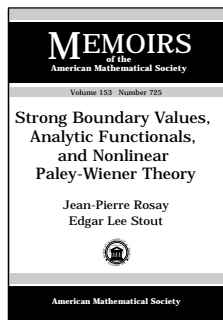


# New Publications Offered by the AMS

## Algebra and Algebraic Geometry



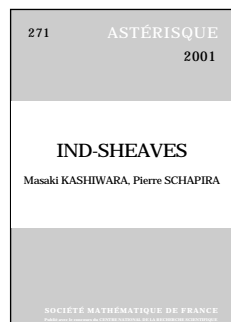
### Strong Boundary Values, Analytic Functionals, and Nonlinear Paley-Wiener Theory

Jean-Pierre Rosay, *University of Wisconsin, Madison* and Edgar Lee Stout, *University of Washington, Seattle*

**Contents:** Introduction; Preliminaries on analytic functionals and hyperfunctions; Appendix on good compact sets; Analytic functionals as boundary values; Nonlinear Paley-Wiener theory; Strong boundary values; Strong boundary values for the solutions of certain partial differential equations; Comparison with other notions of boundary values; Boundary values via Cousin decompositions; The Schwarz reflection principle; References; Index of notions.

**Memoirs of the American Mathematical Society**, Volume 153, Number 725

September 2001, 94 pages, Softcover, ISBN 0-8218-2712-X, 2000 *Mathematics Subject Classification*: 46F15, 32A10; 32A40, 32A45, 32E10, 32E20, 32E35, 32E30, 35G15, 35J67, 42B99, 46A22, 46E10, 35J70, 58J32, **Individual member \$27**, List \$45, Institutional member \$36, Order code MEMO/153/725N



### Ind-Sheaves

Masaki Kashiwara, *Kyoto University, Japan* and Pierre Schapira, *University of Paris VI, France*

*A publication of the Société Mathématique de France.*

Sheaf theory is not well suited to the study of various objects in analysis that are not defined by local properties. The aim of this paper is to show

that it is possible to overcome this difficulty by enlarging the category of sheaves to that of ind-sheaves, and by extending to ind-sheaves the machinery of sheaves.

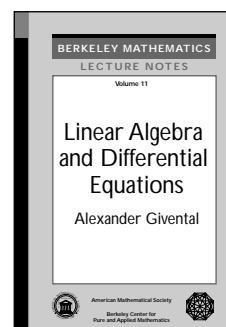
Let  $X$  be a locally compact topological space and let  $k$  be a commutative ring. The authors define the category  $I(k_X)$  of ind-sheaves of  $k$ -modules on  $X$  as the category of ind-objects of the category  $Mod^c(k_X)$  of sheaves of  $k$ -modules on  $X$  with compact support, and they construct “Grothendieck’s six operations” in the derived categories of ind-sheaves, as well as new functors which arise naturally.

A method for constructing ind-sheaves is the use of Grothendieck topologies associated with families  $T$  of open subsets satisfying suitable properties. Sheaves on the site  $X_T$  naturally define ind-sheaves.

When  $X$  is a real analytic manifold, the authors consider the subanalytic site  $X_{sa}$  associated with the family of open subanalytic subsets, and construct various ind-sheaves by this way. They obtain in particular the ind-sheaf  $C_X^{\infty,t}$  of tempered  $C^\infty$ -functions, the ind-sheaf  $C_X^{\infty,w}$  of Whitney  $C^\infty$ -functions and the ind-sheaf  $Db_X^t$  of tempered distributions. On a complex manifold  $X$ , they concentrate on the study of the ind-sheaf  $O_X^t$  of “tempered holomorphic functions” and prove an adjunction formula for integral transforms in this framework.

**Astérisque**, Number 271

May 2001, Softcover, ISBN 2-85629-099-X, 2000 *Mathematics Subject Classification*: 18F20, 32C38, 32S60, **Individual member \$30**, List \$33, Order code AST/271N



**Recommended Text**

### Linear Algebra and Differential Equations

Alexander Givental, *University of California, Berkeley*

This is based on the course, “Linear Algebra and Differential Equations”, taught by the author to sophomore students at UC Berkeley.

**From the Introduction:** “We accept the currently acting syllabus as an outer constraint ... but otherwise we stay rather far from conventional routes.

“In particular, at least half of the time is spent to present the entire agenda of linear algebra and its applications in the 2D environment; Gaussian elimination occupies a visible but

supporting position; abstract vector spaces intervene only in the review section. Our eye is constantly kept on *why?*, and very few facts (the fundamental theorem of algebra, the uniqueness and existence theorem for solutions of ordinary differential equations, the Fourier convergence theorem, and the higher-dimensional Jordan normal form theorem) are stated and discussed without proof.”

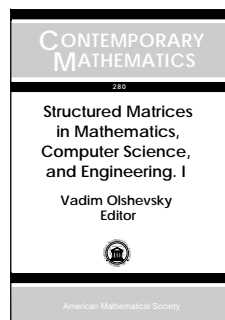
Specific material in the book is organized as follows: Chapter 1 discusses geometry on the plane, including vectors, analytic geometry, linear transformations and matrices, complex numbers, and eigenvalues. Chapter 2 presents differential equations (both ODEs and PDEs), Fourier series, and the Fourier method. Chapter 3 discusses classical problems of linear algebra, matrices and determinants, vectors and linear systems, Gaussian elimination, quadratic forms, eigenvectors, and vector spaces. The book concludes with a sample final exam.

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

**Contents:** Geometry on the plane; Differential equations; Linear algebra.

**Berkeley Mathematical Lecture Notes**, Volume 11

August 2001, 132 pages, Softcover, ISBN 0-8218-2850-9, 2000 *Mathematics Subject Classification:* 15-01; 34-01, 35-01, 51-01, **All AMS members \$15**, List \$19, Order code BMLN/11N



## Structured Matrices in Mathematics, Computer Science, and Engineering I and II

Vadim Olshevsky, *Georgia State University, Atlanta*, Editor

Many important problems in applied sciences, mathematics, and engineering can be reduced to matrix problems. Moreover, various applications often introduce a special structure into the corresponding matrices, so that their entries can be described by a certain compact formula. Classic examples include Toeplitz matrices, Hankel matrices, Vandermonde matrices, Cauchy matrices, Pick matrices, Bezoutians, controllability and observability matrices, and others. Exploiting these and the more general structures often allows us to obtain elegant solutions to mathematical problems as well as to design more efficient practical algorithms for a variety of applied engineering problems.

Structured matrices have been under close study for a long time and in quite diverse (and seemingly unrelated) areas, for example, mathematics, computer science, and engineering. Considerable progress has recently been made in all these areas, and especially in studying the relevant numerical and computational issues. In the past few years, a number of practical algorithms blending speed and accuracy have been developed. This significant growth is fully reflected in these volumes, which collect 38 papers devoted to the numerous aspects of the topic.

The collection of the contributions to these volumes offers a flavor of the plethora of different approaches to attack structured matrix problems. The reader will find that the theory of

structured matrices is positioned to bridge diverse applications in the sciences and engineering, deep mathematical theories, as well as computational and numerical issues. The presentation fully illustrates the fact that the techniques of engineers, mathematicians, and numerical analysts nicely complement each other, and they all contribute to one unified theory of structured matrices.

The book is published in two volumes. The first contains articles on interpolation, system theory, signal and image processing, control theory, and spectral theory. Articles in the second volume are devoted to fast algorithms, numerical and iterative methods, and various applications.

**Contents for Part I: Interpolation and approximation:** H. Dym, Structured matrices, reproducing kernels and interpolation; V. Olshevsky and A. Shokrollahi, A superfast algorithm for confluent rational tangential interpolation problem via matrix-vector multiplication for confluent Cauchy-like matrices; S. A. Goreinov and E. E. Tyrtyshnikov, The maximal-volume concept in approximation by low-rank matrices; M. H. Gutknecht, A matrix interpretation of the extended Euclidean algorithm; V. M. Adukov, The essential polynomial approach to convergence of matrix Padé approximants; *System theory, signal and image processing:* P. Dewilde, Systems of low Hankel rank: A survey; E. Kofidis and P. A. Regalia, Tensor approximation and signal processing applications; I. K. Proudlar, Exploiting Toeplitz-like structure in adaptive filtering algorithms using signal flow graphs; N. Mastronardi, P. Lemmerling, and S. Van Huffel, The structured total least squares problem; W. K. Cochran, R. J. Plemmons, and T. C. Torgersen, Exploiting Toeplitz structure in atmospheric image restoration; *Control theory:* A. C. Antoulas, D. C. Sorensen, and S. Gugercin, A survey of model reduction methods for large-scale systems; B. N. Datta and D. R. Sarkissian, Theory and computations of some inverse Eigenvalue problems for the quadratic pencil; D. Calvetti, B. Lewis, and L. Reichel, Partial Eigenvalue assignment for large linear control systems; H. Faßbender and P. Benner, A hybrid method for the numerical solution of discrete-time algebraic Riccati equations; *Spectral properties. Conditioning:* A. Böttcher and S. Grudsky, Condition numbers of large Toeplitz-like matrices; V. Olshevsky and D. Fasino, How bad are symmetric Pick matrices?; M. Fiedler, Spectral properties of real Hankel matrices; L. Elsner and S. Friedland, Conjectures and remarks on the limit of the spectral radius of nonnegative and block Toeplitz matrices.

**Contemporary Mathematics**, Volume 280

September 2001, approximately 320 pages, Softcover, ISBN 0-8218-1921-6, 2000 *Mathematics Subject Classification:* 15-XX, 47-XX, 65-XX, 93-XX, **Individual member \$47**, List \$79, Institutional member \$63, Order code CONM/280N

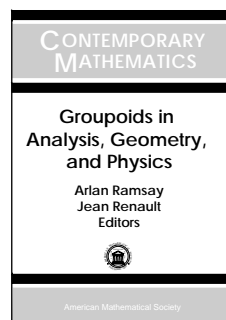
**Contents for Part II: Fast algorithms:** G. Heinig and V. Olshevsky, The Schur algorithm for matrices with Hessenberg displacement structure; Y. Eidelman and I. Gohberg, Fast inversion algorithms for a class of block structured matrices; S. Chandrasekaran and M. Gu, A fast and stable solver for recursively semi-separable systems of linear equations; *Numerical issues:* M. Stewart, Stability properties of several variants of the unitary Hessenberg QR algorithm; M. Kim, H. Park, and L. Eldén, Comparison of algorithms for Toeplitz least squares and symmetric positive definite linear systems; G. Heinig, Stability of Toeplitz matrix inversion formulas; J. Demmel and P. Koev, Necessary and sufficient conditions for accurate and efficient rational function evaluation and factorizations of rational matrices; M. Van Barel and A. Bultheel, Updating and downdating of

orthonormal polynomial vectors and some applications; **P. C. Hansen** and **P. Yalamov**, Rank-revealing decompositions of symmetric Toeplitz matrices; *Iterative methods*. *Preconditioners*: **R. H. Chan**, **M. K. Ng**, and **A. M. Yip**, A survey of preconditioners for ill-conditioned Toeplitz systems; **D. Potts** and **G. Steidl**, Preconditioning of Hermitian block-Toeplitz-Toeplitz-block matrices by level-1 preconditioners; *Linear algebra and various applications*: **D. A. Bini** and **B. Meini**, Approximate displacement rank and applications; **W. F. Trench**, Properties of some generalizations of Kac-Murdock-Szegö matrices; **G. Heinig** and **K. Rost**, Efficient inversion formulas for Toeplitz-plus-Hankel matrices using trigonometric transformations; **L. Gemignani**, On a generalization of Poincaré's theorem for matrix difference equations arising from root-finding problems; **L. Rodman**, Completions of triangular matrices: A survey of results and open problems; **S. S. Capizzano** and **C. T. Possio**, Positive representation formulas for finite difference discretizations of (elliptic) second order PDEs; **P. Tilli**, On some problems involving invariant norms and Hadamard products; **Y. S. Choi**, **I. Koltracht**, and **P. J. McKenna**, A generalization of the Perron-Frobenius theorem for non-linear perturbations of Stieltjes matrices; **M. J. C. Gover** and **A. M. Byrne**, The Rhombus matrix: Definition and properties.

#### Contemporary Mathematics, Volume 281

October 2001, approximately 339 pages, Softcover, ISBN 0-8218-2092-3, 2000 *Mathematics Subject Classification*: 15-XX, 47-XX, 65-XX, 93-XX, **Individual member \$47**, List \$79, Institutional member \$63, Order code CONM/281N

Set: Softcover, LC 88-22155, **Individual member \$89**, List \$149, Institutional member \$119, Order code CONMSET



## Groupoids in Analysis, Geometry, and Physics

**Arlan Ramsay**, *University of Colorado, Boulder*, and **Jean Renault**, *Université d'Orléans, France*, Editors

Groupoids often occur when there is symmetry of a nature not expressible in terms of groups. Other uses of

groupoids can involve something of a dynamical nature. Indeed, some of the main examples come from group actions. It should also be noted that in many situations where groupoids have been used, the main emphasis has not been on symmetry or dynamics issues. While the implicit symmetry and dynamics are relevant, the groupoid records mostly the structure of the space of leaves and the holonomy. More generally, the use of groupoids is very much related to various notions of orbit equivalence.

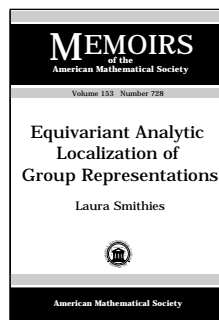
This book presents the proceedings from the Joint Summer Research Conference on "Groupoids in Analysis, Geometry, and Physics" held in Boulder, CO. The book begins with an introduction to ways in which groupoids allow a more comprehensive view of symmetry than is seen via groups. Topics range from foliations, pseudo-differential operators, *KK*-theory, amenability, Fell bundles, and index theory to quantization of Poisson manifolds. Readers will find examples of important tools for working with groupoids.

This book is geared to students and researchers. It is intended to improve their understanding of groupoids and to encourage them to look further while learning about the tools used.

**Contents**: **A. Weinstein**, Groupoids: Unifying internal and external symmetry-A tour through some examples; **D. P. Williams**, A primer for the Brauer group of a groupoid; **C. Anantharaman** and **J. Renault**, Amenable groupoids; **G. Della Rocca** and **M. Takesaki**, The role of groupoids in classification theory. A new approach. The UHF algebra case; **P. S. Muhly**, Bundles over groupoids; **A. Haefliger**, Groupoids and foliations; **I. Moerdijk**, Etale groupoids, derived categories, and operations; **A. L. T. Paterson**, The analytic index for proper, Lie groupoid actions; **P.-Y. Le Gall**, Groupoid  $C^*$ -algebras and operator  $K$ -theory; **B. Monthubert**, Groupoids of manifolds with corners and index theory; **N. P. Landsman** and **B. Ramazan**, Quantization of Poisson algebras associated to Lie algebroids.

#### Contemporary Mathematics

October 2001, approximately 206 pages, Softcover, ISBN 0-8218-2042-7, 2000 *Mathematics Subject Classification*: 22A22, 35S05, 46Lxx, 53C12, 53D50, 57R30, 58H05, **Individual member \$35**, List \$59, Institutional member \$47, Order code CONM-RAMSAYN



## Equivariant Analytic Localization of Group Representations

**Laura Smithies**, *Kent State University, OH*

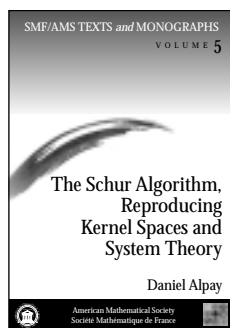
**Contents**: Introduction; Preliminaries; The category  $\mathcal{T}$ ; Two equivalences of categories; The category  $D_{G_0}^b(\mathcal{D}_X)$ ; Descended structures; The category  $D_{G_0}^b(\mathcal{U}_0(\mathfrak{g}))$ ; Localization; Our main equivalence of categories; Equivalence for any regular weight  $\lambda$ ; Bibliography.

**Memoirs of the American Mathematical Society**, Volume 153, Number 728

September 2001, 90 pages, Softcover, ISBN 0-8218-2725-1, LC 2001032796, 2000 *Mathematics Subject Classification*: 22E46, 18B40, **Individual member \$27**, List \$45, Institutional member \$36, Order code MEMO/153/728N

## Analysis

Recommended Text



## The Schur Algorithm, Reproducing Kernel Spaces and System Theory

Daniel Alpay, *Ben-Gurion University of the Negev, Beer-sheva, Israel*

*From a review of the French edition: This excellent survey showing a rich interplay between functional analysis,*

*complex analysis and systems science is very informative and can be highly recommended to functional analysts curious about the systems science impact of their discipline or to theoretically inclined systems scientists, in particular those involved in the realization theory.*

—*Zentralblatt für Mathematik*

The class of Schur functions consists of analytic functions on the unit disk that are bounded by 1. The Schur algorithm associates to any such function a sequence of complex constants, which is much more useful than the Taylor coefficients. There is a generalization to matrix-valued functions and a corresponding algorithm. These generalized Schur functions have important applications to the theory of linear operators, to signal processing and control theory, and to other areas of engineering.

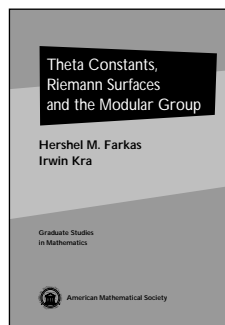
In this book, Alpay looks at matrix-valued Schur functions and their applications from the unifying point of view of spaces with reproducing kernels. This approach is used here to study the relationship between the modeling of time-invariant dissipative linear systems and the theory of linear operators. The inverse scattering problem plays a key role in the exposition. The point of view also allows for a natural way to tackle more general cases, such as nonstationary systems, non-positive metrics, and pairs of commuting nonself-adjoint operators. This is the English translation of a volume originally published in French by the Société Mathématique de France. Translated by Stephen S. Wilson.

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

**Contents:** Introduction; Reproducing kernel spaces; Theory of linear systems; Schur algorithm and inverse scattering problem; Operator models; Interpolation; The indefinite case; The non-stationary case; Riemann surfaces; Conclusion; Bibliography; Index.

SMF/AMS Texts and Monographs, Volume 5

August 2001, 150 pages, Softcover, ISBN 0-8218-2155-5, LC 2001031602, 2000 *Mathematics Subject Classification*: 46E22, 93-02, **All AMS members \$39**, List \$49, Order code SMFAMS/5N



## Theta Constants, Riemann Surfaces and the Modular Group

An Introduction with Applications to Uniformization Theorems, Partition Identities and

## Combinatorial Number Theory

Hershel M. Farkas, *The Hebrew University, Jerusalem, Israel*, and Irwin Kra, *State University of New York, Stony Brook*

There are incredibly rich connections between classical analysis and number theory. For instance, analytic number theory contains many examples of asymptotic expressions derived from estimates for analytic functions, such as in the proof of the Prime Number Theorem. In combinatorial number theory, exact formulas for number-theoretic quantities are derived from relations between analytic functions. Elliptic functions, especially theta functions, are an important class of such functions in this context, which had been made clear already in Jacobi's *Fundamenta nova*. Theta functions are also classically connected with Riemann surfaces and with the modular group  $= \text{PSL}(2, \mathbb{Z})$ , which provide another path for insights into number theory.

Farkas and Kra, well-known masters of the theory of Riemann surfaces and the analysis of theta functions, uncover here interesting combinatorial identities by means of the function theory on Riemann surfaces related to the principal congruence subgroups,  $\Gamma(k)$ . For instance, the authors use this approach to derive congruences discovered by Ramanujan for the partition function, with the main ingredient being the construction of the same function in more than one way. The authors also obtain a variant on Jacobi's famous result on the number of ways that an integer can be represented as a sum of four squares, replacing the squares by triangular numbers and in the process, obtaining a cleaner result.

The recent trend of applying the ideas and methods of algebraic geometry to the study of theta functions and number theory has resulted in great advances in the area. However, the authors choose to stay with the classical point of view. As a result, their statements and proofs are very concrete. In this book the mathematician familiar with the algebraic geometry approach to theta functions and number theory will find many interesting ideas as well as detailed explanations and derivations of new and old results.

Highlights of the book include systematic studies of theta constant identities, uniformizations of surfaces represented by subgroups of the modular group, partition identities, and Fourier coefficients of automorphic functions.

Prerequisites are a solid understanding of complex analysis, some familiarity with Riemann surfaces, Fuchsian groups, and elliptic functions, and an interest in number theory. The book contains summaries of some of the required material, particularly for theta functions and theta constants.

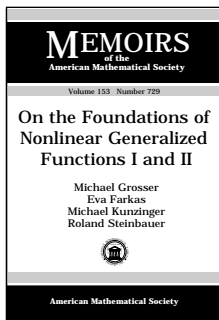
Readers will find here a careful exposition of a classical point of view of analysis and number theory. Presented are numerous examples plus suggestions for research-level problems. The text is suitable for a graduate course or for independent reading.

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

**Contents:** The modular group and elliptic function theory; Theta functions with characteristics; Function theory for the modular group  $\Gamma$  and its subgroups; Theta constant identities; Partition theory: Ramanujan congruences and generalizations; Identities related to partition functions; Combinatorial and number theoretic applications; Bibliography; Bibliographical notes; Index.

#### Graduate Studies in Mathematics

October 2001, approximately 552 pages, Hardcover, ISBN 0-8218-1392-7, LC 2001035711, 2000 *Mathematics Subject Classification*: 30F35, 30F30, 11F20, 11F25, 11F30, 11P81, 11P82, 11P83, 14H42, 14H45, 14H55, 20H10, **All AMS members \$55**, List \$69, Order code GSM-FARKASN



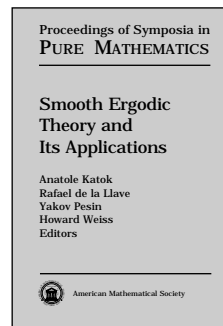
## On the Foundations of Nonlinear Generalized Functions I and II

**Michael Grosser**, *Universitat Wien, Austria*, **Eva Farkas**, *Universitat Wien, Austria*, and **Michael Kunzinger** and **Roland Steinbauer**, *University of Wein, Austria*

**Contents:** *Part 1. On the Foundations of Nonlinear Generalized Functions I:* Introduction; Notation and terminology; Scheme of construction; Calculus; C- and J-formalism; Calculus on  $U_\varepsilon(\Omega)$ ; Construction of a diffeomorphism invariant Colombeau algebra; Sheaf properties; Separating the basic definition from testing; Characterization results; Differential equations; *Part 2. On the Foundations of Nonlinear Generalized Functions II:* Introduction to Part 2; A simple condition equivalent to negligibility; Some more calculus; Non-injectivity of the canonical homomorphism from  $\mathcal{G}^d(\Omega)$  into  $\mathcal{G}^e(\Omega)$ ; Classification of smooth Colombeau algebras between  $\mathcal{G}^d(\Omega)$  and  $\mathcal{G}^e(\Omega)$ ; The algebra  $\mathcal{G}^2$ ; classification results; Concluding remarks; Acknowledgments; Bibliography.

**Memoirs of the American Mathematical Society**, Volume 153, Number 729

August 2001, 93 pages, Softcover, ISBN 0-8218-2729-4, LC 2001032795, 2000 *Mathematics Subject Classification*: 46F30; 26E15, 46E50, 35D05, **Individual member \$27**, List \$45, Institutional member \$36, Order code MEMO/153/729N



## Smooth Ergodic Theory and Its Applications

**Anatole Katok**, *Pennsylvania State University, University Park*, **Rafael de la Llave**, *University of Texas at Austin*, and **Yakov Pesin** and **Howard Weiss**, *Pennsylvania State University, University Park*, Editors

*University, University Park*, Editors

During the past decade, there have been several major new developments in smooth ergodic theory which have attracted substantial interest to the field from mathematicians as well as scientists using dynamics in their work. In spite of the impressive literature, it has been extremely difficult for a student—or even an established mathematician who is not an expert in the area—to acquire a working knowledge of smooth ergodic theory and to learn how to use its tools.

Accordingly, the AMS Summer Research Institute on Smooth Ergodic Theory and Its Applications (Seattle, WA) had a strong educational component, including ten mini-courses on various aspects of the topic that were presented by leading experts in the field. This volume presents the proceedings of that conference.

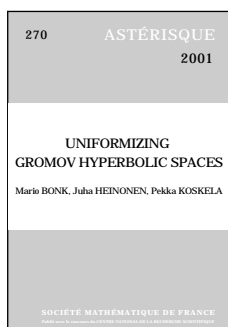
Smooth ergodic theory studies the statistical properties of differentiable dynamical systems, whose origin traces back to the seminal works of Poincaré and later, many great mathematicians who made contributions to the development of the theory. The main topic of this volume, smooth ergodic theory, especially the theory of nonuniformly hyperbolic systems, provides the principle paradigm for the rigorous study of complicated or *chaotic* behavior in deterministic systems. This paradigm asserts that if a non-linear dynamical system exhibits sufficiently pronounced exponential behavior, then global properties of the system can be deduced from studying the linearized system. One can then obtain detailed information on topological properties (such as the growth of periodic orbits, topological entropy, and dimension of invariant sets including attractors), as well as statistical properties (such as the existence of invariant measures, asymptotic behavior of typical orbits, ergodicity, mixing, decay of correlations, and measure-theoretic entropy). Smooth ergodic theory also provides a foundation for numerous applications throughout mathematics (e.g., Riemannian geometry, number theory, Lie groups, and partial differential equations), as well as other sciences.

This volume serves a two-fold purpose: first, it gives a useful gateway to smooth ergodic theory for students and nonspecialists, and second, it provides a state-of-the-art report on important current aspects of the subject. The book is divided into three parts: lecture notes consisting of three long expositions with proofs aimed to serve as a comprehensive and self-contained introduction to a particular area of smooth ergodic theory; thematic sections based on mini-courses or surveys held at the conference; and original contributions presented at the meeting or closely related to the topics that were discussed there.

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

**Contents:** *Lecture notes:* **L. Barreira** and **Ya. Pesin**, Lectures on Lyapunov exponents and smooth ergodic theory; Appendix by **M. Brin**: Hölder continuity of invariant distributions; Appendix by **D. Dolgopyat**, **H. Hu** and **Ya. Pesin**: An example of a smooth hyperbolic measure with countably many ergodic components; **A. Katok** and **E. A. Robinson, Jr.**, Cocycles, cohomology and combinatorial constructions in ergodic theory; **R. de la Llave**, A tutorial on KAM theory; *Survey-expository articles:* *Systems with hyperbolic behavior:* **V. Baladi**, Decay of correlations; **K. Burns**, **C. Pugh**, **M. Shub**, and **A. Wilkinson**, Recent results about stable ergodicity; **H. Hu**, Statistical properties of some almost hyperbolic systems; **Y. Kifer**, Random  $\epsilon$ -expansions; **M. Pollicott**, Dynamical zeta functions; **J. Schmeling** and **H. Weiss**, An overview of the dimension theory of dynamical systems; **G. Świątek**, Collet-Eckmann condition in one-dimensional dynamics; **M. P. Wojtkowski**, Monotonicity,  $J$ -algebra of Potapov and Lyapunov exponents; *Geodesic flows:* **P. Eberlein**, Geodesic flows in manifolds of nonpositive curvature; **G. Knieper**, Closed geodesics and the uniqueness of the maximal measure for rank 1 geodesic flows; *Algebraic systems and rigidity:* **B. Kalinin** and **A. Katok**, Invariant measures for actions of higher rank abelian groups; **D. Kleinbock**, Some applications of homogeneous dynamics to number theory; **K. Schmidt**, Measurable rigidity of algebraic  $\mathbb{Z}^d$ -actions; *KAM-theory:* **L. H. Eliasson**, Almost reducibility of linear quasi-periodic systems; **J. Pöschel**, A lecture on the classical KAM theorem; *Research articles:* **J. Buzzi**, Thermodynamical formalism for piecewise invertible maps: Absolutely continuous invariant measures as equilibrium states; **M. Guysinsky**, Smoothness of holonomy maps derived from unstable foliation; **V. Niţică** and **F. Xavier**, Schrödinger operators and topological pressure on manifolds of negative curvature; **N. Peyerimhoff**, Isoperimetric and ergodic properties of horospheres in symmetric spaces; **A. Windsor**, Minimal but not uniquely ergodic diffeomorphisms; **M. Jakobson**, Piecewise smooth maps with absolutely continuous invariant measures and uniformly scaled Markov partitions.

October 2001, 867 pages, Hardcover, ISBN 0-8218-2682-4, LC 2001041216, 2000 *Mathematics Subject Classification:* 11-XX, 28-XX, 34Cxx, 34Dxx, 37-XX, 53-XX, 70-XX, **Individual member \$98**, List \$164, Institutional member \$131, Order code PSPUM-PESINN



Supplementary Reading

## Uniformizing Gromov Hyperbolic Spaces

**Mario Bonk**, *University of Michigan, Ann Arbor*,  
**Juha Heinonen**, *University of Michigan, Ann Arbor*, and  
**Pekka Koskela**, *University of Jyväskylä, Finland*

A publication of the *Société Mathématique de France*.

The unit disk in the complex plane has two conformally related lives: one as an incomplete space with the metric inherited from  $\mathbb{R}^2$ , the other as a complete Riemannian 2-manifold of constant negative curvature. Consequently, problems in conformal analysis can often be formulated in two equivalent ways depending on which metric one chooses to use. The purpose of this volume is to show that a similar choice is available in much more generality.

Here, the authors replace the incomplete disk by a uniform metric space (defined as a generalization of a uniform domain in  $\mathbb{R}^n$ ) and the space of constant negative curvature by a general Gromov hyperbolic space. They then prove that there is a one-to-one correspondence between quasiisometry classes of (proper, geodesic, and roughly starlike) Gromov hyperbolic spaces and the quasisimilarity classes of bounded locally compact uniform spaces. They study Euclidean domains that are Gromov hyperbolic with respect to the quasihyperbolic metric and the Martin boundaries of such domains. A characterization of planar Gromov hyperbolic domains is given. They also study quasiconformal homeomorphisms of Gromov hyperbolic spaces of bounded geometry; under mild conditions on the spaces they prove that such maps are rough quasiisometries. They employ a version of the classical Gehring-Hayman theorem and methods from analysis on metric spaces such as modulus estimates on Loewner spaces.

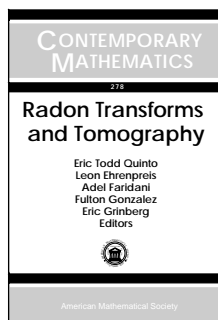
This item will also be of interest to those working in geometry and topology.

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Astérisque, Number 270

May 2001, Softcover, ISBN 2-85629-098-1, 2000 *Mathematics Subject Classification:* 30C65, **Individual member \$30**, List \$33, Order code AST/270N

## Applications



## Radon Transforms and Tomography

**Eric Todd Quinto**, *Tufts University, Medford, MA*,  
**Leon Ehrenpreis**, *Temple University, Philadelphia, PA*,  
**Adel Faridani**, *Oregon State University, Corvallis*,  
**Fulton Gonzalez**, *Tufts University, Medford, MA*, and

**Eric Grinberg**, *Temple University, Philadelphia*,  
 Editors

One of the most exciting features of the fields of Radon transforms and tomography is the strong relationship between high-level pure mathematics and applications to areas such as medical imaging and industrial nondestructive evaluation. The proceedings featured in this volume bring together fundamental research articles in the major areas of Radon transforms and tomography.

This volume includes expository papers that are of special interest to beginners as well as advanced researchers. Topics include local tomography and wavelets, Lambda tomography and related methods, tomographic methods in RADAR, ultrasound, Radon transforms and differential equations, and the Pompeiu problem.

The major themes in Radon transforms and tomography are represented among the research articles. Pure mathematical themes include vector tomography, microlocal analysis, twistor

theory, Lie theory, wavelets, harmonic analysis, and distribution theory. The applied articles employ high-quality pure mathematics to solve important practical problems. Effective scanning geometries are developed and tested for a NASA wind tunnel. Algorithms for limited electromagnetic tomographic data and for impedance imaging are developed and tested. Range theorems are proposed to diagnose problems with tomography scanners. Principles are given for the design of X-ray tomography reconstruction algorithms, and numerical examples are provided.

This volume offers readers a comprehensive source of fundamental research useful to both beginners and advanced researchers in the fields.

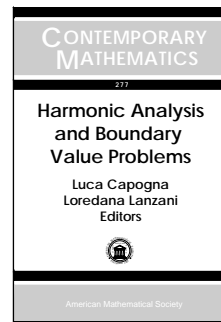
This item will also be of interest to those working in geometry and topology.

**Contents:** *Expository papers:* C. A. Berenstein, Local tomography and related problems; M. Cheney, Tomography problems arising in synthetic aperture radar; A. Faridani, K. A. Buglione, P. Huabsomboon, O. D. Iancu, and J. McGrath, Introduction to local tomography; F. Natterer, Algorithms in ultrasound tomography; E. T. Quinto, Radon transforms, differential equations, and microlocal analysis; L. Zalcman, Supplementary bibliography to "A bibliographic survey of the Pompeiu problem"; *Research papers:* T. Bailey and M. Eastwood, Twistor results for integral transforms; J. Boman, Injectivity for a weighted vectorial Radon transform; O. Dorn, E. L. Miller, and C. M. Rappaport, Shape reconstruction in 2D from limited-view multifrequency electromagnetic data; L. Ehrenpreis, Three problems at Mount Holyoke; F. B. Gonzalez, A Paley-Wiener theorem for central functions on compact Lie groups; I. Pesenson and E. L. Grinberg, Inversion of the spherical Radon transform by a Poisson type formula; S. H. Izen and T. J. Bencic, Application of the Radon transform to calibration of the NASA-Glenn icing research wind tunnel; A. Katsevich, Range theorems for the Radon transform and its dual; S. K. Patch, Moment conditions *indirectly* improve image quality; A. Rieder, Principles of reconstruction filter design in 2D-computerized tomography; B. Rubin and D. Ryabogin, The  $k$ -dimensional Radon transform on the  $n$ -sphere and related wavelet transforms; S. Siltanen, J. L. Mueller, and D. Isaacson, Reconstruction of high contrast 2-D conductivities by the algorithm of A. Nachman; L. B. Vertgeim, Integral geometry problem with incomplete data for tensor fields in a complex space.

**Contemporary Mathematics**, Volume 278

August 2001, 261 pages, Softcover, ISBN 0-8218-2135-0, LC 2001033762, 2000 *Mathematics Subject Classification:* 44A12, 92C55, 92F05, 65T60, 35R30; 43-02, 42A38, 30E05, 43A77, 32L25, **Individual member \$41**, List \$69, Institutional member \$55, Order code CONM/278N

## Differential Equations



### Harmonic Analysis and Boundary Value Problems

Luca Capogna and Loredana Lanzani, *University of Arkansas, Fayetteville*, Editors

This volume presents research and expository articles by the participants of the 25th Arkansas Spring Lecture Series on "Recent Progress in the

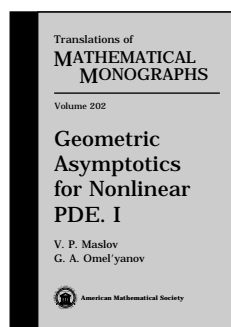
Study of Harmonic Measure from a Geometric and Analytic Point of View" held at the University of Arkansas (Fayetteville). Papers in this volume provide clear and concise presentations of many problems that are at the forefront of harmonic analysis and partial differential equations.

The following topics are featured: the solution of the Kato conjecture, the "two bricks" problem, new results on Cauchy integrals on non-smooth curves, the Neumann problem for sub-Laplacians, and a new general approach to both divergence and nondivergence second order parabolic equations based on growth theorems. The articles in this volume offer both students and researchers a comprehensive volume of current results in the field.

**Contents:** J. D. Sykes and R. M. Brown, The mixed boundary problem in  $L^p$  and Hardy spaces for Laplace's equation on a Lipschitz domain; D. Danielli, N. Garofalo, and D.-M. Nhieu, Sub-elliptic Besov spaces and the characterization of traces on lower dimensional manifolds; S. Hofmann, The solution of the Kato problem; M. B. Korey, A decomposition of functions with vanishing mean oscillation; D. Mitrea and M. Mitrea, General second order, strongly elliptic systems in low dimensional nonsmooth manifolds; E. Ferretti and M. V. Safonov, Growth theorems and Harnack inequality for second order parabolic equations; Z. Shen, Absolute continuity of generalized periodic Schrödinger operators; G. C. Verchota, The use of Rellich identities on certain nongraph boundaries; J. Verdera,  $L^2$  boundedness of the Cauchy integral and Menger curvature.

**Contemporary Mathematics**, Volume 277

August 2001, 158 pages, Softcover, ISBN 0-8218-2745-6, LC 2001033397, 2000 *Mathematics Subject Classification:* 35J25, 35J10, 35J67, 35J85, 31B20, 31B25, 31B35, 31A15, **Individual member \$26**, List \$44, Institutional member \$35, Order code CONM/277N



## Geometric Asymptotics for Nonlinear PDE. I

V. P. Maslov, *Moscow State University, Russia*, and G. A. Omel'yanov, *Moscow Institute of Electronic Engineering, Russia*

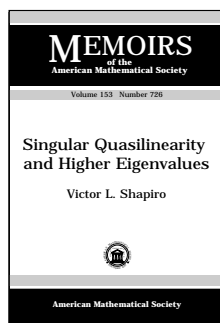
The study of asymptotic solutions to nonlinear systems of partial differential equations is a very powerful tool in the analysis of such systems and their applications in physics, mechanics, and engineering. In the present book, the authors propose a new powerful method of asymptotic analysis of solutions, which can be successfully applied in the case of the so-called "smoothed shock waves", i.e., nonlinear waves which vary fast in a neighborhood of the front and slowly outside of this neighborhood. The proposed method, based on the study of geometric objects associated to the front, can be viewed as a generalization of the geometric optics (or WKB) method for linear equations. This volume offers to a broad audience a simple and accessible presentation of this new method.

The authors present many examples originating from problems of hydrodynamics, nonlinear optics, plasma physics, continuum mechanics, and the theory of phase transitions (free boundary problems). In the examples, characterized by smoothing of singularities due to dispersion or diffusion, asymptotic solutions in the form of distorted solitons, kinks, breathers, or smoothed shock waves are constructed. By a unified rule, a geometric picture is associated with each physical problem; this allows one to obtain tractable asymptotic formulas and provides a geometric interpretation of the physical process. Included are many figures illustrating the various physical effects.

**Contents:** Introduction; Waves in one-dimensional nonlinear media; Nonlinear waves in multidimensional media; Asymptotic solutions of some pseudodifferential equations and dynamical systems with small dispersion; Problems with a free boundary; Multi-phase asymptotic solutions; Asymptotics of stationary solutions to the Navier-Stokes equations describing stretched vortices; List of equations; Bibliography.

**Translations of Mathematical Monographs**, Volume 202

August 2001, 285 pages, Hardcover, ISBN 0-8218-2109-1, LC 2001040045, 2000 *Mathematics Subject Classification*: 35Qxx, 76L05, **Individual member** \$59, List \$99, Institutional member \$79, Order code MMONO/202N



## Singular Quasilinearity and Higher Eigenvalues

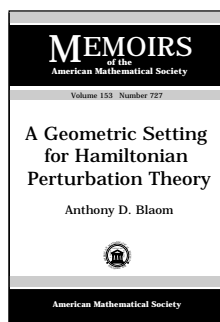
Victor L. Shapiro, *University of California, Riverside, CA*

**Contents:** Quasilinear elliptic equations; Quasilinear parabolic equations.

**Memoirs of the American Mathematical Society**, Volume 153, Number 726

August 2001, 174 pages, Softcover, ISBN 0-8218-2717-0, LC 2001032798, 2000 *Mathematics Subject Classification*: 35J60, 35J70, 35K55, 35K20, 35K40; 33C50, 42C05, 42C10, **Individual member** \$28, List \$47, Institutional member \$38, Order code MEMO/153/726N

## Geometry and Topology



## A Geometric Setting for Hamiltonian Perturbation Theory

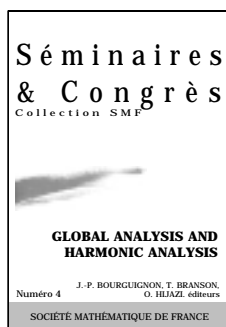
Anthony D. Blaom, *Burwood, Victoria, Australia*

**Contents:** Introduction; *Part 1. Dynamics:* Lie-Theoretic preliminaries; Action-group coordinates; On the existence of action-group coordinates; Naive averaging; An abstract formula-

tion of Nekhoroshev's theorem; Applying the abstract Nekhoroshev's theorem to action-group coordinates; Nekhoroshev-type estimates for momentum maps; *Part 2. Geometry:* On Hamiltonian  $G$ -spaces with regular momenta; Action-group coordinates as a symplectic cross-section; Constructing action-group coordinates; The axisymmetric Euler-Poinsot rigid body; Passing from dynamic integrability to geometric integrability; Concluding remarks; Appendix A. Proof of the Nekhoroshev-Lochak theorem; Appendix B. Proof the  $\mathcal{W}$  is a slice; Appendix C. Proof of the extension lemma; Appendix D. An application of converting dynamic integrability into geometric integrability: The Euler-Poinsot rigid body revisited; Appendix E. Dual pairs, leaf correspondence, and symplectic reduction; Bibliography.

**Memoirs of the American Mathematical Society**, Volume 153, Number 727

August 2001, 112 pages, Softcover, ISBN 0-8218-2720-0, LC 2001032797, 2000 *Mathematics Subject Classification*: 70H09, 70H08, 37J15; 37J40, 70H33, 70H06, **Individual member** \$28, List \$47, Institutional member \$38, Order code MEMO/153/727N



## Global Analysis and Harmonic Analysis

**J.-P. Bourguignon**, *Institut des Hautes Etudes Scientifiques, France*, **T. Branson**, *University of Iowa, Iowa City*, and **O. Hijazi**, *University of Nancy I, France*, Editors

*A publication of the Société Mathématique de France.*

This book presents the proceedings of a meeting intended to gather researchers working in the fields of harmonic analysis and global analysis to discuss some questions of common interest. About twenty talks covered the principal topics, illustrating the recent interactions between these two fields.

The meeting started with a survey on spin geometry and was followed by talks on the spectrum of the Dirac operator in hyperbolic, Kählerian and pseudo-Riemannian geometry.

Different aspects of representation theory were discussed: Schubert cells, unitary representations with reflection symmetry, gradient operators, and Poisson transformations. Another series of talks was devoted to the systematic use of representation theory in global analysis; in particular on the Bernstein-Gelfand-Gelfand sequences in parabolic geometry, the construction of conformally covariant operators, and some refinements of the Kato inequality in Riemannian geometry.

Various presentations ranging from general relativity to harmonic maps, by way of 4-dimensional geometry/topology, Seiberg-Witten theory and the index theorem in 2-dimensional hyperbolic geometry illustrated the diversity of applications of techniques from harmonic analysis.

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.

**Séminaires et Congrès**, Number 4

April 2001, Softcover, ISBN 2-85629-094-9, 2000 *Mathematics Subject Classification*: 11F03, 22E30, 22E46, 32G05, 32J81, 32V05, 35J60, 43A65, 43A85, 53A20, 53A30, 53A40, 53A55, 53B15, 53B21, 53B50, 53Cxx, 53C05, 53C07, 53C15, 53C21, 53C25, 53C35, 53C50, 57R57, 57S25, 58E15, 58Jxx, 58J05, 58J50, **Individual member \$69**, List \$77, Order code SECO/4N

## Previously Announced Publications

**Recommended Text**

### A Modern Theory of Integration

**Robert G. Bartle**, *Eastern Michigan University, Ypsilanti, and University of Illinois, Urbana*

The theory of integration is one of the twin pillars on which analysis is built. The first version of integration that students see is the Riemann integral. Later, graduate students learn that the Lebesgue integral is "better" because it removes some restrictions on the integrands and the domains over which we integrate. However, there are still drawbacks to Lebesgue inte-

gration, for instance, dealing with the Fundamental Theorem of Calculus, or with "improper" integrals.

This book is an introduction to a relatively new theory of the integral (called the "generalized Riemann integral" or the "Henstock-Kurzweil integral") that corrects the defects in the classical Riemann theory and both simplifies and extends the Lebesgue theory of integration. Although this integral includes that of Lebesgue, its definition is very close to the Riemann integral that is familiar to students from calculus. One virtue of the new approach is that no measure theory and virtually no topology is required. Indeed, the book includes a study of measure theory as an application of the integral.

Part 1 fully develops the theory of the integral of functions defined on a compact interval. This restriction on the domain is not necessary, but it is the case of most interest and does not exhibit some of the technical problems that can impede the reader's understanding. Part 2 shows how this theory extends to functions defined on the whole real line. The theory of Lebesgue measure from the integral is then developed, and the author makes a connection with some of the traditional approaches to the Lebesgue integral. Thus, readers are given full exposure to the main classical results.

The text is suitable for a first-year graduate course, although much of it can be readily mastered by advanced undergraduate students. Included are many examples and a very rich collection of exercises. There are partial solutions to approximately one-third of the exercises. A complete solutions manual is available separately.

**Graduate Studies in Mathematics**, Volume 32

March 2001, 458 pages, Hardcover, ISBN 0-8218-0845-1, LC 00-065063, 2000 *Mathematics Subject Classification*: 26-01; 26A39, 26A42, 28-01, **All AMS members \$47**, List \$59, Order code GSM/32

### Solutions Manual to A Modern Theory of Integration

**Robert G. Bartle**, *Eastern Michigan University, Ypsilanti, and University of Illinois, Urbana*

**Graduate Studies in Mathematics**, Volume 32

March 2001, 72 pages, Softcover, ISBN 0-8218-2821-5, LC 2001022204, 2000 *Mathematics Subject Classification*: 26-01; 26A39, 26A42, 28-01, **All AMS members \$11**, List \$14, Order code GSM/32.M

**Recommended Text**

### Lecture Notes in Algebraic Topology

**James F. Davis** and **Paul Kirk**, *Indiana University, Bloomington*

The amount of algebraic topology a graduate student specializing in topology must learn can be intimidating. Moreover, by their second year of graduate studies, students must make the transition from understanding simple proofs line-by-line to understanding the overall structure of proofs of difficult theorems.

To help students make this transition, the material in this book is presented in an increasingly sophisticated manner. It is intended to bridge the gap between algebraic and geometric topology, both by providing the algebraic tools that a geometric topologist needs and by concentrating on those areas of algebraic topology that are geometrically motivated.

Prerequisites for using this book include basic set-theoretic topology, the definition of CW-complexes, some knowledge of the fundamental group/covering space theory, and the construction of singular homology. Most of this material is briefly reviewed at the beginning of the book.

The topics discussed by the authors include typical material for first- and second-year graduate courses. The core of the exposition consists of chapters on homotopy groups and on spectral sequences. There is also material that would interest students of geometric topology (homology with local coefficients and obstruction theory) and algebraic topology (spectra and generalized homology), as well as preparation for more advanced topics such as algebraic  $K$ -theory and the  $s$ -cobordism theorem.

A unique feature of the book is the inclusion, at the end of each chapter, of several projects that require students to present proofs of substantial theorems and to write notes accompanying their explanations. Working on these projects allows students to grapple with the “big picture”, teaches them how to give mathematical lectures, and prepares them for participating in research seminars.

The book is designed as a textbook for graduate students studying algebraic and geometric topology and homotopy theory. It will also be useful for students from other fields such as differential geometry, algebraic geometry, and homological algebra. The exposition in the text is clear; special cases are presented over complex general statements.

**Graduate Studies in Mathematics**, Volume 35

August 2001, 367 pages, Hardcover, ISBN 0-8218-2160-1, LC 2001022609, 2000 *Mathematics Subject Classification*: 55-01, 57-01, **All AMS members \$44**, List \$55, Order code GSM/35

A Classic

Recommended Text

## Differential Geometry, Lie Groups, and Symmetric Spaces

**Sigurdur Helgason**, *Massachusetts Institute of Technology, Cambridge*

*From reviews for the First Edition:*

*A great book ... a necessary item in any mathematical library.*  
—S. S. Chern, *University of California*

*Written with unmatched lucidity, systematically, carefully, beautifully.*

—S. Bochner, *Princeton University*

*Helgason's monograph is a beautifully done piece of work and should be extremely useful for several years to come, both in teaching and in research.*

—D. Spencer, *Princeton University*

*A brilliant book: rigorous, tightly organized, and covering a vast amount of good mathematics.*

—Barrett O'Neill, *University of California*

*Renders a great service in permitting the non-specialist, with a minimum knowledge of differential geometry and Lie groups, an initiation to the theory of symmetrical spaces.*

—H. Cartan, *Secretariat Mathématique, Paris*

*The mathematical community has long been in need of a book on symmetric spaces. S. Helgason has admirably satisfied this need with his book, Differential Geometry and Symmetric Spaces. It is a remarkably well-written book ... a masterpiece of concise, lucid mathematical exposition ... it might be used as a textbook for “how to write mathematics”.*

—Louis Auslander

*[The author] will earn the gratitude of many generations of mathematicians for this skillful, tasteful, and highly efficient presentation. It will surely become a classic.*

—G. D. Mostow, *Yale University*

The study of homogeneous spaces provides excellent insights into both differential geometry and Lie groups. In geometry, for instance, general theorems and properties will also hold for homogeneous spaces, and will usually be easier to understand and to prove in this setting. For Lie groups, a significant amount of analysis either begins with or reduces to analysis on homogeneous spaces, frequently on symmetric spaces. For many years and for many mathematicians, Sigurdur Helgason's classic *Differential Geometry, Lie Groups, and Symmetric Spaces* has been—and continues to be—the standard source for this material.

Helgason begins with a concise, self-contained introduction to differential geometry. He then introduces Lie groups and Lie algebras, including important results on their structure. This sets the stage for the introduction and study of symmetric spaces, which form the central part of the book. The text concludes with the classification of symmetric spaces by means of the Killing-Cartan classification of simple Lie algebras over  $\mathbb{C}$  and Cartan's classification of simple Lie algebras over  $\mathbb{R}$ .

The excellent exposition is supplemented by extensive collections of useful exercises at the end of each chapter. All the problems have either solutions or substantial hints, found at the back of the book.

For this latest edition, Helgason has made corrections and added helpful notes and useful references. The sequels to the present book are published in the AMS's *Mathematical Surveys and Monographs Series: Groups and Geometric Analysis*, Volume 83, and *Geometric Analysis on Symmetric Spaces*, Volume 39.

Sigurdur Helgason was awarded the Steele Prize for *Differential Geometry, Lie Groups, and Symmetric Spaces* and *Groups and Geometric Analysis*.

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

**Graduate Studies in Mathematics**, Volume 34

July 2001, 641 pages, Hardcover, ISBN 0-8218-2848-7, LC 2001022205, 2000 *Mathematics Subject Classification*: 22E15, 22E46, 22E60, 22F30, 32M15, 43A85, 43A90, 53B05, 53B20, 53C35, **All AMS members \$55**, List \$69, Order code GSM/34

## Stable Groups

**Bruno Poizat**, *Université Claude Bernard, Villeurbanne, France*

*From a review of the French edition:*

*This is a beautiful book in which almost everything known about stable groups appears.*

—*Zentralblatt für Mathematik*

This is the English translation of the book originally published in 1987. It is a faithful reproduction of the original, supple-

mented by a new Foreword and brought up to date by a short postscript. The book gives an introduction by a specialist in contemporary mathematical logic to the model-theoretic study of groups, i.e., into what can be said about groups, and for that matter, about all the traditional algebraic objects.

The author introduces the groups of finite Morley rank (those satisfying the most restrictive assumptions from the point of view of logic), and highlights their resemblance to algebraic groups, of which they are the prototypes. (All the necessary prerequisites from algebraic geometry are included in the book.) Then, whenever possible, generalizations of properties of groups of finite Morley type to broader classes of superstables and stable groups are described.

The exposition in the first four chapters can be understood by mathematicians who have some knowledge of logic (model theory). The last three chapters are intended for specialists in mathematical logic.

**Mathematical Surveys and Monographs**, Volume 87

June 2001, 129 pages, Hardcover, ISBN 0-8218-2685-9, LC 2001022098, 2000 *Mathematics Subject Classification*: 03C45, 03C60, 14Lxx, 20Gxx, **Individual member \$29**, List \$49, Institutional member \$39, Order code SURV/87

**Timely Topic**

## Chaotic Elections! A Mathematician Looks at Voting

Donald G. Saari, *University of California, Irvine*

What does the 2000 U.S. presidential election have in common with selecting a textbook for a calculus course in your department? Was Ralph Nader's influence on the election of George W. Bush greater than the now-famous chads? In *Chaotic Elec-*

*tions!*, Don Saari analyzes these questions, placing them in the larger context of voting systems in general. His analysis shows that the fundamental problems with the 2000 presidential election are not with the courts, recounts, or defective ballots, but are caused by the very way Americans vote for president.

This expository book shows how mathematics can help to identify and characterize a disturbingly large number of paradoxical situations that result from the choice of a voting procedure. Moreover, rather than being able to dismiss them as anomalies, the likelihood of a dubious election result is surprisingly large. These consequences indicate that election outcomes—whether for president, the site of the next Olympics, the chair of a university department, or a prize winner—can differ from what the voters really wanted. They show that by using an inadequate voting procedure, we can, inadvertently, choose badly. To add to the difficulties, it turns out that the mathematical structures of voting admit several strategic opportunities, which are described.

Finally, mathematics also helps identify positive results: By using mathematical symmetries, we can identify what the phrase “what the voters really want” might mean and obtain a unique voting method that satisfies these conditions.

Saari's book should be required reading for anyone who wants to understand not only what happened in the presidential election of 2000, but also how we can avoid similar problems from appearing anytime any group is making a choice using a voting procedure. Reading this book requires little more than high school mathematics and an interest in how the apparently simple situation of voting can lead to surprising paradoxes.

April 2001, 159 pages, Softcover, ISBN 0-8218-2847-9, LC 2001022386, 2000 *Mathematics Subject Classification*: 91B12, 91B14, 00A05, **All AMS members \$18**, List \$23, Order code ELECT