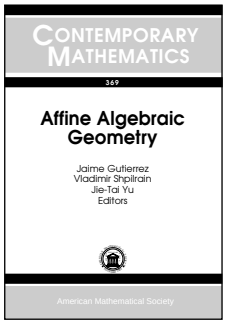
New Publications Offered by the AMS

Algebra and Algebraic Geometry



Affine Algebraic Geometry

Jaime Gutierrez, *University of Cantabria, Santander, Spain*, **Vladimir Shpilrain**, *City College of New York,* and **Jie-Tai Yu**, *University of Hong Kong,* Editors

A Special Session on affine and algebraic geometry took place at the first joint meeting between the American Mathematical Society (AMS) and the Real Sociedad Matemática Española (RSME) held in Seville (Spain). This volume contains articles by participating speakers at the Session.

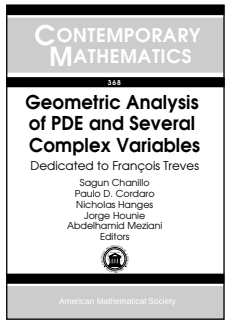
The book contains research and survey papers discussing recent progress on the Jacobian Conjecture and affine algebraic geometry and includes a large collection of open problems. It is suitable for graduate students and research mathematicians interested in algebraic geometry.

Contents: Open problems in affine algebraic geometry (collected by G. Freudenburg and P. Russell); **T. Asanuma**, Purely inseparable k-forms of affine algebraic curves; **T. Asanuma**, **S. M. Bhatwadekar**, and **N. Onoda**, Generic fibrations by A^1 and A^* over discrete valuation rings; **M. de Bondt** and **A. van den Essen**, Hesse and the Jacobian Conjecture; **P. Cassou-Noguès**, Bad field generators; **V. Drensky**, Coordinates in ideals of polynomial algebras; **H. Flenner** and **M. Zaidenberg**, On the uniqueness of $\mathbb{C}^*$-actions on affine surfaces; **T. Kambayashi** and **M. Miyanishi**, On two recent views of the Jacobian Conjecture; **T. Kishimoto**, Singularities on normal affine 3-folds containing $\mathbb{A}^1$-cylinderlike open subsets; **H. Kraft**, Free $\mathbb{C}^+$-actions on affine threefolds; **L. Makar-Limanov**, Again $x + x^2y + z^2 + t^3 = 0$; **K. Masuda** and **M. Miyanishi**, Equivariant cancellation for algebraic varieties; **R. Peretz**, Constructing polynomial mappings using non-commutative algebras; **T. Shaska** and **J. L. Thompson**, On the generic curve of genus 3; **I. E. Shparlinski**, Orders of points on elliptic curves; **V. Shpilrain** and **J.-T. Yu**, Test polynomials, retracts, and the Jacobian conjecture; **D. Wright**, The Jacobian Conjecture: ideal membership questions and recent advances.

Contemporary Mathematics, Volume 369

March 2005, 276 pages, Softcover, ISBN 0-8218-3476-2, LC 2004062382, 2000 *Mathematics Subject Classification*: 14Rxx, 14H50, 14J50, 14E05, 13P10, 12Y05, **All AMS members $63**, List $79, Order code CONM/369

Analysis



Geometric Analysis of PDE and Several Complex Variables

Dedicated to François Treves

Sagun Chanillo, *Rutgers University, Piscataway, NJ*, **Paulo D. Cordaro**, *Instituto de Matemática e Estatística, Universidade de São Paulo, IME-USP, Brazil*, **Nicholas Hanges**, *Herbert H. Lehman College, CUNY, Bronx, NY*, **Jorge Hounie**, *Universidade Federal de São Carlos, Brazil*, and **Abdelhamid Meziani**, *Florida International University, Miami*, Editors

This volume is dedicated to François Treves, who made substantial contributions to the geometric side of the theory of partial differential equations (PDEs) and several complex variables. One of his best-known contributions, reflected in many of the articles here, is the study of hypo-analytic structures.

An international group of well-known mathematicians contributed to the volume. Articles generally reflect the interaction of geometry and analysis that is typical of Treves's work, such as the study of the special types of

partial differential equations that arise in conjunction with CR-manifolds, symplectic geometry, or special families of vector fields. There are many topics in analysis and PDEs covered here, unified by their connections to geometry.

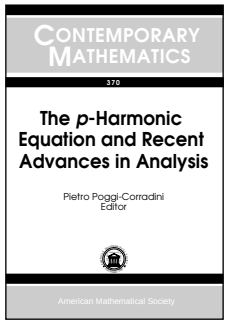
The material is suitable for graduate students and research mathematicians interested in geometric analysis of PDEs and several complex variables.

This item will also be of interest to those working in geometry and topology.

Contents: P. Ahern and **X. Gong**, Cusp-type singularities of real analytic curves in the complex plane; **S. Berhanu** and **J. Hounie**, The F. and M. Riesz property for vector fields; **A. Bove**, Gevrey hypo-ellipticity for sums of squares of vector fields: Some examples; **H. Brezis**, **P. Mironescu**, and **A. C. Ponce**, $W^{1,1}$-maps with values into S^1; **S. Chanillo**, Analytic hypoellipticity and spectral problems for Schrödinger's equation; **H. Chen** and **Z. Luo**, Formal solutions for higher order nonlinear totally characteristic PDEs with irregular singularities; **F. Colombini** and **N. Lerner**, Uniqueness of L^∞ solutions for a class of conormal BV vector fields; **P. D. Cordaro** and **N. Hanges**, Impact of lower order terms on a model pde in two variables; **M. Derridj** and **D. S. Tartakoff**, Global analytic hypoellipticity for a class of quasilinear sums of squares of vector fields; **M. Eastwood**, Representations via overdetermined systems; **G. Francsics** and **P. D. Lax**, A semi-explicit fundamental domain for a Picard modular group in complex hyperbolic space; **S. Gindikin**, Complex horospherical transform on real sphere; **J. Gorsky** and **A. A. Himonas**, On analyticity in space variable of solutions to the KdV equation; **L. Hörmander**, The multinomial distribution and some Bergman kernels; **X. Huang**, **S. Ji**, and **D. Xu**, Several results for holomorphic mappings from B^n into B^N; **H. Jacobowitz**, Whitney and Mizohata structures; **A. E. Kogoj** and **E. Lanconelli**, One-side Liouville theorems for a class of hypoelliptic ultraparabolic equations; **L. Lempert**, Acyclic sheaves in Banach spaces; **A. Li** and **Y. Y. Li**, A Liouville type theorem for some conformally invariant fully nonlinear equations; **S. T. Melo**, Norm closure of classical pseudodifferential operators does not contain Hörmander's class; **G. Métivier**, Remarks on the well-posedness of the nonlinear Cauchy problem; **A. Meziani**, Representation of solutions of planar elliptic vector fields with degeneracies; **L. Nirenberg**, Some recollections of working with François Treves; **M.-C. Shaw**, Boundary value problems on Lipschitz domains in $\mathbb{R}^n$ or $\mathbb{C}^n$; **S. Spagnolo**, Hyperbolic systems well posed in all Gevrey classes.

Contemporary Mathematics, Volume 368

March 2005, 414 pages, Softcover, ISBN 0-8218-3386-3, LC 2004055409, 2000 *Mathematics Subject Classification*: 35–XX, 32–XX, **All AMS members $87**, List $109, Order code CONM/368



The p-Harmonic Equation and Recent Advances in Analysis

Pietro Poggi-Corradini, *Kansas State University, Manhattan*, Editor

Comprised of papers from the IIIrd Prairie Analysis Seminar held at Kansas State University, this book reflects the many directions of current research in harmonic analysis and partial differential equations. Included is the work of the distinguished main speaker, Tadeusz Iwaniec, his invited guests John Lewis and Juan Manfredi, and many other leading researchers.

The main topic is the so-called p-harmonic equation, which is a family of nonlinear partial differential equations generalizing the usual Laplace equation. This study of p-harmonic equations touches upon many areas of analysis with deep relations to functional analysis, potential theory, and calculus of variations.

The material is suitable for graduate students and research mathematicians interested in harmonic analysis and partial differential equations.

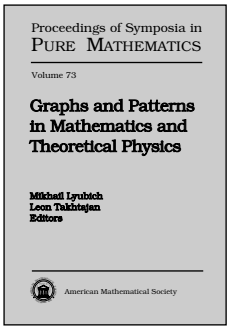
This item will also be of interest to those working in differential equations.

Contents: F. H. Beatrous, **T. J. Bieske**, and **J. J. Manfredi**, The maximum principle for vector fields; **I. Blank**, A partial classification of the blowups of the singularities in a composite membrane problem; **A. Domokos** and **J. J. Manfredi**, $C^{1,\alpha}$-regularity for p-harmonic functions in the Heisenberg group for p near 2; **L. D'Onofrio** and **T. Iwaniec**, Notes on p-harmonic analysis; **M. Foss**, A condition sufficient for the partial regularity of minimizers in two-dimensional nonlinear elasticity; **C. Frosini**, Dynamics on bounded domains; **K. E. Hare** and **A. M. Stokolos**, On the rate of tangential convergence of functions from Hardy spaces, $0 < p < 1$; **P. A. Hästö**, Counter-examples of regularity in variable exponent Sobolev spaces; **L. V. Kovalev** and **D. Opěla**, Quasiregular gradient mappings and strong solutions of elliptic equations; **R. S. Krausshar**, **Y. Qiao**, and **J. Ryan**, Harmonic, monogenic and hypermonogenic functions on some conformally flat manifolds in R^n arising from special arithmetic groups of the Vahlen group; **J. L. Lewis**, On symmetry and uniform rectifiability arising from some overdetermined elliptic and parabolic boundary conditions; **L. Forzani** and **D. Maldonado**, Recent progress on the Monge-Ampère equation; **J. Onninen**, Mappings of finite distortion: Future directions and problems; **M. Stawiska**, Riemann-Hurwitz formula and Morse theory.

Contemporary Mathematics, Volume 370

March 2005, 211 pages, Softcover, ISBN 0-8218-3610-2, LC 2004062294, 2000 *Mathematics Subject Classification*: 30–06, 31–06, 32–06, 35–06, 46–06, 47–06, **All AMS members $47**, List $59, Order code CONM/370

Mathematical Physics



Graphs and Patterns in Mathematics and Theoretical Physics

Mikhail Lyubich, *Stony Brook University, NY, and University of Toronto, ON, Canada*, and **Leon Takhtajan**, *Stony Brook University, NY*, Editors

The Stony Brook Conference, "Graphs and Patterns in Mathematics and Theoretical Physics", was dedicated to Dennis Sullivan in honor of his sixtieth birthday. The event's scientific content, which was suggested by Sullivan, was largely based on mini-courses and survey lectures. The main idea was to help researchers and graduate students in mathematics and theoretical physics who encounter graphs in their research to overcome conceptual barriers.

The collection begins with Sullivan's paper, "Sigma models and string topology," which describes a background algebraic structure for the sigma model based on algebraic topology and transversality. Other contributions to the volume were organized into five sections: Feynman Diagrams, Algebraic Structures, Manifolds: Invariants and Mirror Symmetry, Combinatorial Aspects of Dynamics, and Physics. These sections, along with more research-oriented articles, contain the following surveys: "Feynman diagrams for pedestrians and mathematicians" by M. Polyak, "Notes on universal algebra" by A. Voronov, "Unimodal maps and hierarchical models" by M. Yampolsky, and "Quantum geometry in action: big bang and black holes" by A. Ashtekar.

This comprehensive volume is suitable for graduate students and research mathematicians interested in graph theory and its applications in mathematics and physics.

This item will also be of interest to those working in discrete mathematics and combinatorics.

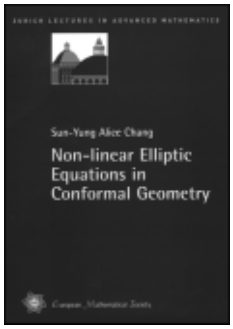
Contents: D. Sullivan, Sigma models and string topology; *Feynman diagrams:* **M. Polyak**, Feynman diagrams for pedestrians and mathematicians; **D. Kreimer**, Structures in Feynman graphs: Hopf algebras and symmetries; *Algebraic structures:* **A. A. Voronov**, Notes on universal algebra; **D. Tamarkin** and **B. Tsygan**, The ring of differential operators on forms in noncommutative calculus; **V. Gorbounov**, **F. Malikov**, and **V. Schechtman**, Twisted chiral de Rham algebras on $\mathbb{P}^1$; *Manifolds: Invariants and mirror symmetry:* **R. Kashaev** and **N. Reshetikhin**, Invariants of tangles with flat connections in their complements; **S. Garoufalidis** and **J. Levine**, Tree-level invariants of three-manifolds, Massey products and the Johnson homomorphism; **K. Fukaya**, Multivalued Morse theory, asymptotic analysis and mirror symmetry; *Combinatorial aspects of dynamics:* **R. Forman**, Some applications of combinatorial differential topology; **A. de Carvalho**, Extensions, quotients and generalized pseudo-Anosov maps; **M. Yampolsky**, Unimodal maps and hierarchical models; *Physics:* **A. Ashtekar**, Quantum geometry in action: big bang and black holes; **P. van Nieuwenhuizen**, Supersymmetry, supergravity, superspace and BRST symmetry in a simple model.

Proceedings of Symposia in Pure Mathematics, Volume 73

April 2005, 418 pages, Hardcover, ISBN 0-8218-3666-8, LC 2004062363, 2000 *Mathematics Subject Classification*: 81Txx, 57–XX, 18–XX, 53Dxx, 55–XX, 37–XX, 17Bxx, **All AMS members $71**, List $89, Order code PSPUM/73

New AMS-Distributed Publications

Geometry and Topology



Non-linear Elliptic Equations in Conformal Geometry

Sun-Yung Alice Chang, *Princeton University, NJ*

Non-linear elliptic partial differential equations are an important tool in the study of Riemannian metrics in differential geometry, in particular for problems concerning the conformal change of metrics in Riemannian geometry. In recent years the role played by the second order semi-linear elliptic equations in the study of Gaussian curvature and scalar curvature has been extended to a family of fully non-linear elliptic equations associated with other symmetric functions of the Ricci tensor. A case of particular interest is the second symmetric function of the Ricci tensor in dimension four closely related to the Pfaffian.

In these lectures, starting from the background material, the author reviews the problem of prescribing Gaussian curvature on compact surfaces. She then develops the analytic tools (e.g., higher order conformal invariant operators, Sobolev inequalities, blow-up analysis) in order to solve a fully nonlinear equation in prescribing the Chern-Gauss-Bonnet integrand on compact manifolds of dimension four.

The material is suitable for graduate students and research mathematicians interested in geometry, topology, and differential equations.

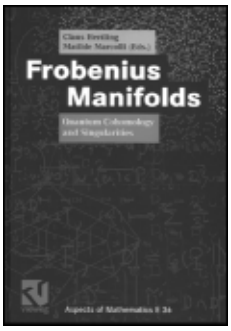
This item will also be of interest to those working in differential equations.

Distributed within the Americas by the American Mathematical Society.

Contents: Gaussian curvature equation; Moser–Trudinger inequality (on the sphere); Polyakov formula on compact surfaces; Conformal covariant operators—Paneitz operator; Functional determinant on 4-manifolds; Extremal metrics for the log-determinant functional; Elementary symmetric functions; A priori estimates for the regularized equation $(*)_\delta$; Smoothing via the Yamabe flow; Deforming σ_2 to a constant function.

Zurich Lectures in Advanced Mathematics

October 2004, 100 pages, Softcover, ISBN 3-03719-006-x, 2000 *Mathematics Subject Classification*: 53Axx, 58Jxx, **All AMS members $22**, List $28, Order code EMSZLEC/2



Frobenius Manifolds

Quantum Cohomology and Singularities

Claus Hertling, *Universität Mannheim, Germany*, and **Matilde Marcoli**, *Max Planck Institute for Mathematics, Bonn, Germany*, Editors

Quantum cohomology, the theory of Frobenius manifolds and the relations to integrable systems have been flourishing areas since the early 1990s. A conference was organized at the Max-Planck-Institute for Mathematics to bring together leading experts in these areas. This volume originated from that meeting and presents the state of the art in the subject.

Frobenius manifolds are complex manifolds with a multiplication and a metric on the holomorphic tangent bundle, which satisfy several natural conditions. This notion was defined in 1991 by Dubrovin, motivated by physics results. Another source of Frobenius manifolds is singularity theory. Duality between string theories lies behind the phenomenon of mirror symmetry. One mathematical formulation can be given in terms of the isomorphism of certain Frobenius manifolds. A third source of Frobenius manifolds is given by integrable systems, more precisely, bihamiltonian hierarchies of evolutionary PDE's. As in the case of quantum cohomology, here Frobenius manifolds are part of an a priori much richer structure, which, because of strong constraints, can be determined implicitly by the underlying Frobenius manifolds.

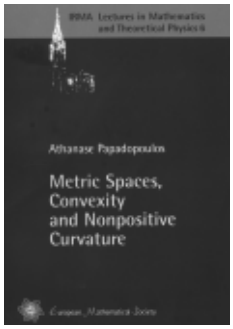
This volume is suitable for graduate students and research mathematicians interested in geometry and topology.

A publication of Vieweg Verlag. The AMS is exclusive distributor in North America. Vieweg Verlag Publications are available worldwide from the AMS outside of Germany, Switzerland, Austria, and Japan.

Contents: **A. Douai** and **C. Sabbah**, Gauss-Manin systems, Brieskorn lattices and Frobenius structures (II); **J. Fernandez** and **G. Pearlstein**, Opposite filtrations, variations of Hodge structure, and Frobenius modules; **E. Getzler**, The jet-space of a Frobenius manifold and higher-genus Gromov-Witten invariants; **A. B. Givental**, Symplectic geometry of Frobenius structures; **C. Hertling** and **Yu. I. Manin**, Unfoldings of meromorphic connections and a construction of Frobenius manifolds; **R. Kaufmann**, Discrete torsion, symmetric products and the Hilbert scheme; **X. Liu**, Relations among universal equations for Gromov-Witten invariants; **A. Losev** and **Yu. I. Manin**, Extended modular operad; **S. Merkulov**, Operads, deformation theory and F-manifolds; **A. Polishchuk**, Witten's top Chern class on the moduli space of higher spin curves; **K. Saito**, Uniformization of the orbifold of a finite reflection group; **I. Satake**, The Laplacian for a Frobenius manifold; **B. Siebert**, Virtual fundamental classes, global normal cones and Fulton's canonical classes; **A. Takahashi**, A note on BPS invariants on Calabi-Yau 3-folds; List of Participants.

Vieweg Aspects of Mathematics, Volume 36

September 2004, 378 pages, Hardcover, ISBN 3-528-03206-5, 2000 *Mathematics Subject Classification*: 53D45, 14N35; 37K10, 37K20, 34M35, 32S40, 14B05, **All AMS members $75**, List $83, Order code VWAM/36



Metric Spaces, Convexity and Nonpositive Curvature

Athanase Papadopoulos, *Institut de Recherche Mathématique Avancée, Strasbourg, France*

This book covers metric spaces of nonpositive curvature in the sense of Busemann, that is, metric spaces whose distance function satisfies a convexity condition. Also contained is a systematic introduction to the theory of geodesics as well as a detailed presentation of some facets of convexity theory, which are useful in the study of nonpositive curvature.

Concepts and techniques discussed in the volume are illustrated by many examples from classical hyperbolic geometry and from the theory of Teichmüller spaces. It is useful for graduate students and researchers in geometry, topology and analysis.

Distributed within the Americas by the American Mathematical Society.

Contents: Introduction: Some historical markers; Lengths of paths in metric spaces; Length spaces and geodesic spaces; Maps between metric spaces; Distances; Convexity in vector spaces; Convex functions; Strictly convex normed vector spaces; Busemann spaces; Locally convex spaces; Asymptotic rays and the visual boundary; Isometries; Busemann functions, co-rays and horospheres; References; Index.

IRMA Lectures in Mathematics and Theoretical Physics, Volume 6

December 2004, 300 pages, Softcover, ISBN 3-03719-010-8, 2000 *Mathematics Subject Classification*: 26–01, 30F25, 30F45, 30F60, 32Q45, 32G15, 51–01, 51K05, 51K10, 51M09, 51M10, 51F99, 52–01, 52A07, 52A41, 53–01, 53C70, 54–01, 54E35, **All AMS members $43**, List $54, Order code EMSILMTP/6