# Preface

The International Workshop on Computer Algebra in Scientific Computing (CASC) is a leading conference which provides the opportunity for all researchers from home and abroad to present their research results annually. CASC is the forum of excellence for the exploration of the frontiers in the field of computer algebra and its applications in scientific computing. It brings together scholars, engineers, and scientists from various disciplines including computer algebra. This workshop provides a platform for the delegates to exchange new ideas and application experiences, share research results, discuss existing issues and challenges, and explore international cooperation in cutting-edge technology face to face.

This year, the 19th CASC conference was held in Beijing (China). Study on computer algebra in China started with the work of Prof. Wen-Tsun Wu on automated geometry theorem proving and characteristic set methods for polynomial equation solving in the late 1970s. In 1990, the Research Center of Mathematics Mechanization (MMRC) was established in the Chinese Academy of Sciences, and the center runs a series of academic programs on computer algebra and related areas.

In particular, jointly with the Japanese Society for Symbolic and Algebraic Computation, the Asian Symposium on Computer Mathematics was started in 1995 and held every two years. MMRC also organized The International Symposium on Symbolic and Algebraic Computation (ISSAC) in 2005. Other major research groups include the Laboratory of Automated Reasoning at the Chongqing Branch of the Chinese Academy of Sciences led by Prof. Jingzhong Zhang, and the research group at Beihang University led by Prof. Dongming Wang. In 2007, the Computer Mathematics Society of China was established, and Prof. Xiao-Shan Gao was the founding president of the society. The society runs an annual conference with approximately 100–150 participants.

Prof. Xiao-Shan Gao has kindly agreed to be one of the General Chairs of the CASC 2017 workshop. This has affected the choice of Beijing as a venue for CASC 2017.

This volume contains 26 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 contributions corresponding to the invited talks.

Polynomial algebra, which is at the core of computer algebra, is represented by contributions devoted to the convergence conditions of interval Newton's method applied to the solution of a nonlinear system; certifying the simple real zeros of overdetermined polynomial systems with interval methods; decomposition of polynomial sets into lexicographic Gröbner bases and into normal triangular sets; computation of all the isolated solutions to a special class of polynomial systems with the aid of a special homotopy continuation method; computing real witness points of general polynomial systems with the aid of the penalty function based critical point approach; algorithms for zero-dimensional ideals using linear recurrent sequences;

finding quasihomogeneous isolated hypersurface singularities with the aid of an interface of the computer algebra system (CAS) POLYMAKE in the CAS SINGULAR; and full rank representation of real algebraic sets with applications in visualizing plane and space curves with singularities. Two papers deal with the problems arising in polynomial interpolation: one focussing on the optimal knots selection for spline interpolation in the case of sparse reduced data, and one focussing on sparse interpolation algorithms for black box univariate or multivariate polynomials whose coefficients are from a finite set.

The invited talk of Lihong Zhi is devoted to computing multiple zeros of polynomial systems. It shows how to compute the multiplicity structure of each multiple zero and the lower bound on the minimal distance between the multiple zero and other zeros of the system. The developed algorithms were implemented in the CAS Maple.

Several papers deal with using computer algebra for the investigation of various mathematical and applied topics related to ordinary differential equations (ODEs), focussing on, for example, the introduction of the concept of a Laurent Gröbner basis for the investigation of the Laurent (differential) polynomial systems, and the study of local integrability of an autonomous system of ODEs with the aid of an approach based on power geometry.

The invited talk by S. Abramov handles the problem of the solvability of linear systems of ordinary differential equations whose coefficients have the form of infinite formal power series. The problem is to decide whether the system has non-zero Laurent series, regular, or formal exponential-logarithmic solutions, and to find all such solutions if they exist. Maple-based procedures are presented for constructing local solutions.

Four 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, focussing on, for example, the symbolic-numeric integration of the dynamical Cosserat partial differential equations describing the mechanical behavior of elastic rods; the symbolic-numeric solution with Maple of the parametric self-adjoint 2D elliptic boundary-value problem with the aid of a high-accuracy finite element method; and a new symbolic-numeric preconditioned solver for incompressible Navier–Stokes equations using the integral form of collocation equations.

Applications of CASs in mechanics, physics, and biology are represented by the following themes: investigation of the asymptotic stability of a satellite with a gravitational stabilizer; satellite dynamics subject to damping torques; *Mathematica*-based analysis of the relative equilibria stability in a problem of celestial mechanics; stationary motions of the generalized Kowalewski gyrostat and their stability; and symbolic versus numerical computation and visualization of parameter regions for multistationarity of biological networks.

The remaining topics include the computation of some integer sequences in Maple; algorithms for computing the integer points of a polyhedron; a divide and conquer algorithm for sparse nonlinear interpolation; and normalization of indexed differentials based on function distance invariants.

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