

## From Combinatorics to Dynamical Systems

Journées de Calcul Formel, Strasbourg, March 22-23, 2002

Bearbeitet von  
Frederic Fauvet, Claude Mitschi

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# Preface

This volume presents the proceedings of the Conference “Journées de calcul formel en l’honneur de Jean Thomann”, which took place at IRMA in March 2002. This meeting was aimed at bringing together mathematicians working in various areas of Thomann’s interests, specifically in dynamical systems, computer algebra, and theoretical physics.

Jean Thomann was born on June 30, 1936, in Strasbourg. He received his mathematical education in Strasbourg where among his professors were Marcel Berger, Jean-Louis Koszul and René Thom. While a research engineer with the IN2P3, Institut National de Physique des Particules, he worked at the Institut de Recherche Nucléaire, at the Centre de Calcul du CNRS in Strasbourg, and at IRMA.

It is important to mention that the present volume has historical ties to the proceedings<sup>(1)</sup>, <sup>(2)</sup>, <sup>(3)</sup> of three pioneering workshops “Computer Algebra and Differential Equations” (CADE) held in Grenoble 1988, Cornell 1990, Luminy 1992. These proceedings have become standard references in the area, and as with these classical texts, this volume includes papers of both theoretical and applied nature.

The unifying theme of these proceedings is computer algebra. As for the organization of the material, the book begins with articles of combinatorial or algebraic nature, then proceeds to articles involving more analytical tools.

The book includes a foreword by Jean-Pierre Ramis (in French) followed by nine articles.

The first paper by M. Espie, J.-C. Novelli and G. Racinet is devoted to computations in certain graded Lie algebras related to multiple zeta values. Some of these computations have been implemented in computer algebra systems with an unexpected experimental result leading to a new conjecture. The next four articles study differential systems with irregular singularities from algebraic as well as analytic points of view. The article of E. Corel gives an algebraic and algorithmic treatment of formal exponents at an irregular singularity and provides new and effective methods for computing such exponents and exponential parts for solutions of linear differential systems. The article of J. L. Martins studies irregular meromorphic connections in higher dimensions based on the seminal work of C. Sabbah. Using essentially algebraic techniques, the author obtains results concerning the summability of solutions. The paper of M. A. Barkatou, F. Chyzak and M. Loday-Richaud describes and compares various algorithms concerning the rank reduction of differential systems. It is

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<sup>1</sup>*Computer Algebra and Differential Equations*, edited by E. Tournier, Academic Press, 1989

<sup>2</sup>*Differential Equations and Computer Algebra*, edited by M. F. Singer, Academic Press, 1991

<sup>3</sup>*Computer Algebra and Differential Equations*, London Math. Soc. Lecture Note Ser. 193, edited by E. Tournier, Cambridge University Press, 1994

intimately related to questions of classification of irregular connections and computations of differential Galois groups. The article of M. Canalis-Durand presents new formal and numerical algorithms providing estimates of the growth of coefficients for a certain type of divergent series which are ubiquitous in dynamical systems with irregular singularities, such as in Quantum Field Theory.

The next three papers contain effective calculations, formal and numerical, for dynamical systems arising from certain questions in physics. The article of D. Boucher and J.-A. Weil presents computations of non-integrability of Hamiltonian systems, based on the Morales-Ramis theorem in differential Galois theory. The paper of L. Brenig uses the Quasi Polynomial formalism and generalized Lotka–Volterra normal forms to obtain effective integrability for some dynamical systems, with interesting combinatorial consequences. The article of R. Conte, M. Musette and T.-L. Yee involves computations of Padé approximants related to concepts of analytic integrability of equations of physical significance with chaotic behaviour.

The article of J. Della Dora and M. Mirica-Ruse explains a new mathematical formalization of the recent concept of hybrid systems, with ideas and techniques from dynamical systems and automata theory.

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Strasbourg, September 2003

*Frédéric Fauvet and Claude Mitschi*