New Publications Offered by the AMS

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Algebra and Algebraic Geometry

Classifying Spaces of Sporadic Groups
David J. Benson, University of Aberdeen, Scotland, United Kingdom, and Stephen D. Smith, University of Illinois at Chicago, IL

For each of the 26 sporadic finite simple groups, the authors construct a 2-completed classifying space using a homotopy decomposition in terms of classifying spaces of suitable 2-local subgroups. This construction leads to an additive decomposition of the mod 2 group cohomology. The authors also summarize the current status of knowledge in the literature about the ring structure of the mod 2 cohomology of sporadic simple groups.

Contents: Overview of our main results; Exposition of background material: Review of selected aspects of group cohomology; Simplicial sets and their equivalence with topological spaces; Bousfield-Kan completions and homotopy colimits; Decompositions and ample collections of $p$-subgroups; 2-local geometries for simple groups; Main results on sporadic groups: Decompositions for the individual sporadic groups; Details of proofs for individual groups; Bibliography; Index.

Mathematical Surveys and Monographs, Volume 147

Positive Polynomials and Sums of Squares
Murray Marshall, University of Saskatchewan, Saskatoon, SK, Canada

The study of positive polynomials brings together algebra, geometry and analysis. The subject is of fundamental importance in real algebraic geometry, when studying the properties of objects defined by polynomial inequalities. Hilbert’s 17th problem and its solution in the first half of the 20th century were landmarks in the early days of the subject. More recently, new connections to the moment problem and to polynomial optimization have been discovered. The moment problem relates linear maps on the multidimensional polynomial ring to positive Borel measures.

This book provides an elementary introduction to positive polynomials and sums of squares, the relationship to the moment problem, and the application to polynomial optimization. The focus is on the exciting new developments that have taken place in the last 15 years, arising out of Schmüdgen’s solution to the moment problem in the compact case in 1991. The book is accessible to a well-motivated student at the beginning graduate level. The objects being dealt with are concrete and down-to-earth, namely polynomials in $n$ variables with real coefficients, and many examples are included. Proofs are presented as clearly and as simply as possible. Various new, simpler proofs appear in the book for the first time. Abstraction is employed only when it serves a useful purpose, but, at the same time, enough abstraction is included to allow the reader easy access to the literature. The book should be essential reading for any beginning student in the area.

Contents: Preliminaries; Positive polynomials and sums of squares; Krivine’s Positivstellensatz; The moment problem; Non-compact case; Archimedean $T$-modules; Schmüdgen’s Positivstellensatz; Putinar’s question; Weak isotropy of quadratic forms; Scheiderer’s local-global principle; Semidefinite programming and optimization; Appendix 1: Tarski-Seidenberg theorem; Appendix 2: Algebraic sets; Bibliography.

Mathematical Surveys and Monographs, Volume 146
Selected Papers of Alberto P. Calderón with Commentary

Alexandra Bellow, Northwestern University, Evanston, IL, Carlos E. Kenig, University of Chicago, IL, and Paul Malliavin, Editors

Alberto Calderón was one of the leading mathematicians of the twentieth century. His fundamental, pioneering work reshaped the landscape of mathematical analysis. This volume presents a wide selection from some of Calderón’s most influential papers. They range from singular integrals to partial differential equations, from interpolation theory to Cauchy integrals on Lipschitz curves, from inverse problems to ergodic theory. The depth, originality, and historical impact of these works are vividly illustrated by the accompanying commentaries by some of today’s leading figures in analysis. In addition, two biographical chapters preface the volume. They discuss Alberto Calderón’s early life and his mathematical career.


Collected Works, Volume 21


C*-Algebras and Finite-Dimensional Approximations

Nathaniel P. Brown, Pennsylvania State University, State College, PA, and Narutaka Ozawa, University of California, Los Angeles, CA

C*-approximation theory has provided the foundation for many of the most important conceptual breakthroughs and applications of operator algebras. This book systematically studies (most of) the numerous types of approximation properties that have been important in recent years: nuclearity, exactness, quasidiagonality, local reflexivity, and others. Moreover, it contains user-friendly proofs, insofar as that is possible, of many fundamental results that were previously quite hard to extract from the literature. Indeed, perhaps the most important novelty of the first ten chapters is an earnest attempt to explain some fundamental, but difficult and technical, results as painlessly as possible. The latter half of the book presents related topics and applications—written with researchers and advanced, well-trained students in mind. The authors have tried to meet the needs both of students wishing to learn the basics of an important area of research as well as researchers who desire a fairly comprehensive reference for the theory and applications of C*-approximation theory.

Contents: Fundamental facts; Basic theory: Nuclear and exact C*-algebras; Definitions, basic facts and examples; Tensor products; Constructions; Exact groups and related topics; Amenable traces and Kirchberg’s factorization property; Quasidiagonal C*-algebras; AF embeddability; Local reflexivity and other tensor product conditions; Summary and open problems; Special topics: Simple C*-algebras; Approximation properties for groups; Weak expectation property and local lifting property; Weakly exact von Neumann algebras; Applications: Classification of group von Neumann algebras; Herrero’s approximation problem; Counterexamples in K-homology and K-theory; Appendices.
Ultrafilters and ultraproducts; Operator spaces, completely bounded maps and duality; Lifting theorems; Positive definite functions, cocycles and Schoenberg’s Theorem; Groups and graphs; Bimodules over von Neumann algebras; Bibliography; Notation index; Subject index.

Graduate Studies in Mathematics, Volume 88

Applications

This book comprises a collection of articles stemming from a DIMACS Working Group and DIMACS Workshop on Theoretical Advances in Information Recording held at Rutgers University, Piscataway, NJ. Written by leading researchers in information theory and data storage technology, the articles address problems related to the efficient and reliable storage of information in devices based upon novel optical, magnetic, and biological recording mechanisms.

The primary focus of the articles is on signal processing and coding techniques applicable to exploratory technologies being considered for future generations of storage devices, including two-dimensional optical storage (TwoDOS), heat-assisted magnetic recording (HAMR), and volumetric macro-molecular data storage. Specific topics addressed include channel equalization, timing recovery, data detection, modulation coding, and error control coding. Several articles explore the emerging connections between data storage, information theory, and the storage and processing of genetic information in living cells. Articles in the volume also illustrate the broader applicability of fundamental advances in information theory that have arisen in the context of information storage technology.

The volume is suitable for graduate students and research scientists interested in applications of information theory, communication theory, and coding theory to man-made and natural data storage systems.

Co-published with the Center for Discrete Mathematics and Theoretical Computer Science beginning with Volume 8. Volumes 1–7 were co-published with the Association for Computer Machinery (ACM).

Contents:

- W. M. J. Coene and A. H. J. Immink, Modulation coding for a two-dimensional optical storage channel;
- R. Radhakrishnan, B. Vasić, F. Erden, and C. He, Characterization of heat-assisted magnetic recording channels;
- A. R. Nayak, J. R. Barry, and S. W. McLaughlin, Cramér-Rao bound for timing recovery on channels with inter-symbol interference;
- M. Mansuripur and P. Khulbe, Macro-molecular data storage with petabyte/cm³ density, highly parallel read/write operations, and genuine 3D storage capability;
- G. Battail, Can we explain the faithful communication of genetic information?;
- O. Milenkovic, Data storage and processing in cells: An information theoretic approach;
- N. Kashyap and P. H. Siegel, Ghostbusting: Coding for optical communications.

DIMACS: Series in Discrete Mathematics and Theoretical Computer Science, Volume 73

Discrete Mathematics and Combinatorics

This book comprises a collection of articles stemming from a DIMACS Working Group and DIMACS Workshop on Theoretical Advances in Information Recording held at Rutgers University, Piscataway, NJ. Written by leading researchers in information theory and data storage technology, the articles address problems related to the efficient and reliable storage of information in devices based upon novel optical, magnetic, and biological recording mechanisms.

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DIMACS: Series in Discrete Mathematics and Theoretical Computer Science, Volume 73

New Publications Offered by the AMS

For a complete list of new publications, visit the AMS online catalog at http://www.ams.org/bookstore.

The AMS-IMS-SIAM Joint Summer Research Conference “Integer Points in Polyhedra” was held in Snowbird, Utah in June 2006. This proceedings volume contains research and survey articles originating from the conference.

The volume is a cross section of recent advances connected to lattice-point questions. Similar to the talks given at the conference, topics range from commutative algebra to optimization, from discrete geometry to statistics, from mirror symmetry to geometry of numbers. The book is suitable for researchers and graduate students interested in combinatorial aspects of the above fields.

Contents:

- K. Aardal, Lattice reformulation of integer programming problems;
- V. Baldoni, N. Berline, and M. Vergne, Local Euler-Macaulay expansion of Barvinok valuations and Ehrhart coefficients of a rational polytope;
- V. Batyrev, Combinatorial aspects of mirror symmetry;
- B. Braun and M. Develin, Euler-Maclaurin expansion of Barvinok valuations and Ehrhart problems;
- A. Ordine, and K. Rybnikov, Perfect Delaunay polytopes and perfect quadratic functions on lattices;
- H. Ohhsugi and T. Hibi, Quadratic Gröbner bases arising from combinatorics;
- K. Karu, Ehrhart analogue of the h-vector;
- A. Takemura and R. Yoshida, Saturation
points on faces of a rational polyhedral cone; Z. Xu, An explicit formulation for two dimensional vector partition functions; M. Beck, B. Nill, B. Reznick, C. Savage, I. Soprunov, and Z. Xu, Let me tell you my favorite lattice-point problem ....

**Contemporary Mathematics**, Volume 452

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**A Course on the Web Graph**

*Anthony Bonato, Wilfrid Laurier University, Waterloo, ON, Canada*

_A Course on the Web Graph_ provides a comprehensive introduction to state-of-the-art research on the applications of graph theory to real-world networks such as the web graph. It is the first mathematically rigorous textbook discussing both models of the web graph and algorithms for searching the web.

After introducing key tools required for the study of web graph mathematics, an overview is given of the most widely studied models for the web graph. A discussion of popular web search algorithms, e.g. PageRank, is followed by additional topics, such as applications of infinite graph theory to the web graph, spectral properties of power law graphs, domination in the web graph, and the spread of viruses in networks.

The book is based on a graduate course taught at the AARMS 2006 Summer School at Dalhousie University. As such it is self-contained and includes over 100 exercises. The reader of the book will gain a working knowledge of current research in graph theory and its modern applications. In addition, the reader will learn first-hand about models of the web, and the mathematics underlying modern search engines.

**Contents:** Graphs and probability; The web graph; Random graphs; Models for the web graph; Searching the web; The infinite web; New directions in internet mathematics; Bibliography; Index.

**Graduate Studies in Mathematics**, Volume 89

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**General and Interdisciplinary**

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**Third International Congress of Chinese Mathematicians**

*Ka-Sing Lau and Zhou-Ping Xin, The Chinese University of Hong Kong, China, and Shing-Tung Yau, Harvard University, Cambridge, MA, Editors*

These volumes consist of the proceedings of the Third International Congress of Chinese Mathematicians, held at the Chinese University of Hong Kong in December 2004. The congress brought together eminent Chinese and overseas mathematicians to discuss the latest developments in pure and applied mathematics.

This two-part proceedings contains the contents of lectures given by the plenary speakers and the invited speakers—the major portion comprising new results—together with some expository and survey articles. Eleven major topics are treated: algebra, number theory and cryptography; algebraic geometry and algebraic topology; geometric analysis; complex analysis and complex geometry; harmonic analysis and functional analysis; applied mathematics; dynamical systems, fractals and wavelets; numerical analysis; PDE; probability, statistics, and financial mathematics; and education.

Titles in this series are co-published with International Press, Cambridge, MA.

**Contents:** Part 1: J. A. Smoller and J. B. Temple, Shock waves and cosmology; C.-Q. Cheng and J. Yan, Variational construction of diffusion orbits in convex Hamiltonian systems with multiple degrees of freedom; T. L. Lai, Saddlepoint approximations and boundary crossing probabilities for random fields and their applications; N. Mok, Recognizing certain rational homogeneous manifolds of Picard number 1 from their varieties of minimal rational tangents; C.-W. Shu, Discontinuous Galerkin methods for convection dominated partial differential equations; X.-J. Zhou, Singularity behavior of the mean curvature flow; J. Zhou, Localization and duality; B.-L. Chen and X.-P. Zhu, Surgical Ricci flow on four-manifolds with positive isotropic curvature; E. Viehweg and K. Zuo, Special subvarieties of \( \mathcal{A}_g \); L. Fu and D. Wan, Local monodromy of the Kloosterman sheaf at \( \infty \); T. Yang, Hilbert modular functions and their CM values; Y. Hu, Geometric invariant theory and birational geometry; X. Sun, Remarks on Gieseker's degeneration and its normalization; W.-S. Cheung and B. Wong, Bundle rigidity of complex surfaces; S. S.-T. Yau, CR equivalence problem of strongly pseudoconvex CR manifolds; L. Weiming and X.-Y. Zhou, Vector bundles on non-primary Hopf manifolds with abelian fundamental group; D.-C. Chang and P. Greiner, Subelliptic PDE's and subRiemannian geometry; S.-C. Chang, The Q-curvature flow on a closed 3-manifold of positive Q-curvature; T.-J. Li, The space of symplectic structures on closed 4-manifolds; L. Ni, Ancient solutions to Kahler-Ricci flow; M.-T. Wang, A convergence result of the Lagrangian mean curvature flow; R.-H. Wang, On piecewise algebraic variety; B. H. Liu, An introduction to chiral equivariant cohomology; L. Ji, Large scale geometry, compactifications and the integral Novikov conjectures for arithmetic groups; M.-D. Choi, Normal dilations; L. Ge and J. Shen, On the generator problem of von Neumann algebras;

AMS/IP Studies in Advanced Mathematics, Volume 42


Geometry and Topology

Poisson Geometry in Mathematics and Physics

Giuseppe Dito, University of Bourgogne, Dijon, France, Jiang-Hua Lu, Hong Kong University of Science and Technology, Kowloon, Hong Kong, China, Yoshiaki Maeda, Keio University, Yokohama, Japan, and Alan Weinstein, University of California, Berkeley, CA, Editors

This volume is a collection of articles by speakers at the conference “Poisson 2006: Poisson Geometry in Mathematics and Physics”, which was held June 5–9, 2006, in Tokyo, Japan. Poisson 2006 was the fifth in a series of international conferences on Poisson geometry that are held every two years. The aim of these conferences is to bring together mathematicians and mathematical physicists who work in diverse areas but have common interests in Poisson geometry. The program for Poisson 2006 was remarkable for the overlap of topics that included deformation quantization, generalized complex structures, differentiable stacks, normal forms, and group-valued moment maps and reduction. The articles represent current research in Poisson geometry and should be valuable to anyone interested in Poisson geometry, symplectic geometry, and mathematical physics. This volume also contains lectures by the principal speakers of the three-day school held at Keio University that preceded Poisson 2006.


Contemporary Mathematics, Volume 450

The book gives a detailed presentation of the classification of the simple groups of finite Morley rank which contain a nontrivial unipotent 2-subgroup. They are linear algebraic groups over algebraically closed fields of characteristic 2. Although the story told in the book is inspired by the classification of the finite simple groups, it goes well beyond this source of inspiration. Not only do the techniques adapted from finite group theory cover, in a peculiar way, various portions of the three generations of approaches to finite simple groups but model theoretic methods also play an unexpected role. The book contains a complete account of all this material, part of which has not been published. In addition, almost every general result about groups of finite Morley rank is exposed in detail and the book ends with a chapter where the authors provide a list of open problems in the relevant fields of mathematics. As a result, the book provides food for thought to finite group theorists, model theorists, and algebraic geometers who are interested in group theoretic problems.

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

Contents: Part A. Methods: Tools; K-groups and L-groups; Specialized topics; Generic covering and conjugacy theorems; Part B. Mixed type groups: Mixed type; Part C. Even type groups: Strong embedding and weak embedding; Standard components of type SL2; The C(G, T) theorem and a plan of attack; Quasithin groups; Conclusion; Bibliography; Index of notation; Index of terminology; Index.
New AMS-Distributed Publications

Analysis

Finsler Geometry, Sapporo 2005
In Memory of Makoto Matsumoto

Sorin V. Sabau and Hideo Shimada, Hokkaido Tokai University, Sapporo, Japan

This volume contains surveys and original articles based on the talks given at the 40th Finsler Symposium on Finsler Geometry, held on September 9-10, 2005 at Hokkaido Tokai University, Sapporo, Japan. The symposium was not only a meeting of the Finsler geometers from Japan and abroad but also a commemoration of the late Professor Makoto Matsumoto. The papers included in this volume contain fundamental topics of modern Riemann-Finsler geometry, interesting for specialists in Finsler geometry as well as researchers in Riemannian geometry or other fields of differential geometry and its applications.

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

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 48


March 2008 Notices of the AMS 421
Probability

On Cramér’s Theory in Infinite Dimensions

Raphaël Cerf, Université Paris Sud, Orsay, France

This text is a self-contained account of Cramér’s theory in infinite dimensions. The point of view is slightly different from the classical texts of Azencott, Bahadur and Zabell, Dembo and Zeitouni, and Deuschel and Stroock. The authors have been trying to understand the relevance of the topological hypotheses necessary to carry out the core of the theory. They have also drawn some inspiration from the analogy between the large deviation proofs in statistical mechanics and for i.i.d. random variables.

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

A publication of the Société Mathématique de France, Marseilles (SMF), distributed by the AMS in the U.S., Canada, and Mexico. Orders from other countries should be sent to the SMF. Members of the SMF receive a 30% discount from list.

Contents: Introduction; Large deviation theory; Topological vector spaces; The model; The weak large deviation principle; The Cramér transform \( I(\mu, A) \) as a function of \( \mu \); The Cramér transform and the Log–Laplace; Convex regularity; Enhanced upper bound; The Cramér transform \( I(\mu, A) \) as a function of \( \mu \); The Cramér transform and the Log–Laplace; \( I(A) \); the discrete case; \( I(A) \); the smooth case; \( I(A) \); the finite dimensional case; \( I(A) \); the infinite dimensions; Exponential tightness; Cramér’s theorem in \( \mathbb{R}^d \); Cramér’s theorem in the weak topology; Cramér’s theorem in a Banach space; Gaussian measures; Sanov’s theorem: autonomous derivation; Cramér’s theorem implies Sanov’s theorem; Sanov’s theorem implies the compact Cramér theorem; Mosco convergence; A. Lusin’s theorem; B. The mean of a probability measure; C. Ky Fan’s proof of the minimax theorem; Index; Bibliography.

Panoramas et Synthèses, Number 23