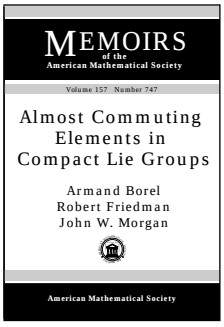
New Publications Offered by the AMS

Algebra and Algebraic Geometry



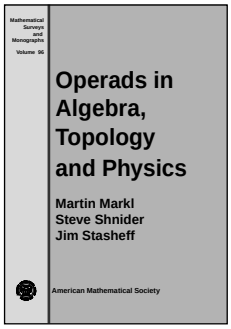
Almost Commuting Elements in Compact Lie Groups

Armand Borel, *Institute for Advanced Study, Princeton, NJ*, and **Robert Friedman** and **John W. Morgan**, *Columbia University, New York City, NY*

Contents: Introduction; Almost commuting N-tuples; Some characterizations of groups of type A; c-pairs; Commuting triples; Some results on diagram automorphisms and associated root systems; The fixed subgroup of an automorphism; C-triples; The tori $\overline{S}(k)$ and $\overline{S}^{W_C}(\overline{\mathbf{g}}, k)$ and their Weyl groups; The Chern-Simons invariant; The case when $\langle C \rangle$ is not cyclic; Bibliography; Diagrams and tables.

Memoirs of the American Mathematical Society, Volume 157, Number 747

May 2002, 136 pages, Softcover, ISBN 0-8218-2792-8, LC 2002018237, 2000 *Mathematics Subject Classification*: 22C05, 17B20; 57R20, 17B40, **Individual member $31**, List $52, Institutional member $42, Order code MEMO/157/747N



Operads in Algebra, Topology and Physics

Martin Markl, *Czech Academy of Sciences, Prague, Czech Republic*, **Steve Shnider**, *Bar-Ilan University, Ramat-Gan, Israel*, and **Jim Stasheff**, *University of North Carolina, Chapel Hill*

Operads are mathematical devices which describe algebraic structures of many varieties and in various categories. Operads are particularly important in categories with a good notion of "homotopy" where they play a key role in organizing hierarchies of higher homotopies. Significant examples first appeared in the sixties though the formal definition and appropriate generality waited for the seventies. These early occurrences were in algebraic topology in the study of (iterated) loop spaces and their chain algebras. In the nineties, there was a renaissance and further development of the theory inspired by the discovery of new relationships with graph cohomology, representation theory, algebraic geometry, derived categories, Morse theory, symplectic and contact geometry, combinatorics, knot theory, moduli spaces, cyclic cohomology, and, not least, theoretical physics, especially string field theory and deformation quantization. The generalization of quadratic duality (e.g., Lie algebras as dual to commutative algebras) together with the property of Koszulness in an essentially operadic context provided an additional computational tool for studying homotopy properties outside of the topological setting.

The book contains a detailed and comprehensive historical introduction describing the development of operad theory from the initial period when it was a rather specialized tool in homotopy theory to the present when operads have a wide range of applications in algebra, topology, and mathematical physics. Many results and applications currently scattered in the literature are brought together here along with new results and insights. The basic definitions and constructions are carefully explained and include many details not found in any of the standard literature.

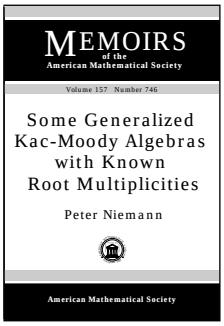
There is a chapter on topology, reviewing classical results with the emphasis on the W-construction and homotopy invariance. Another chapter describes the (co)homology of operad algebras, minimal models, and homotopy algebras. A chapter on geometry focuses on the configuration spaces and their compactifications. A final chapter deals with cyclic and modular operads and applications to graph complexes and moduli spaces of surfaces of arbitrary genus.

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

Contents: *Part I:* Introduction and history; *Part II:* Operads in a symmetric monoidal category; Topology–review of classical results; Algebra; Geometry; Generalization of operads; Epilog; Bibliography; Glossary of notations; Index.

Mathematical Surveys and Monographs, Volume 96

June 2002, approximately 360 pages, Hardcover, ISBN 0-8218-2134-2, LC 2002016342, 2000 *Mathematics Subject Classification*: 18D50, 55P48, **Individual member $53**, List $89, Institutional member $71, Order code SURV/96N



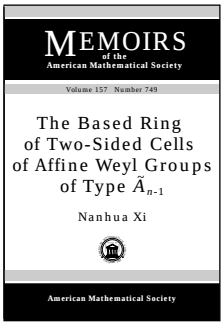
Some Generalized Kac-Moody Algebras with Known Root Multiplicities

Peter Niemann, *Logica UK Ltd, London, UK*

Contents: Introduction; Generalized Kac-Moody algebras; Modular forms; Lattices and their Theta-functions; The proof of Theorem 1.7; The real simple roots; Hyperbolic Lie algebras; Appendix A; Appendix B; Bibliography; Notation.

Memoirs of the American Mathematical Society, Volume 157, Number 746

May 2002, 119 pages, Softcover, ISBN 0-8218-2888-6, LC 2002018236, 2000 *Mathematics Subject Classification*: 17B65, **Individual member $30**, List $50, Institutional member $40, Order code MEMO/157/746N



The Based Ring of Two-Sided Cells of Affine Weyl Groups of Type $\widetilde{A}_{n-1}$

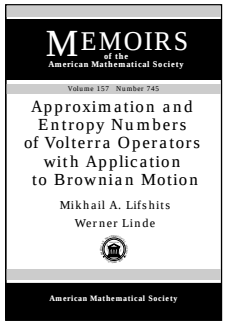
Nanhua Xi, *University of Sydney, NSW, Australia*

Contents: Cells in affine Weyl groups; Type $\widetilde{A}_{n-1}$; Canonical left cells; The group F_λ and its representation; A bijection between $\Gamma_\lambda \cap \Gamma_\lambda^{-1}$ and Irr F_λ; A factorization formula in $J_{\Gamma_\lambda \cap \Gamma_\lambda^{-1}}$; A multiplication formula in $J_{\Gamma_\lambda \cap \Gamma_\lambda^{-1}}$; The based rings $J_{\Gamma_\lambda \cap \Gamma_\lambda^{-1}}$ and $J_{\mathfrak{c}}$; Bibliography; Index; Notation.

Memoirs of the American Mathematical Society, Volume 157, Number 749

May 2002, 95 pages, Softcover, ISBN 0-8218-2891-6, LC 2002018239, 2000 *Mathematics Subject Classification*: 20G05, 18F25; 16S80, 20C07, **Individual member $29**, List $48, Institutional member $38, Order code MEMO/157/749N

Analysis



Approximation and Entropy Numbers of Volterra Operators with Application to Brownian Motion

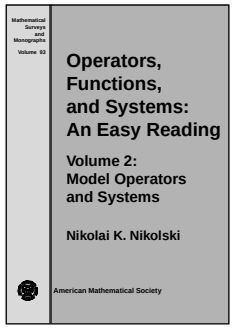
Mikhail A. Lifshits, *Saint Petersburg State University, St. Petersburg, Russia*, and **Werner Linde**, *Friedrich-Schiller University, Jena, Germany*

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

Contents: Introduction; Main results; Scale transformations; Upper estimates for entropy numbers; Lower estimates for entropy numbers; Approximation numbers; Small ball behaviour of weighted Wiener processes; Appendix; Bibliography.

Memoirs of the American Mathematical Society, Volume 157, Number 745

May 2002, 87 pages, Softcover, ISBN 0-8218-2791-X, LC 2002018235, 2000 *Mathematics Subject Classification*: 47G10; 47B06, 60G15, 47B38, **Individual member $29**, List $48, Institutional member $38, Order code MEMO/157/745N



Operators, Functions, and Systems: An Easy Reading

Volume 2: Model Operators and Systems

Nikolai K. Nikolski, *University of Bordeaux I, Talence, France*

This unique work combines together in two volumes four formally distinct topics of modern analysis and its applications:

A. Hardy classes of holomorphic functions

B. Spectral theory of Hankel and Toeplitz operators

C. Function models for linear operators and free interpolations, and

D. Infinite-dimensional system theory and signal processing

Volume I contains parts A and B; this volume, Volume II, contains Parts C and D.

Hardy classes of holomorphic functions: This topic is known to be the most powerful tool of complex analysis for a variety of applications, starting with Fourier series, through the Riemann zeta-function, all the way to Wiener's theory of signal processing.

Spectral theory of Hankel and Toeplitz operators: These now become the supporting pillars for a large part of harmonic and complex analysis and for many of their applications. In this book, moment problems, Nevanlinna-Pick and

Carathéodory interpolation, and best rational approximations are considered to illustrate the power of Hankel and Toeplitz operators.

Function models for linear operators and free interpolation: This is a universal topic and, indeed, is the most influential operator theory technique in the post-spectral-theorem era. In this book, its capacity is tested by solving generalized Carleson-type interpolation problems.

Infinite-dimensional system theory and signal processing: This topic is the touchstone of the three previously developed techniques. The presence of this applied topic in a pure mathematics environment reflects important changes in the mathematical landscape of the last 20 years, in that the role of the main consumer and customer of harmonic, complex, and operator analysis has more and more passed from differential equations, scattering theory, and probability, to control theory and signal processing.

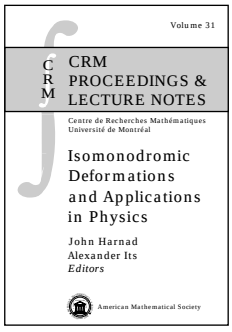
These volumes are geared toward a wide audience of readers, from graduate students to professional mathematicians. They develop an elementary approach while retaining an expert level that can be applied in advanced analysis and selected applications.

Contents: *Model operators and free interpolation:* Foreword to part C; The basic function model; Elements of spectral theory in the language of the characteristic function; Decompositions into invariant subspaces and free interpolation; *Analytic problems in linear system theory:* Foreword to part D; Basic theory; First optimizations: Multiplicity of the spectrum and the DISC; Eigenvector decompositions, vector valued exponentials, and squared optimization; A glance at bases of exponentials and of reproducing kernels; A brief introduction to H^∞ control; Bibliography; Author index; Subject index; Symbol index; Errata to volume 1.

Mathematical Surveys and Monographs, Volume 93

May 2002, 439 pages, Hardcover, ISBN 0-8218-2876-2, LC 2001053556, 2000 *Mathematics Subject Classification*: 47–02, 30–02, 93–02, 30D55, 47B35, 47A45, 93B05, 93C05, **Individual member $59**, List $98, Institutional member $78, Order code SURV/93N

Differential Equations



Isomonodromic Deformations and Applications in Physics

John Harnad, *University of Montreal, QC, Canada*, and **Alexander Its**, *Indiana University - Purdue University, Indianapolis*, Editors

The area of inverse scattering transform method or soliton theory has evolved over the past two decades in a vast variety of exciting new algebraic and analytic directions and has found numerous new applications. Methods and applications range from quantum group theory and exactly solvable statistical models to random matrices, random permutations, and number theory. The theory of isomonodromic deformations of systems of differential equations with rational coefficents, and most notably, the related apparatus of the Riemann-Hilbert problem, underlie the analytic side of this striking development.

The contributions in this volume are based on lectures given by leading experts at the CRM workshop (Montreal, Canada). Included are both survey articles and more detailed expositions relating to the theory of isomonodromic deformations, the Riemann-Hilbert problem, and modern applications.

The first part of the book represents the mathematical aspects of isomonodromic deformations; the second part deals mostly with the various appearances of isomonodromic deformations and Riemann-Hilbert methods in the theory of exactly solvable quantum field theory and statistical mechanical models, and related issues. The book elucidates for the first time in the current literature the important role that isomonodromic deformations play in the theory of integrable systems and their applications to physics.

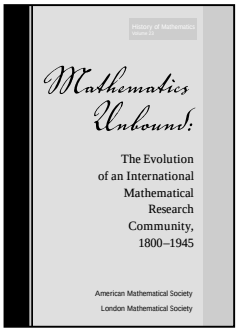
This item will also be of interest to those working in mathematical physics.

Contents: *Isomonodromic deformations:* **A. Bolibruch**, Inverse problems for linear differential equations with meromorphic coefficients; **J. Harnad**, Virasoro generators and bilinear equations for isomonodromic tau functions; **A. A. Kapaev**, Lax pairs for Painlevé equations; **D. A. Korotkin**, Isomonodromic deformations and Hurwitz spaces; **Y. Ohyama**, Classical solutions of Schlesinger equations and twistor theory; **M. A. Olshanetsky**, W-geometry and isomonodromic deformations; **C. A. Tracy** and **H. Widom**, Airy kernel and Painlevé II; *Applications in physics and related topics:* **M. Bertola**, Jacobi groups, Jacobi forms and their applications; **P. A. Clarkson** and **C. M. Cosgrove**, Symmetry, the Chazy equation and Chazy hierarchies; **F. Göhmann**, Universal correlations of one-dimensional electrons at low density; **F. Göhmann** and **V. E. Korepin**, A quantum version of the inverse scattering transformation; **Y. Nakamura**, Continued fractions and integrable systems; **A. Yu. Orlov** and **D. M. Scherbin**, Hypergeometric functions related to Schur functions and integrable systems; **J. Palmer**, Ising model scaling functions at short distance; **N. A. Slavnov**, The partition function of the six-vertex model as a Fredholm determinant.

CRM Proceedings & Lecture Notes, Volume 31

March 2002, 218 pages, Softcover, ISBN 0-8218-2804-5, LC 2002016306, 2000 *Mathematics Subject Classification*: 34Exx, 34Mxx, 35Qxx, 58Cxx, 81Txx, 30–XX, 33–XX, **Individual member $38**, List $64, Institutional member $51, Order code CRMP/31N

General and Interdisciplinary



Mathematics Unbound: The Evolution of an International Mathematical Research Community, 1800–1945

Karen Hunger Parshall, *University of Virginia, Charlottesville*, and **Adrian C. Rice**, *Randolph-Macon College, Ashland, VA*, Editors

Although today's mathematical research community takes its international character very much for granted, this "global nature" is relatively recent, having evolved over a period of roughly 150 years—from the beginning of the nineteenth century to the middle of the twentieth century. During this time, the practice of mathematics changed from being centered on a collection of disparate national communities to being characterized by an international group of scholars for whom the goal of mathematical research and cooperation transcended national boundaries. Yet, the development of an international community was far from smooth and involved obstacles such as war, political upheaval, and national rivalries. Until now, this evolution has been largely overlooked by historians and mathematicians alike.

This book addresses the issue by bringing together essays by twenty experts in the history of mathematics who have investigated the genesis of today's international mathematical community. This includes not only developments within component national mathematical communities, such as the growth of societies and journals, but also more wide-ranging political, philosophical, linguistic, and pedagogical issues.

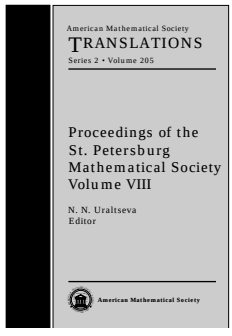
The resulting volume is essential reading for anyone interested in the history of modern mathematics. It will be of interest to mathematicians, historians of mathematics, and historians of science in general.

Copublished with the London Mathematical Society. Members of the LMS may order directly from the AMS at the AMS member price. The LMS is registered with the Charity Commissioners.

Contents: K. H. Parshall and **A. C. Rice**, The evolution of an international mathematical research community, 1800–1945: An overview and an agenda; **I. Grattan-Guinness**, The end of dominance: The diffusion of French mathematics elsewhere, 1820–1870; **E. Ausejo** and **M. Hormigón**, Spanish initiatives to bring mathematics in Spain into the international mainstream; **S. E. Despeaux**, International mathematical contributions to British scientific journals, 1800–1900; **J. Lützen**, International participation in Liouville's *Journal de mathématiques pures et appliquées*; **H. Gispert**, The effects of war on France's international role in mathematics, 1870–1914; **T. Archibald**, Charles Hermite and German mathematics in France; **J. E. Barrow-Green**, Gösta Mittag-Leffler and the foundation and administration of *Acta Mathematica*; **L. Martini**, An episode in the evolution of a mathematical community: The case of Cesare Arzelà at Bologna; **A. Brigaglia**, The first international mathematical community: The *Circolo matematico di Palermo*; **J. J. Gray**, Languages for mathematics and the language of mathematics in a world of nations; **C. Sasaki**, The emergence of the Japanese mathematical community in the modern western style, 1855–1945; **J. W. Dauben**, Internationalizing mathematics east and west: Individuals and institutions in the emergence of a modern mathematical community in China; **X. Yibao**, Chinese–U. S. mathematical relations, 1859–1949; **D. D. Fenster**, American initiatives toward internationalization: The case of Leonard Dickson; **R. Siegmund-Schultze**, The effects of Nazi rule on the international participation of German mathematicians: An overview and two case studies; **S. L. Segal**, War, refugees, and the creation of an international mathematical community; **O. Lehto**, The formation of the international mathematical union; Index.

History of Mathematics, Volume 23

June 2002, approximately 416 pages, Hardcover, ISBN 0-8218-2124-5, 2000 *Mathematics Subject Classification*: 01A55, 01A60, 01A70, 01A72, 01A73, 01A74, 01A80, **All AMS members $68**, List $85, Order code HMATH/23N



Proceedings of the St. Petersburg Mathematical Society, Volume VIII

N. N. Uraltseva, *St. Petersburg State University, Russia*, Editor

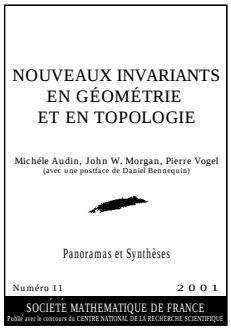
The articles in this collection present new results in partial differential equations, numerical analysis, probability theory, and geometry. The results, ideas, and methods given in the book will be of interest to a broad range of specialists.

Contents: A. N. Borodin, Distribution of the supremum for linear combinations of local times of random processes; **O. L. Vinogradov** and **V. V. Zhuk**, Sharp Jackson type inequalities for differentiable functions and minimization of the step of the moduli of continuity; **Yu. K. Dem′yanovich**, Biorthogonal system of minimal splines on a nonuniform grid; **V. V. Zhuk** and **G. I. Natanson**, S. N. Bernstein and direct and converse theorems of contructive function theory; **I. A. Ibragimov**, On S. N. Bernstein's work in probability; **N. M. Ivochkina**, Some trends in the development of the theory of fully nonlinear second order evolution equations; **R. Lauter**, **B. A. Plamenevskii**, and **O. V. Sarafanov**, Coefficients in asymptotics of solutions to pseudodifferential equations on manifolds with conical points; **G. A. Leonov**, The Brockett problem in the theory of nonstationary stabilization of linear differential equations; **V. N. Malozemov** and **A. N. Sergeev**, Discrete nonperiodic splines on a uniform grid; **A. I. Nazarov** and **Ya. Yu. Nikitin**, Some extremal problems for Gaussian and empirical random fields; **F. V. Petrov** and **S. E. Rukshin**, Two theorems about convex polyhedra.

American Mathematical Society Translations—Series 2, Volume 205

May 2002, 208 pages, Hardcover, ISBN 0-8218-2941-6, 2000 *Mathematics Subject Classification*: 01A60, 35K60, 35S15, 41–03, 41A25, 52B45, 58J40, 60–03, 60G55, 60G60, 60J65, 65D07, 93C10; 41A15, 47G30, 60Fxx, **Individual member $57**, List $95, Institutional member $76, Order code TRANS2/205N

Geometry and Topology



Nouveaux Invariants en Geometrie et en Topologie

Michéle Audin, *Université Louis Pasteur et CNRS, Strasbourg, France*, **John W Morgan**, *Columbia University, New York*, and **Pierre Vogel** and **Daniel Bennequin**, *Université Paris, France*

A publication of the Société Mathématique de France.

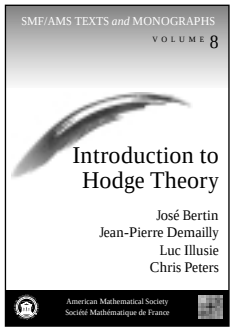
This volume offers a presentation of recent developments of three types of geometric invariants: symplectic invariants, including Gromov-Witten invariants, invariants of four-manifolds and Seiberg-Witten theory, and finite type invariants for three-manifolds. The book concludes with a description of the links between these three types of invariants and contemporary quantum field theory. The text is in French and English.

Distributed by the AMS in the United States, Canada, and Mexico. Orders from other countries should be sent to the SMF, Maison de la SMF, B.P. 67, 13274 Marseille cedex 09, France, or to Institut Henri Poincaré, 11 rue Pierre et Marie Curie, 75231 Paris cedex 05, France. Members of the SMF receive a 30% discount from list.

Contents: M. Audin, Invariants en géométrie symplectique via les courbes holomorphes; **J. W. Morgan**, Seiberg-Witten invariants; **P. Vogel**, Invariants de type fini; **D. Bennequin**, Invariants contemporains.

Panoramas et Synthèses, Number 11

December 2001, 159 pages, Softcover, ISBN 2-85629-111-2, 2000 *Mathematics Subject Classification*: 53Dxx, 53C23, 57M25, 57M27, 57R57, 58Jxx, 81–XX, **Individual member $30**, List $33, Order code PASY/11N



Introduction to Hodge Theory

José Bertin, *University of Grenoble I, St. Martin D'Heres, France*, **Jean-Pierre Demailly**, *University of Grenoble I, St. Martin d'Heres, France*, **Luc Illusie**, *University of Paris-Sud, Orsay, France*, and **Chris Peters**, *University of Grenoble I, St. Martin d'Heres, France*

From reviews of the French Edition:

The present book … may be regarded as a masterly introduction to Hodge theory in its classical and very recent, analytic and algebraic aspects … it is by far much more than only an introduction to the subject. The material leads the reader to the forefront of research in many areas related to Hodge theory, and that in a detailed highly self-contained manner … this text is also a valuable source for active researchers and teachers in the field …

—Zentralblatt MATH

The book under review is a collection of three articles about Hodge theory and related developments, which are all aimed at non-experts and fulfill, in an extremely satisfactory manner, two functions. First, the basic methods used in the theories are discussed and developed in great detail; second, some newer developments are described, giving the reader a good overview of the more important applications. Furthermore, the style makes these articles a joy to work through, even for the mathematician not encountering these subjects for the first time.

—Mathematical Reviews

Hodge theory originated as an application of harmonic theory to the study of the geometry of compact complex manifolds. The ideas have proved to be quite powerful, leading to fundamentally important results throughout algebraic geometry. This book consists of expositions of various aspects of modern Hodge theory. Its purpose is to provide the nonexpert reader with a precise idea of the current status of the subject. The three chapters develop distinct but closely related subjects: L^2 Hodge theory and vanishing theorems; Frobenius and Hodge degeneration; variations of Hodge structures and mirror symmetry. The techniques employed cover a wide range of methods borrowed from the heart of mathematics: elliptic PDE theory, complex differential geometry, algebraic geometry in characteristic p, cohomological and sheaf-theoretic methods, deformation theory of complex varieties, Calabi-Yau manifolds, singularity theory, etc. A special effort has been made to approach the various themes from their most natural starting points. Each of the three chapters is supplemented with a detailed introduction and numerous references. The reader will find precise statements of quite a number of open problems that have been the subject of active research in recent years.

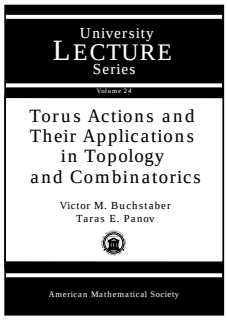
The reader should have some familiarity with differential and algebraic geometry, with other prerequisites varying by chapter. The book is suitable as an accompaniment to a second course in algebraic geometry.

SMF members are entitled to AMS member discounts.

Contents: J.-P. Demailly, L^2 Hodge theory and vanishing theorems; **L. Illusie**, Frobenius and Hodge degeneration; **J. Bertin** and **C. Peters**, Variations of Hodge structure, Calabi-Yau manifolds and mirror symmetry.

SMF/AMS Texts and Monographs, Volume 8

May 2002, 232 pages, Softcover, ISBN 0-8218-2040-0, LC 2002019611, 2000 *Mathematics Subject Classification*: 14C30, 14D07, 14F17, 13A35, 58A14, 14–02, 32–02; 81–02, **All AMS members $52**, List $65, Order code SMFAMS/8N



Torus Actions and Their Applications in Topology and Combinatorics

Victor M. Buchstaber and **Taras E. Panov**, *Moscow State University, Russia*

Here, the study of torus actions on topological spaces is presented as a bridge connecting combinatorial and convex geometry with commutative and homological algebra, algebraic geometry, and topology. This established link helps in understanding the geometry and topology of a space with torus action by studying the combinatorics of the space of orbits. Conversely, subtle properties of a combinatorial object can be realized by interpreting it as the orbit structure for a proper manifold or as a complex acted on by a torus. The latter can be a symplectic manifold with Hamiltonian torus action, a toric variety or manifold, a subspace arrangement complement, etc., while the combinatorial objects include simplicial and cubical complexes, polytopes, and arrangements. This approach also provides a natural topological interpretation in terms of torus actions of many constructions from commutative and homological algebra used in combinatorics.

The exposition centers around the theory of moment-angle complexes, providing an effective way to study invariants of triangulations by methods of equivariant topology. The book includes many new and well-known open problems and would be suitable as a textbook. It will be useful for specialists both in topology and in combinatorics and will help to establish even tighter connections between the subjects involved.

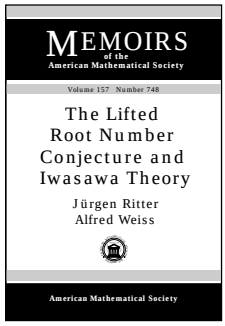
This item will also be of interest to those working in discrete mathematics and combinatorics.

Contents: Introduction; Polytopes; Topology and combinatorics of simplicial complexes; Commutative and homological algebra of simplicial complexes; Cubical complexes; Toric and quasitoric manifolds; Moment-angle complexes; Cohomology of moment-angle complexes and combinatorics of triangulated manifolds; Cohomology rings of subspace arrangement complements; Bibliography; Index.

University Lecture Series, Volume 24

May 2002, approximately 152 pages, Softcover, ISBN 0-8218-3186-0, LC 2002018243, 2000 *Mathematics Subject Classification*: 52B70, 57Q15, 57R19, 14M25, 52B05, 13F55, 05B35, **All AMS members $23**, List $29, Order code ULECT/24N

Number Theory



The Lifted Root Number Conjecture and Iwasawa Theory

Jürgen Ritter, *University of Augsburg, Germany*, and **Alfred Weiss**, *University of Alberta, Edmonton, AB, Canada*

Contents: Introduction; The Tripod; Restriction, deflation; change of maps, and variance with S; Definition of $\mathfrak{O}_S$; Ω_Φ as a shadow of $\mathfrak{O}_S$; $\mathfrak{O}_S$ over the maximal order in the case when $G$is abelian; Local considerations; Towards a representing homomorphism for Ω_{φ_L}; Real cyclotomic extensions tame over l; References.

Memoirs of the American Mathematical Society, Volume 157, Number 748

May 2002, 90 pages, Softcover, ISBN 0-8218-2928-9, LC 2002018238, 2000 *Mathematics Subject Classification*: 11R23, 11R27, 11R32, 11R33, 11R37, 11R42, 11S20, 11S23, 11S31, 11S40; 11–02, 11R18, 11R65, **Individual member $29**, List $48, Institutional member $38, Order code MEMO/157/748N

Previously Announced Publications

Pick Interpolation and Hilbert Function Spaces

Jim Agler, *University of California at San Diego*, and **John E. McCarthy**, *Washington University, St. Louis, MO*

The book first rigorously develops the theory of reproducing kernel Hilbert spaces. The authors then discuss the Pick problem of finding the function of smallest H^∞ norm that has specified values at a finite number of points in the disk. Their viewpoint is to consider H^∞ as the multiplier algebra of the Hardy space and to use Hilbert space techniques to solve the problem. This approach generalizes to a wide collection of spaces.

The authors then consider the interpolation problem in the space of bounded analytic functions on the bidisk and give a complete description of the solution. They then consider very general interpolation problems. The book includes developments of all the theory that is needed, including operator model theory, the Arveson extension theorem, and the hereditary functional calculus.

Graduate Studies in Mathematics, Volume 44

April 2002, 308 pages, Hardcover, ISBN 0-8218-2898-3, LC 2001056501, 2000 *Mathematics Subject Classification*: 47A57, 30E05, 46E20, 32A70, **All AMS members $39**, List $49, Order code GSM/44RT204

Celestial Mechanics

Dedicated to Donald Saari for his 60th Birthday

A. Chenciner, *Institute de Mécanique Céleste, Paris, France*, **R. Cushman**, *University of Utrecht, Netherlands*, and **C. Robinson** and **Z. Xia**, *Northwestern University, Evanston, IL*, Editors

This volume reflects the proceedings from an international conference on celestial mechanics held at Northwestern University (Evanston, IL) in celebration of Donald Saari's sixtieth birthday. Many leading experts and researchers presented their recent results.

Don Saari's significant contribution to the field came in the late 1960s through a series of important works. His work revived the singularity theory in the n-body problem which was started by Poincaré and Painlevé. Saari's solution of the Littlewood conjecture, his work on singularities, collision and noncollision, on central configurations, his decompositions of configurational velocities, etc., are still much studied today and were reflected throughout the conference.

This volume covers various topics of current research, from central configurations to stability of periodic orbits, from variational methods to diffusion mechanisms, from the dynamics of secular systems to global dynamics of the solar systems via frequency analysis, from Hill's problem to the low energy transfer orbits and mission design in space travel, and more. This classic field of study is very much alive today and this volume offers a comprehensive representation of the latest research results.

Contributors include: A. Albouy, J. Llibre, E. Belbruno, F. Beukers, R. Cushman, A. Chenciner, M. Corbera, W. S. Koon, J. E. Marsden, S. D. Ross, M. W. Lo, E. A. Lacomba, E. Perez-Chavela, C. Marchal, R. Moeckel, R. Montgomery, P. H. Rabinowitz, E. W. Stredulinsky, C. Robinson, C. Simó, Y.-S. Sun, J.-L. Zhou, J.-Q. Zheng, M. Valtonen, Q. Wang, and Z. Xia.

Contemporary Mathematics, Volume 292

February 2002, approximately 280 pages, Softcover, ISBN 0-8218-2902-5, LC 2001055364, 2000 *Mathematics Subject Classification*: 70Fxx, 70Hxx, 37N05, 37Jxx, **Individual member $41**, List $69, Institutional member $55, Order code CONM/292RT204

Wavelet Analysis and Applications

Donggao Deng, *Zhongshan University, Guangzhou, People's Republic of China*, **Daren Huang**, *Zhejiang University, Hangzhou, People's Republic of China*, **Rong-Qing Jia**, *University of Alberta, Edmonton, AB, Canada*, **Wei Lin**, *Zhongshan University, Guangzhou, People's Republic of China*, and **Jianzhong Wang**, *Sam Houston State University, Huntsville, TX*, Editors

Wavelet analysis has been one of the major research directions in science in the last decade. More and more mathematicians and scientists join this exciting research area. Certainly, wavelet analysis has had a great impact in areas such as approximation theory, harmonic analysis, and scientific computation. More importantly, wavelet analysis has shown great potential in applications to information technology such as signal processing, image processing, and computer graphics.

China has played a significant role in this development of wavelet analysis as evidenced by many fruitful theoretical results and practical applications. A conference on wavelet analysis and its applications was organized to exchange ideas and results with international research groups at Zhongshan University (Guangzhou, China). This volume contains the proceedings from that conference.

Comprised here are selected papers from the conference, covering a wide range of research topics of current interest. Many significant results are included in the study of refinement equations and refinable functions, properties and construction of wavelets, spline wavelets, multi-wavelets, wavelet packets, shift-invariant spaces, approximation schemes and subdivision algorithms, and tilings. Several papers also focus on applications of wavelets to numerical solutions of partial differential equations and integral equations, image processing and facial recognition, computer vision, and feature extraction from data.

Titles in this series are copublished with International Press, Cambridge, MA.

Contributors include: A. Aldroubi, Q. Sun, W.-S. Tang, R. Ashino, C. Heil, M. Nagase, R. Vaillancourt, S. Basu, C. A. Micchelli, P. Olsen, O. Bratteli, P. E. T. Jorgensen, G. J. Chae, H. O. Kim, R. Y. Kim, W. Chen, W. Lin, D.-Q. Dai, T. N. T. Goodman, S. L. Lee, L. Gori, F. Pitolli, B. Han, S. D. Riemenschneider, D. P. Hardin, T. A. Hogan, D. Huang, Z. Wang, Z. Zhang, R.-Q. Jia, Q.-T. Jiang, J. Ning, J. K. Lim, I. Kirat, K.-S. Lau, X.-z. Liang, M.-c. Liu, S. Li, I. Ya. Novikov, J. Tang, S. Kawato, J. Ohya, J. Wang, M. V. Wickerhauser, L. Yang, Y. Y. Tang, P. C. Yuen, G. C. Feng, J. H. Lai, D. Q. Dai, and D.-X. Zhou.

AMS/IP Studies in Advanced Mathematics, Volume 25

March 2002, 326 pages, Softcover, ISBN 0-8218-2991-2, LC 2001056568, 2000 *Mathematics Subject Classification*: 42C40, **All AMS members $44**, List $55, Order code AMSIP/25RT204

Diffusions, Superdiffusions and Partial Differential Equations

E. B. Dynkin, *Cornell University, Ithaca, NY*

Interactions between the theory of partial differential equations of elliptic and parabolic types and the theory of stochastic processes are beneficial for both probability theory and analysis. At the beginning, mostly analytic results were used by probabilists. More recently, analysts (and physicists) took inspiration from the probabilistic approach. Of course, the development of analysis in general and of the theory of partial differential equations in particular, was motivated to a great extent by problems in physics. A difference between physics and probability is that the latter provides not only an intuition, but also rigorous mathematical tools for proving theorems.

The subject of this book is connections between linear and semilinear differential equations and the corresponding Markov processes called diffusions and superdiffusions. Most of the book is devoted to a systematic presentation (in a more general setting, with simplified proofs) of the results obtained

since 1988 in a series of papers of Dynkin and Dynkin and Kuznetsov. Many results obtained originally by using superdiffusions are extended in the book to more general equations by applying a combination of diffusions with purely analytic methods. Almost all chapters involve a mixture of probability and analysis.

Similar to the other books by Dynkin, *Markov Processes* (Springer-Verlag), *Controlled Markov Processes* (Springer-Verlag), and *An Introduction to Branching Measure-Valued Processes* (American Mathematical Society), this book can become a classical account of the presented topics.

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

Colloquium Publications, Volume 50

March 2002, 236 pages, Hardcover, ISBN 0-8218-3174-7, LC 2001058957, 2000 *Mathematics Subject Classification*: 60J60, 35Jxx; 35K55, 60J65, **All AMS members $39**, List $49, Order code COLL/50RT204

Supplementary Reading

Ruled Varieties

An Introduction to Algebraic Differential Geometry

Gerd Fischer and **Jens Piontkowski**

A publication of the Vieweg Verlag.

The simplest surfaces, aside from planes, are the traces of a line moving in ambient space or, more precisely, the unions of one-parameter families of lines. The fact that these lines can be produced using a ruler explains their name, "ruled surfaces". The mechanical production of ruled surfaces is relatively easy, and they can be visualized by means of wire models. These models are not only of practical use, but also provide artistic inspiration.

Mathematically, ruled surfaces are the subject of several branches of geometry, especially differential geometry and algebraic geometry. In classical geometry, especially differential geometry and algebraic geometry. In classical geometry, we know that surfaces of vanishing Gaussian curvature have a ruling that is even developable. Analytically, developable means that the tangent plane is the same for all points of the ruling line, which is equivalent to saying that the surface can be covered by pieces of paper. A classical result from algebraic geometry states that rulings are very rare for complex algebraic surfaces in three-space: Quadrics have two rulings, smooth cubics contain precisely 27 lines, and in general, a surface of degree at least four contains no line at all. There are exceptions, such as cones or tangent surfaces of curves. It is also well-known that these two kinds of surfaces are the only developable ruled algebraic surfaces in projective three-space.

The natural generalization of a ruled surface is a ruled variety, i.e., a variety of arbitrary dimension that is "swept out" by a moving linear subspace of ambient space. It should be noted that a ruling is not an intrinsic but an extrinsic property of a variety, which only makes sense relative to an ambient affine or projective space. This book considers ruled varieties mainly from the point of view of complex projective algebraic geometry, where the strongest tools are available. Some local techniques could be generalized to complex analytic varieties, but in the real analytic or even differentiable case there is little hope for generalization: The reason being that rulings, and especially developable rulings, have the tendency to produce severe singularities.

As in the classical case of surfaces, there is a strong relationship between the subject of this book, ruled varieties, and differential geometry. For the purpose of this book, however, the Hermitian Fubini-Study metric and the related concepts of curvature are not necessary. In order to detect developable rulings, it suffices to consider a bilinear second fundamental form that is the differential of the Gauss map. This method does not give curvature as a number, but rather measures the degree of vanishing of curvature; this point of view has been used in a fundamental paper of Griffiths and Harris. One of the purposes of this book is to make parts of this paper more accessible, to give detailed and more elementary proofs, and to report on recent progress in this area.

The AMS is exclusive distributor in North America, and non-exclusive distributor worldwide except in Germany, Switzerland, Austria, and Japan.

Vieweg Advanced Lectures in Mathematics

May 2001, 141 pages, Softcover, ISBN 3-528-03138-7, 2000 *Mathematics Subject Classification*: 14M99, 53A20, **All AMS members $41**, List $45, Order code VWALM/8RT204

Supplementary Reading

Conformal Field Theory and Topology

Toshitaki Kohno, *University of Tokyo, Japan*

Geometry and physics have been developed with a strong influence on each other. One of the most remarkable interactions between geometry and physics since 1980 has been an application of quantum field theory to topology and differential geometry. This book focuses on a relationship between two-dimensional quantum field theory and three-dimensional topology which has been studied intensively since the discovery of the Jones polynomial in the middle of the 1980s and Witten's invariant for 3-manifolds derived from Chern-Simons gauge theory. An essential difficulty in quantum field theory comes from infinite-dimensional freedom of a system. Techniques dealing with such infinite-dimensional objects developed in the framework of quantum field theory have been influential in geometry as well. This book gives an accessible treatment for a rigorous construction of topological invariants originally defined as partition functions of fields on manifolds.

The book is organized as follows: The Introduction starts from classical mechanics and explains basic background materials in quantum field theory and geometry. Chapter 1 presents conformal field theory based on the geometry of loop groups. Chapter 2 deals with the holonomy of conformal field theory. Chapter 3 treats Chern-Simons perturbation theory. The final chapter discusses topological invariants for 3-manifolds derived from Chern-Simons perturbation theory.

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

Translations of Mathematical Monographs (*Iwanami Series in Modern Mathematics*), Volume 210

May 2002, approximately 184 pages, Softcover, ISBN 0-8218-2130-X, 2000 *Mathematics Subject Classification*: 54C40, 14E20; 46E25, 20C20, **All AMS members $28**, List $35, Order code MMONO/210RT204

Recommended Text

Introduction to the Theory of Random Processes

N. V. Krylov, *University of Minnesota, Minneapolis*

This book concentrates on some general facts and ideas of the theory of stochastic processes. The topics include the Wiener process, stationary processes, infinitely divisible processes, and Itô stochastic equations.

Basics of discrete time martingales are also presented and then used in one way or another throughout the book. Another common feature of the main body of the book is using stochastic integration with respect to random orthogonal measures. In particular, it is used for spectral representation of trajectories of stationary processes and for proving that Gaussian stationary processes with rational spectral densities are components of solutions to stochastic equations. In the case of infinitely divisible processes, stochastic integration allows for obtaining a representation of trajectories through jump measures. The Itô stochastic integral is also introduced as a particular case of stochastic integrals with respect to random orthogonal measures.

Although it is not possible to cover even a noticeable portion of the topics listed above in a short book, it is hoped that after having followed the material presented here, the reader will have acquired a good understanding of what kind of results are available and what kind of techniques are used to obtain them.

With more than 100 problems included, the book can serve as a text for an introductory course on stochastic processes or for independent study.

Other works by this author published by the AMS include, *Lectures on Elliptic and Parabolic Equations in Hölder Spaces* and *Introduction to the Theory of Diffusion Processes*.

Graduate Studies in Mathematics, Volume 43

April 2002, approximately 240 pages, Hardcover, ISBN 0-8218-2985-8, 2000 *Mathematics Subject Classification*: 60–01; 60G99, **All AMS members $28**, List $35, Order code GSM/43RT204

Quantum Computation

A Grand Mathematical Challenge for the Twenty-First Century and the Millennium

Samuel J. Lomonaco, Jr., Editor

This book presents written versions of the eight lectures given during the AMS Short Course held at the Joint Mathematics Meetings in Washington, D.C. The objective of this course was to share with the scientific community the many exciting mathematical challenges arising from the new field of quantum computation and quantum information science. The course was geared toward demonstrating the great breadth and depth of this mathematically rich research field. Interrelationships with existing mathematical research areas were emphasized as much as possible. Moreover, the course was designed so that participants with little background in quantum mechanics would, upon completion, be prepared to begin reading the research literature on quantum computation and quantum information science.

Based on audience feedback and questions, the written versions of the lectures have been greatly expanded, and supplementary material has been added. The book features an overview of relevant parts of quantum mechanics with an introduction to quantum computation, including many potential quantum mechanical computing devices; introduction to quantum algorithms and quantum complexity theory; in-depth discussion on quantum error correcting codes and quantum cryptography; and finally, exploration into diverse connections between quantum computation and various areas of mathematics and physics.

Contributors include: S. J. Lomonaco, Jr., H. E. Brandt, P. W. Shor, U. V. Vazirani, D. Gottesman, A. Kitaev, and L. H. Kauffman.

Proceedings of Symposia in Applied Mathematics, Volume 58

March 2002, approximately 360 pages, Hardcover, ISBN 0-8218-2084-2, LC 2001055366, 2000 *Mathematics Subject Classification*: 81–01, 81–02, 81P68, 68Q05, 94A60; 22E70, 57M99, 81V80, 94A15, **Individual member $41**, List $69, Institutional member $55, Order code PSAPM/58RT204

Far-from-Equilibrium Dynamics

Yasumasa Nishiura, *Hokkaido University, Sapporo, Japan*

This book is devoted to the study of evolution of nonequilibrium systems. Such a system usually consists of regions with different dominant scales, which coexist in the space-time where the system lives. In the case of high nonuniformity in special direction, one can see patterns separated by clearly distinguishable boundaries or interfaces.

The author considers several examples of nonequilibrium systems. One of the examples describes the invasion of the solid phase into the liquid phase during the crystallization process. Another example is the transition from oxidized to reduced states in certain chemical reactions. An easily understandable example of the transition in the temporal direction is a sound beat, and the author describes typical patterns associated with this phenomenon.

The main goal of the book is to present a mathematical approach to the study of highly nonuniform systems and to illustrate it with examples from physics and chemistry. The two main theories discussed are the theory of singular perturbations and the theory of dissipative systems. A set of carefully selected examples of physical and chemical systems nicely illustrates the general methods described in the book.

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

Translations of Mathematical Monographs (*Iwanami Series in Modern Mathematics*), Volume 209

March 2002, approximately 336 pages, Softcover, ISBN 0-8218-2625-5, 2000 *Mathematics Subject Classification*: 34D15, 35B25, 35B32, 35B40, 35K57, 37D10, 37L10, 74N20, **All AMS members $47**, List $59, Order code MMONO/209RT204