



INTERNATIONAL
CONGRESS OF
MATHEMATICIANS
MADRID 2006

VOLUME III

Invited Lectures

Marta Sanz-Solé
Javier Soria
Juan Luis Varona
Joan Verdera

Editors



European Mathematical Society

Contents

10 Ordinary differential equations and dynamical systems (continued)

Robert Ghrist

- Braids and differential equations 1

*Anton Gorodetski, Brian Hunt and Vadim Kaloshin**

- Newton interpolation polynomials, discretization method, and certain
prevalent properties in dynamical systems 27

Bryna Kra

- From combinatorics to ergodic theory and back again 57

Patrice Le Calvez

- From Brouwer theory to the study of homeomorphisms of surfaces 77

Michael Shub

- All, most, some differentiable dynamical systems 99

Anton Zorich

- Geodesics on flat surfaces 121

11 Partial differential equations

Stefano Bianchini

- Asymptotic behavior of smooth solutions for partially dissipative
hyperbolic systems and relaxation approximation 147

Patrick Gérard

- Nonlinear Schrödinger equations in inhomogeneous media:
wellposedness and illposedness of the Cauchy problem 157

François Golse

- The periodic Lorentz gas in the Boltzmann-Grad limit 183

Matthew J. Gursky

- Conformal invariants and nonlinear elliptic equations 203

Hitoshi Ishii

- Asymptotic solutions for large time of Hamilton–Jacobi equations 213

Mario Pulvirenti

- The weak-coupling limit of large classical and quantum systems 229

Ovidiu Savin

- Symmetry of entire solutions for a class of semilinear elliptic equations 257

Sylvia Serfaty

- Vortices in the Ginzburg–Landau model of superconductivity 267

*In case of several authors, invited speakers are marked with an asterisk.

| | |
|---|-----|
| <i>Neil S. Trudinger</i> | |
| Recent developments in elliptic partial differential equations of Monge–Ampère type | 291 |
| <i>Luis Vega</i> | |
| The initial value problem for nonlinear Schrödinger equations | 303 |
| <i>Juan J. L. Velázquez</i> | |
| Singular solutions of partial differential equations modelling chemotactic aggregation | 321 |

12 Mathematical physics

| | |
|--|-----|
| <i>Alberto S. Cattaneo</i> | |
| From topological field theory to deformation quantization and reduction | 339 |
| <i>Bernard Derrida</i> | |
| Matrix ansatz and large deviations of the density in exclusion processes | 367 |
| <i>Jean-Michel Maillet</i> | |
| Correlation functions of the XXZ Heisenberg spin chain: Bethe ansatz approach | 383 |
| <i>Marcos Mariño</i> | |
| Gromov–Witten invariants and topological strings: a progress report | 409 |
| <i>Igor Rodnianski</i> | |
| The Cauchy problem in General Relativity | 421 |
| <i>Christoph Schweigert*, Jürgen Fuchs, and Ingo Runkel</i> | |
| Categorification and correlation functions in conformal field theory | 443 |
| <i>Avy Soffer</i> | |
| Soliton dynamics and scattering | 459 |
| <i>Cédric Villani</i> | |
| Hypoocoercive diffusion operators | 473 |

13 Probability and statistics

| | |
|--|-----|
| <i>Anton Bovier</i> | |
| Metastability: a potential theoretic approach | 499 |
| <i>Raphaël Cerf</i> | |
| On Ising droplets | 519 |
| <i>Amir Dembo</i> | |
| Simple random covering, disconnection, late and favorite points | 535 |
| <i>Peter Donnelly</i> | |
| Modelling genes: mathematical and statistical challenges in genomics | 559 |
| <i>K. David Elworthy* and Xue-Mei Li</i> | |
| Geometric stochastic analysis on path spaces | 575 |

| | |
|--|-----|
| <i>Jianqing Fan* and Runze Li</i> | |
| Statistical challenges with high dimensionality: feature selection in knowledge discovery | 595 |
| <i>Alice Guionnet</i> | |
| Random matrices and enumeration of maps | 623 |
| <i>Steven P. Lalley</i> | |
| The weak/strong survival transition on trees and nonamenable graphs | 637 |
| <i>Yves Le Jan</i> | |
| New developments in stochastic dynamics | 649 |
| <i>Peter McCullagh* and Jie Yang</i> | |
| Stochastic classification models | 669 |
| <i>Andrei Okounkov</i> | |
| Random partitions and instanton counting | 687 |
| <i>Dominique Picard* and Gérard Kerkycharian</i> | |
| Estimation in inverse problems and second-generation wavelets | 713 |
| <i>Wendelin Werner</i> | |
| Conformal restriction properties | 741 |

14 Combinatorics

| | |
|--|-----|
| <i>Alexander Barvinok</i> | |
| The complexity of generating functions for integer points in polyhedra and beyond | 763 |
| <i>Mireille Bousquet-Mélou</i> | |
| Rational and algebraic series in combinatorial enumeration | 789 |
| <i>Jim Geelen, Bert Gerards*, and Geoff Whittle</i> | |
| Towards a structure theory for matrices and matroids | 827 |
| <i>Mark Haiman</i> | |
| Cherednik algebras, Macdonald polynomials and combinatorics | 843 |
| <i>Jeong Han Kim</i> | |
| Poisson cloning model for random graphs | 873 |
| <i>Tomasz Łuczak</i> | |
| Randomness and regularity | 899 |
| <i>Imre Z. Ruzsa</i> | |
| Additive combinatorics and geometry of numbers | 911 |
| <i>Francisco Santos</i> | |
| Geometric bistellar flips: the setting, the context and a construction | 931 |
| <i>Robin Thomas</i> | |
| A survey of Pfaffian orientations of graphs | 963 |

15 Mathematical aspects of computer science

| | |
|--|------|
| <i>Manindra Agrawal</i> | |
| Determinant versus permanent | 985 |
| <i>Alexander S. Holevo</i> | |
| The additivity problem in quantum information theory | 999 |
| <i>Jon Kleinberg</i> | |
| Complex networks and decentralized search algorithms | 1019 |
| <i>Omer Reingold</i> | |
| On expander graphs and connectivity in small space | 1045 |
| <i>Tim Roughgarden</i> | |
| Potential functions and the inefficiency of equilibria | 1071 |
| <i>Ronitt Rubinfeld</i> | |
| Sublinear time algorithms | 1095 |
| <i>Luca Trevisan</i> | |
| Pseudorandomness and combinatorial constructions | 1111 |

16 Numerical analysis and scientific computing

| | |
|--|------|
| <i>Pavel Bochev and Max Gunzburger*</i> | |
| Least-squares finite element methods | 1137 |
| <i>Zhiming Chen</i> | |
| A posteriori error analysis and adaptive methods for partial differential equations | 1163 |
| <i>Ricardo G. Durán</i> | |
| Error estimates for anisotropic finite elements and applications | 1181 |
| <i>Nira Dyn</i> | |
| Linear subdivision schemes for the refinement of geometric objects | 1201 |
| <i>Randall J. LeVeque</i> | |
| Wave propagation software, computational science, and reproducible research | 1227 |
| <i>Yvon Maday</i> | |
| Reduced basis method for the rapid and reliable solution of partial differential equations | 1255 |
| <i>Endre Süli</i> | |
| Finite element algorithms for transport-diffusion problems: stability, adaptivity, tractability | 1271 |

17 Control theory and optimization

| | |
|--|------|
| <i>Vivek S. Borkar</i> | |
| Ergodic control of diffusion processes | 1299 |

| | |
|--|------|
| <i>Stephen Boyd</i> | |
| Convex optimization of graph Laplacian eigenvalues | 1311 |
| <i>Oleg Yu. Emanouilov (Imanuvilov)</i> | |
| Controllability of evolution equations of fluid dynamics | 1321 |
| <i>Arjan van der Schaft</i> | |
| Port-Hamiltonian systems: an introductory survey | 1339 |
| <i>Olof J. Staffans</i> | |
| Passive linear discrete time-invariant systems | 1367 |
| <i>Enrique Zuazua</i> | |
| Control and numerical approximation of the wave and heat equations | 1389 |

18 Application of mathematics in the sciences

| | |
|---|------|
| <i>Russel E. Caflisch</i> | |
| Multiscale modeling for epitaxial growth | 1419 |
| <i>Emmanuel J. Candès</i> | |
| Compressive sampling | 1433 |
| <i>Vicent Caselles</i> | |
| Total variation based image denoising and restoration | 1453 |
| <i>Michael Griebel* and Jan Hamaekers</i> | |
| A wavelet based sparse grid method for the electronic Schrödinger equation | 1473 |
| <i>Claude Le Bris</i> | |
| Mathematical and numerical analysis for molecular simulation: accomplishments and challenges | 1507 |
| <i>Martin A. Nowak</i> | |
| Evolutionary dynamics of cooperation | 1523 |
| <i>David Nualart</i> | |
| Fractional Brownian motion: stochastic calculus and applications | 1541 |
| <i>Anders Szepessy</i> | |
| Atomistic and continuum models for phase change dynamics | 1563 |

19 Mathematics education and popularization of mathematics

| | |
|--|------|
| <i>Petar S. Kenderov</i> | |
| Competitions and mathematics education | 1583 |
| <i>Alan Siegel</i> | |
| Understanding and misunderstanding the Third International Mathematics and Science Study: what is at stake and why K-12 education studies matter | 1599 |
| <i>Ian Stewart</i> | |
| Mathematics, the media, and the public | 1631 |

| | |
|---|------|
| <i>Michèle Artigue, Ehud de Shalit, and Anthony Ralston</i> | |
| Panel A: Controversial issues in K-12 mathematical education | 1645 |
| <i>Lee Peng Yee, Jan de Lange, and William Schmidt</i> | |
| Panel B: What are PISA and TIMSS? What do they tell us? | 1663 |
| <i>Fr. Ben Nebres, Shiu-Yuen Cheng, Konrad Osterwalder, and Hung-Hsi Wu</i> | |
| Panel C: The role of mathematicians in K-12 mathematics education | 1673 |

20 History of mathematics

| | |
|---|------|
| <i>Leo Corry</i> | |
| On the origins of Hilbert's sixth problem: physics and the empiricist approach to axiomatization | 1697 |
| <i>Niccolò Guicciardini</i> | |
| Method versus calculus in Newton's criticisms of Descartes and Leibniz | 1719 |

Special activity

| | |
|--|------|
| <i>Sebastià Xambó Descamps, Hyman Bass, Gilda Bolaños Evia, Ruedi Seiler, and Mika Seppälä</i> | |
| e-learning mathematics | 1743 |
| Author index | 1769 |