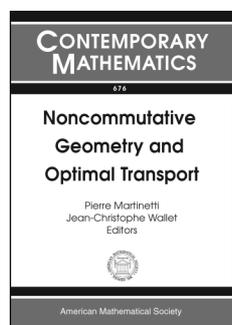


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## Algebra and Algebraic Geometry



### Noncommutative Geometry and Optimal Transport

**Pierre Martinetti**, *Università di Genova, Italy*, and **Jean-Christophe Wallet**, *CNRS, Université Paris-Sud 11, Orsay, France*, Editors

This volume contains the proceedings of the Workshop on Noncommutative

Geometry and Optimal Transport, held on November 27, 2014, in Besançon, France.

The distance formula in noncommutative geometry was introduced by Connes at the end of the 1980s. It is a generalization of Riemannian geodesic distance that makes sense in a noncommutative setting, and provides an original tool to study the geometry of the space of states on an algebra. It also has an intriguing echo in physics, for it yields a metric interpretation for the Higgs field. In the 1990s, Rieffel noticed that this distance is a noncommutative version of the Wasserstein distance of order 1 in the theory of optimal transport. More exactly, this is a noncommutative generalization of Kantorovich dual formula of the Wasserstein distance. Connes distance thus offers an unexpected connection between an ancient mathematical problem and the most recent discovery in high energy physics. The meaning of this connection is far from clear. Yet, Rieffel's observation suggests that Connes distance may provide an interesting starting point for a theory of optimal transport in noncommutative geometry.

This volume contains several review papers that will give the reader an extensive introduction to the metric aspect of noncommutative geometry and its possible interpretation as a Wasserstein distance on a quantum space, as well as several topic papers.

*This item will also be of interest to those working in mathematical physics.*

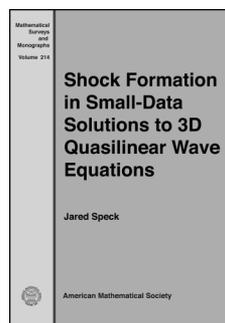
**Contents:** **P. Martinetti**, From Monge to Higgs: A survey of distance computations in noncommutative geometry; **F. Latrémolière**, Quantum metric spaces and the Gromov-Hausdorff propinquity; **M. Dubois-Violette**, Lectures on the classical moment problem and its noncommutative generalization; **N. Franco** and **J.-C. Wallet**, Metrics and causality on Moyal planes; **F. D'Andrea**, Pythagoras

theorem in noncommutative geometry; **M. Guillemard**, An overview of groupoid crossed products in dynamical systems.

**Contemporary Mathematics**, Volume 676

November 2016, 222 pages, Softcover, ISBN: 978-1-4704-2297-4, LC 2016017993, 2010 *Mathematics Subject Classification*: 00B25, 46L87, 58B34, 53C17, 46L60, **AMS members US\$86.40**, List US\$108, Order code CONM/676

## Differential Equations



### Shock Formation in Small-Data Solutions to 3D Quasilinear Wave Equations

**Jared Speck**, *Massachusetts Institute of Technology, Cambridge, MA*

In 1848 James Challis showed that smooth solutions to the compressible

Euler equations can become multivalued, thus signifying the onset of a shock singularity. Today it is known that, for many hyperbolic systems, such singularities often develop. However, most shock-formation results have been proved only in one spatial dimension. Serge Alinhac's groundbreaking work on wave equations in the late 1990s was the first to treat more than one spatial dimension. In 2007, for the compressible Euler equations in vorticity-free regions, Demetrios Christodoulou remarkably sharpened Alinhac's results and gave a complete description of shock formation.

In this monograph, Christodoulou's framework is extended to two classes of wave equations in three spatial dimensions. It is shown that if the nonlinear terms fail to satisfy the null condition, then for small data, shocks are the only possible singularities that can develop. Moreover, the author exhibits an open set of small data whose solutions form a shock, and he provides a sharp description of the blow-up. These results yield a sharp converse of the fundamental result of Christodoulou and Klainerman, who showed that small-data solutions are global when the null condition is satisfied.

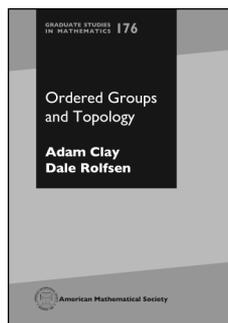
Readers who master the material will have acquired tools on the cutting edge of PDEs, fluid mechanics, hyperbolic conservation laws, wave equations, and geometric analysis.

**Contents:** Introduction; Overview of the two main theorems; Initial data, basic geometric constructions, and the future null condition failure factor; Transport equations for the Eikonal function quantities; Connection coefficients of the rescaled frames and geometric decompositions of the wave operator; Construction of the rotation vectorfields and their basic properties; Definition of the commutation vectorfields and deformation tensor calculations; Geometric operator commutator formulas and schematic notation for repeated differentiation; The structure of the wave equation inhomogeneous terms after one commutation; Energy and cone flux definitions and the fundamental divergence identities; Avoiding derivative loss and other difficulties via modified quantities; Small data, sup-norm bootstrap assumptions, and first pointwise estimates; Sharp estimates for the inverse foliation density; Square integral coerciveness and the fundamental square-integral-controlling quantities; Top-order pointwise commutator estimates involving the Eikonal function; Pointwise estimates for the easy error integrands and identification of the difficult error integrands corresponding to the commuted wave equation; Pointwise estimates for the difficult error integrands corresponding to the commuted wave equation; Elliptic estimates and Sobolev embedding on the spheres; Square integral estimates for the Eikonal function quantities that do not rely on modified quantities; A priori estimates for the fundamental square-integral-controlling quantities; Local well-posedness and continuation criteria; The sharp classical lifespan theorem; Proof of shock formation for nearly spherically symmetric data; Extension of the results to a class of non-covariant wave equations; Summary of notation and conventions; Bibliography; Index.

**Mathematical Surveys and Monographs**, Volume 214

December 2016, approximately 518 pages, Hardcover, ISBN: 978-1-4704-2857-0, LC 2016022109, 2010 *Mathematics Subject Classification*: 35L67; 35L05, 35L10, 35L72, 35Q31, 35L15, **AMS members US\$88**, List US\$110, Order code SURV/214

## Geometry and Topology



### Ordered Groups and Topology

**Adam Clay**, *University of Manitoba, Winnipeg, MB, Canada*, and **Dale Rolfsen**, *University of British Columbia, Vancouver, BC, Canada*

This book deals with the connections between topology and ordered groups. It begins with a self-contained introduction to orderable groups and from there explores

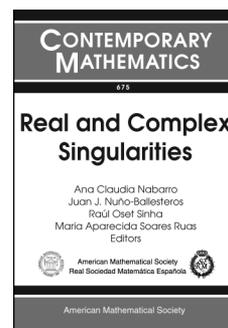
the interactions between orderability and objects in low-dimensional topology, such as knot theory, braid groups, and 3-manifolds, as well as groups of homeomorphisms and other topological structures. The book also addresses recent applications of orderability in the studies of codimension-one foliations and Heegaard-Floer homology. The use of topological methods in proving algebraic results is another feature of the book.

The book was written to serve both as a textbook for graduate students, containing many exercises, and as a reference for researchers in topology, algebra, and dynamical systems. A basic background in group theory and topology is the only prerequisite for the reader.

**Contents:** Orderable groups and their algebraic properties; Hölder's theorem, convex subgroups and dynamics; Free groups, surface groups and covering spaces; Knots; Three-dimensional manifolds; Foliations; Left-orderings of the braid groups; Groups of homeomorphisms; Conradian left-orderings and local indicability; Spaces of orderings; Bibliography; Index.

**Graduate Studies in Mathematics**, Volume 176

December 2016, 154 pages, Hardcover, ISBN: 978-1-4704-3106-8, LC 2016029680, 2010 *Mathematics Subject Classification*: 20-02, 57-02; 20F60, 57M07, **AMS members US\$63.20**, List US\$79, Order code GSM/176



### Real and Complex Singularities

**Ana Claudia Nabarro**, *Universidade de São Paulo, São Carlos, SP, Brazil*, **Juan J. Nuño-Ballesteros**, *Universitat de València, Burjassot, València, Spain*, **Raúl Oset Sinha**, *Universitat de València, Burjassot, València, Spain*, and **Maria Aparecida Soares Ruas**, *Universidade de São Paulo, São Carlos, SP, Brazil*, Editors

This volume is a collection of papers presented at the XIII International Workshop on Real and Complex Singularities, held from July 27–August 8, 2014, in São Carlos, Brazil, in honor of María del Carmen Romero Fuster's 60th birthday.

The volume contains the notes from two mini-courses taught during the workshop: on intersection homology by J.-P. Brasselet, and on non-isolated hypersurface singularities and Lê cycles by D. Massey. The remaining contributions are research articles which cover topics from the foundations of singularity theory (including classification theory and invariants) to topology of singular spaces (links of singularities and semi-algebraic sets), as well as applications to topology (cobordism and Lefschetz fibrations), dynamical systems (Morse-Bott functions) and differential geometry (affine geometry, Gauss-maps, caustics, frontals and non-Euclidean geometries).

**Contents:** **R. I. Baykur** and **K. Hayano**, Hurwitz equivalence for Lefschetz fibrations and their multisections; **R. R. Binotto**, **S. I. R. Costa**, and **M. C. Romero Fuster**, The curvature Veronese of a 3-manifold immersed in Euclidean space; **J.-P. Brasselet**, Introduction to intersection homology with and without sheaves; **D. Dreibelbis**, Gauss maps and duality of sphere bundles; **N. Dutertre** and **J. A. Moya-Pérez**, Topological formulas for closed semi-algebraic sets by Euler integration; **A. Honda**, On associate families of spacelike Delaunay surfaces; **S. Ichiki** and **T. Nishimura**, Generalized distance-squared mappings of  $\mathbb{R}^{n+1}$  into  $\mathbb{R}^{2n+1}$ ; **S. Izumiya**, Caustics of world hyper-sheets in the Minkowski space-time; **M. Kawashima**, On genericity of a linear deformation of an isolated singularity; **J. Martínez-Alfaro**, **I. S. Meza-Sarmiento**, and **R. Oliveira**, Topological classification of simple Morse Bott functions on surfaces; **R. Martins** and **J. J. Nuño-Ballesteros**, The link of a frontal surface

singularity; **D. B. Massey**, Non-isolated hypersurface singularities and Lê cycles; **R. Mendes** and **J. J. Nuño-Ballesteros**, Knots and the topology of singular surfaces in  $\mathbb{R}^4$ ; **A. J. Miranda** and **M. J. Saia**, A presentation matrix associated to the discriminant of a co-rank one map-germ from  $\mathbb{C}^n$  to  $\mathbb{C}^n$ ; **M. G. Monera** and **E. Sanabria-Codesal**, Critical points of the Gauss map and the exponential tangent map; **G. Reeve** and **F. Tari**, Minkowski medial axes and shocks of plane curves; **O. Saeki** and **T. Yamamoto**, Cobordism group of Morse functions on surfaces with boundary; **M. J. Saia** and **L. F. Sánchez**, Affine metric for locally strictly convex manifolds of codimension 2; **K. Saji**, Criteria for Morin singularities for maps into lower dimensions, and applications; **M. Takahashi**, Legendre curves in the unit spherical bundle over the unit sphere and evolutes.

**Contemporary Mathematics**, Volume 675

November 2016, approximately 359 pages, Softcover, ISBN: 978-1-4704-2205-9, LC 2016010844, 2010 *Mathematics Subject Classification*: 58Kxx, 32Sxx, 53Axx, 57Rxx, 14Pxx, 37Dxx, **AMS members US\$86.40**, List US\$108, Order code CONM/675

## New AMS-Distributed Publications

### Algebra and Algebraic Geometry

#### Development of Moduli Theory—Kyoto 2013

**Osamu Fujino**, *Osaka University, Japan*, **Shigeyuki Kondô**, *Nagoya University, Japan*, **Atsushi Moriwaki**, *Kyoto University, Japan*, **Masa-Hiko Saito**, *Kobe University, Japan*, and **Kôta Yoshioka**, *Kobe University, Japan*, Editors

This volume contains the proceedings of the 6th Mathematical Society of Japan Seasonal Institute—Development of Moduli Theory, which was held as the Seasonal Institute 2013, with support from the Mathematical Society of Japan and the 2013 Research Project of the Research Institute of Mathematical Science, Kyoto University.

This volume, dedicated to Shigeru Mukai on the occasion of his sixtieth birthday, consists of five survey articles and eight research articles.

*This item will also be of interest to those working in number theory.*

Published for the Mathematical Society of Japan by Kinokuniya, Tokyo, and distributed worldwide, except in Japan, by the AMS.

**Advanced Studies in Pure Mathematics**, Volume 69

July 2016, 537 pages, Hardcover, ISBN: 978-4-86497-032-7, 2010 *Mathematics Subject Classification*: 14-06; 11G50, 14C05, 14C22, 14C25, 14C30, 14D20, 14D21, 14D23, 14H10, 14H50, 14J10, 14J15, 14J26, 14J27, 14J28, 14J29, 14J50, 14J60, 14K10, 14K25, 14N35, 18E30, 32M15, 32N15, **AMS members US\$136.80**, List US\$171, Order code ASPM/69

## Analysis

### School on Real and Complex Singularities in São Carlos, 2012

**Raimundo Nonato Araújo dos Santos**, *Universidade de São Paulo, São Carlos, SP, Brazil*, **Victor Hugo Jorge Pérez**, *Universidade de São Paulo, São Carlos, SP, Brazil*, **Takashi Nishimura**, *Yokohama National University, Japan*, and **Osamu Saeki**, *Kyushu University, Fukuoka, Japan*, Editors

This volume is a collection of six lecture notes presented at the School on Singularity Theory, São Carlos, Brazil, July 16–21, 2012, or at the 12th International Workshop on Real and Complex Singularities, São Carlos, Brazil, July 22–27, 2012. Topics treated in the six lecture notes written by established authors cover a wide range, including topology and geometry of real singularities, singularities of holomorphic map-germs, singularities of complex algebraic sets, algorithms of the computer algebra "SINGULAR", singularities of maps and characteristic classes, and limit cycles of systems of ordinary differential equations.

Each lecture note is extremely well written with plenty of examples and may be considered excellent reading on the relevant topic. This book is suitable as a desktop reference and is widely recommended for graduate students studying singularity theory and researchers in various fields who would like to enjoy the world of singularities.

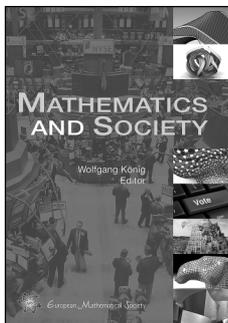
*This item will also be of interest to those working in algebra and algebraic geometry.*

Published for the Mathematical Society of Japan by Kinokuniya, Tokyo, and distributed worldwide, except in Japan, by the AMS.

**Advanced Studies in Pure Mathematics**, Volume 68

July 2016, 373 pages, Hardcover, ISBN: 978-4-86497-030-3, 2010 *Mathematics Subject Classification*: 32Sxx; 14Pxx, 14Bxx, 14Qxx, 57Rxx, 34Cxx, **AMS members US\$100.80**, List US\$126, Order code ASPM/68

## General Interest



### Mathematics and Society

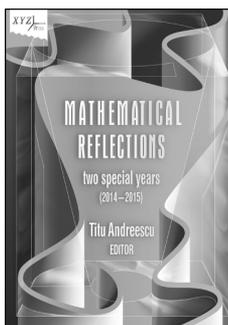
**Wolfgang König**, *Weierstrass Institute for Applied Analysis and Stochastics, Berlin, Germany, and Technical University of Berlin, Germany*, Editor

The ubiquity and importance of mathematics in our complex society is generally not in doubt. However, even a scientifically interested layperson would be hard pressed to point out aspects of our society where contemporary mathematical research is essential. The way mathematics comes into play in finance, engineering, weather and industry is widely unknown by the public. And who thinks of application fields such as biology, encryption, architecture, or voting systems?

This volume comprises a number of success stories of mathematics in our society—important areas being shaped by cutting-edge mathematical research. The authors are eminent mathematicians with a strong talent for public presentation, addressing scientifically interested laypersons as well as professionals in mathematics and its application disciplines.

July 2016, 314 pages, Hardcover, ISBN: 978-3-03719-164-4, 2010 *Mathematics Subject Classification*: 00-XX, **AMS members US\$38.40**, List US\$48, Order code EMSMATHSOC

## Math Education



### Mathematical Reflections: Two Special Years (2014–2015)

**Titu Andreescu**, *University of Texas at Dallas, TX*, Editor

This book, a compilation and revision of the 2014 and 2015 volumes from the online journal of the same name, is aimed at high school students, participants in math competitions, undergraduates, and anyone

who has a fire for mathematics. Passionate readers submitted many of the problems, solutions, and articles and all require creativity, experience, and comprehensive mathematical knowledge.

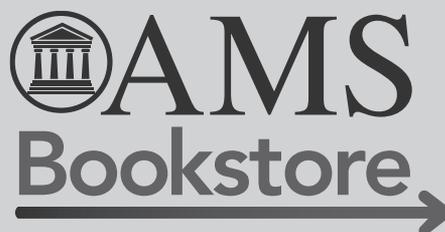
This book is a great resource for students training for advanced national and international mathematics competitions such as USAMO and IMO.

A publication of XYZ Press. Distributed in North America by the American Mathematical Society.

**XYZ Series**, Volume 20

June 2016, 583 pages, Hardcover, ISBN: 978-0-9968745-3-3, 2010 *Mathematics Subject Classification*: 00A05, 00A07, 97U40, 97D50, **AMS members US\$47.96**, List US\$59.95, Order code XYZ/20

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