computeralgebra Rundbrief*, the biannual magazine of the Fachgruppe, has been edited for the last decade by Markus Wessler from Kassel. And for some years now, Werner Seiler and Wolfram Koepf have been offering special computer algebra courses for gifted high school students. Therefore, it should not surprising at all that CASC 2011, the 13th Workshop on Computer Algebra in Scientific Computing, took place in Kassel.

The twelve earlier CASC conferences, CASC 1998, CASC 1999, CASC 2000, CASC 2001, CASC 2002, CASC 2003, CASC 2004, CASC 2005, CASC 2006, CASC 2007, CASC 2009, and CASC 2010 were held, respectively, in St. Petersburg (Russia), in Munich (Germany), in Samarkand (Uzbekistan), in Konstanz (Germany), in Yalta (Ukraine), in Passau (Germany), in St. Petersburg (Russia), in Kalamata (Greece), in Chişinău (Moldova), in Bonn (Germany), in Kobe (Japan), and in Tsakhkadzor (Armenia), and they all proved to be very successful.

This volume contains twenty six full papers submitted to the workshop by the participants and accepted by the Program Committee after a thorough reviewing process, and two extended abstracts of the invited talks.

One of the traditional topics of the CASC workshops, which is a cornerstone of symbolic algebraic computation, polynomial algebra, is represented by contributions devoted to the development of object-oriented computer algebra software for the modeling of algebraic structures as typed objects, the methods of deciding whether a multivariate polynomial is regular (i.e., not a zero divisor) modulo regular differential chains, generation of a new involutive division by

antigraded monomial ordering, construction of irreducible polynomials over finite fields, divide-and-conquer algorithms for univariate polynomial arithmetic, and contributions to polynomial computations in non-commutative algebras.

Two papers deal with matrix algorithms: the knowledge-based automatic generation of partitioned matrix expressions and acceleration of the inversion of triangular Toeplitz matrices.

Several papers are devoted to the investigation with the aid of computer algebra of various topics related to the ordinary differential equations (ODEs): solution of boundary-value problems for ODEs with the aid of Maple, equilibrium and bifurcation analysis of the systems of autonomous ODEs, the determination of all Laurent-series solutions of a linear ODE system, investigation of a 2D system of ODEs by studying its polynomial ideals, finding a region of attraction to an equilibrium of a nonlinear ODE system.

One topic which is especially important for applications in scientific computing is the development of symbolic-numerical algorithms. This topic is represented by three papers. The first of them shows how one can apply a specialized symbolic-numeric cylindrical algebraic decomposition for computing the exact optimal value function. Another paper deals with the symbolic-numerical solution of the 2D Schrödinger equation to study the quantum tunneling problem for a coupled pair of ions. The third paper presents symbolic-numeric stability analysis of satellite dynamics under the influence of gravitational and aerodynamic forces.

Several papers deal with the application of symbolic computations in applied problems of physics, mechanics, social science, and engineering: the handling of complex nonlinear analog circuits with the aid of the *Mathematica* toolbox Analog Insydes 2011, the determination of the Hilbert-space metric rendering a given Hamiltonian self-adjoint in quantum mechanics, beams line design for solving the problems in the design of particle beam accelerators, modeling of convection in porous media in polar coordinates, the stability investigation of equilibrium position in the four-body problem of celestial mechanics, application of CAS GAP in quantum physics, the analysis of decision-making and coalition formation in social and political life using the CAS RelView, the application of CAS *Mathematica* for obtaining invariant manifolds of Lagrange systems, the use of quantifier elimination for studying some systems arising in the life sciences.

Our particular thanks are due to the CASC 2011 local Organizing Committee in Kassel, i.e., W.M. Seiler (University of Kassel), who has ably handled all the local arrangements in Kassel. Furthermore, we want to thank all the members of the Program Committee for their invaluable work. And last but not least we are extremely grateful to W. Meixner for his extensive help in the preparation of the camera-ready manuscript for this volume.

July 2011

V.P. Gerdt
W. Koepf
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Organization

CASC 2011 was organized jointly by the Department of Informatics at the Technische Universität München, Germany, and the Institute for Mathematics at Kassel, Germany.

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Local Organization

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Website

`http://wwwmayr.in.tum.de/CASC2011`

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