Preface

One of the main goals of the International Workshops on Computer Algebra in Scientific Computing, which started in 1998 and since then have been held annually, is to highlight cutting-edge advances in all major disciplines of Computer Algebra (CA). And the second goal of the CASC workshops is to bring together both the researchers in theoretical computer algebra and the engineers as well as other allied professionals applying CA tools for solving problems in industry and in various branches of scientific computing.

This year the 18th CASC conference was held in Bucharest (Romania). Computer Algebra is popular among scientists in Romania. Researchers from many institutions, such as the University of Bucharest, the Institute of Mathematics "Simion Stoilow" of the Romanian Academy, the West University of Timişoara, the University "Al. I. Cuza" of Iaşi, the Institute of Computing "Tiberiu Popoviciu" from Cluj-Napoca, the "Horia Hulubei" National Institute for Research and Development in Physics and Nuclear Engineering (Bucharest–Măgurele), and "Ovidius" University in Constanţa, are working on subjects such as numerical simulation using computer algebra systems, symbolic–numeric methods for polynomial equations and inequalities, algorithms and complexity in computer algebra, application of computer algebra to natural sciences and engineering, polynomial algebra, and real quantifier elimination. In Romania there are several international conferences on Computer Algebra and related topics such as the International Symposium on Symbolic and Numeric Algorithms for Scientific Computing, SYNASC, in Timişoara, or the series of conferences on commutative algebra and computer algebra held in Constanţa and Bucharest.

The above has affected the choice of Bucharest as a venue for the CASC 2016 workshop.

This volume contains 30 full papers submitted to the workshop by the participants and accepted by the Program Committee after a thorough reviewing process with usually three independent referee reports. Additionally, the volume includes two invited talks.

Polynomial algebra, which is at the core of computer algebra, is represented by contributions devoted to improved algorithms for computing the Janet and Pommaret bases, the dynamic Gröbner bases computation, the algorithmic computation of polynomial amoebas, refinement of the bound of Lagrange for the positive roots of univariate polynomials, computation of characteristic polynomials of matrices whose entries are integer coefficient bivariate polynomials, finding the multiple eigenvalues of a matrix dependent on a parameter, the application of a novel concept of a resolving decomposition for the effective construction of free resolutions, enhancing the extended Hensel construction with the aid of a Gröbner basis, a hybrid symbolic-numeric method for computing a Puiseux series expansion for every space curve that is a solution of a polynomial system, numerical computation of border curves of bi-parametric real polynomial systems, and the application of sparse interpolation in Hensel lifting and

pruning algorithms for pretropisms of Newton polytopes. Polynomial algebra also plays a central role in contributions concerned with elimination algorithms for sparse matrices over finite fields, new algorithms for computing sparse representations of systems of parametric rational fractions, and quadric arrangement in classifying rigid motions of a 3D digital image.

Several papers are devoted to using computer algebra for the investigation of various mathematical and applied topics related to ordinary differential equations (ODEs): application of the Julia package `Flows.jl` for the analysis of split-step time integrators of nonlinear evolution equations, the use of the CAS Maple 18 for the derivation of operator splitting methods for the numerical solution of evolution equations, and the complexity analysis of operator matrices transformations as applied to systems of linear ODEs.

Three papers deal with applications of symbolic and symbolic-numeric computations for investigating and solving partial differential equations (PDEs) and ODEs in mathematical physics and fluid mechanics: the construction of a closed form solution to the kinematic part of the Cosserat partial differential equations describing the mechanical behavior of elastic rods, symbolic-numeric solution with Maple of a second-order system of ODEs arising in the problem of multichannel scattering, and symbolic-numeric optimization of the preconditioners in a numerical solver for incompressible Navier–Stokes equations.

Applications of CASs in mechanics and physics are represented by the following themes: qualitative analysis of the general integrable case of the problem of motion of a rigid body in a double force field, investigation of the influence of aerodynamic forces on satellite equilibria with the aid of the Gröbner basis method, and generation of irreducible representations of the point symmetry groups in the rotor + shape vibrational space of a nuclear collective model in the intrinsic frame.

The first invited talk by Th. Hahn focuses on the application of computer algebra in high-energy physics, in particular, the *Mathematica* packages FeynArts and FormCalc. The second invited talk by C.S. Calude and D. Thompson deals with the problems of incompleteness and undecidability. These are important problems related to the foundations of mathematics. The authors discuss some challenges proof-assistants face in handling undecidable problems. Several example problems, including the automated proofs, are presented. The authors briefly describe the computer program Isabelle, which they use as the proof assistant.

CASC 2016 features for the first time a full blown Topical Session. In this fairly new feature of the CASC series, up to six talks around a common theme are invited. The authors have an extended page limit, but their submissions are refereed according to the same principles and with the same rigour as normal submissions. This time the topic was *Satisfiability Checking and Symbolic Computation (SC^2)* and the session also marks the beginning of a European FET-CSA project with the same title (see http://www.sc-square.org for more information about this project and its objectives). There is a large thematic overlap between the fields of satisfiability checking (traditionally more a subject in computer science) and of symbolic computation (nowadays mainly studied by mathematicians). However, the corresponding communities are fairly disjoint and each has its own conference series. The central goal of the SC^2 project consists of bridging this gap and of bringing together people from both sides.

Thus, the 2016 Topical Session intends to familiarize the CASC participants with the many interesting problems in this domain. It was well organised by E. Abraham, J. Davenport, P. Fontaine, and Th. Sturm and comprises five talks. One is a one-hour survey talk by D. Monniaux on satisfiability modulo theory. The other four talks concern the investigation of the complexity of cylindrical algebraic decomposition with respect to polynomial degree, efficient simplification techniques for special real quantifier elimination, the description of a new SAT + CAS verifier for combinatorial conjectures, and a generalized branch-and-bound approach in SAT modulo nonlinear integer arithmetic.

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