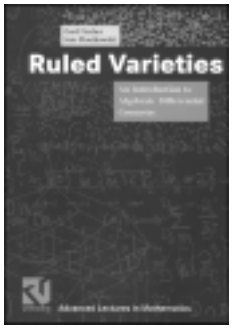
New Publications Offered by the AMS

Algebra and Algebraic Geometry

Supplementary Reading



Ruled Varieties

An Introduction to Algebraic Differential Geometry

Gerd Fischer and **Jens Piontkowski,** *Heinrich-Heine Universität, Düsselfdorf, Germany*

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.

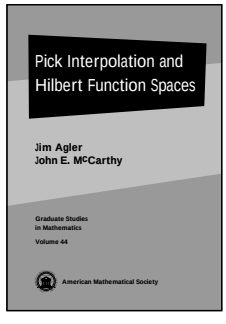
The AMS is exclusive distributor in North America, and non-exclusive distributor worldwide except in Germany, Switzerland, Austria, and Japan.

Contents: Review from classical differential and projective geometry; Grassmannians; Ruled varieties; Tangent and secant varieties; Bibliography; Index; List of symbols.

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/8N

Analysis



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.

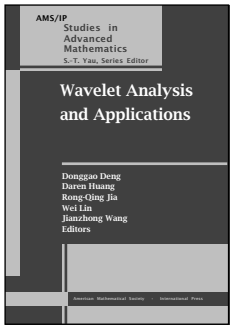
The authors then consider the interpolation problem in the space of bounded analytic functions on the bidisk and give a complete description of the solution. They then consider very general interpolation problems. The book includes developments of all the theory that is needed, including operator model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

Contents: Prerequisites and notation; Introduction; Kernels and function spaces; Hardy spaces; $P^2(\mu)$; Pick redux; Qualitative properties of the solution of the Pick problem in $H^\infty(\mathbb{D})$; Characterizing kernels with the complete Pick property; The universal Pick kernel; Interpolating sequences; Model theory I: Isometries; The bidisk; The extremal three point problem on $\mathbb{D}^2$; Collections of kernels; Model theory II: Function spaces; Localization; Schur products; Parrott's lemma; Riesz interpolation; The spectral theorem for normal m-tuples; Bibliography; Index.

Graduate Studies in Mathematics, Volume 44

March 2002, approximately 328 pages, Hardcover, ISBN 0-8218-2898-3, 2000 *Mathematics Subject Classification*: 47A57, 30E05, 46E20, 32A70, **All AMS members $39**, List $49, Order code GSM/44N

Applications



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.

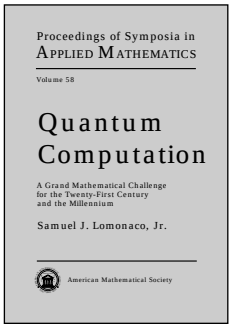
Comprised here are selected papers from the conference, covering a wide range of research topics of current interest. Many significant results are included in the study of refinement equations and refinable functions, properties and construction of wavelets, spline wavelets, multi-wavelets, wavelet packets, 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.

Contents: A. Aldroubi, **Q. Sun**, and **W.-S. Tang**, Non-uniform sampling in multiply generated shift-invariant subspaces of $L^p(\mathbb{R}^d)$; **R. Ashino**, **C. Heil**, **M. Nagase**, and **R. Vaillancourt**, Multiwavelets, pseudodifferential operators and microlocal analysis; **S. Basu**, **C. A. Micchelli**, and **P. Olsen**, A maximum entropy criterion for feature extraction; **O. Bratteli** and **P. E. T. Jorgensen**, Wavelet filters and infinite-dimensional unitary groups; **G. J. Chae**, **H. O. Kim**, and **R. Y. Kim**, On the Cohen-type conditions for the stabiltiy of shifts of a refinable function; **W. Chen** and **W. Lin**, Trigonometric Hermite wavelet and natural integral equations for Stokes problem; **D.-Q. Dai**, Vision, harmonic oscillator and wavelets; **T. N. T. Goodman** and **S. L. Lee**, Some properties of refinable splines; **L. Gori** and **F. Pitolli**, On some applications of a class of totally positive bases; **B. Han** and **S. D. Riemenschneider**, Interpolatory biorthogonal wavelets and CBC algorithm; **D. P. Hardin** and **T. A. Hogan**, Constructing orthogonal refinable function vectors with prescribed approximation order and smoothness; **D. Huang**, **Z. Wang**, and **Z. Zhang**, On M-band wavelets having three vanishing moments; **R.-Q. Jia** and **Q.-T. Jiang**, Approximation power of refinable vectors of functions; **J. Ning**, Wavelet decomposition under translate; **H. O. Kim** and **J. K. Lim**, Applications of shift-invariant space theory to some problems of multi-resolution analysis of $L^2(\mathbb{R}^d)$; **I. Kirat** and **K.-S. Lau**, On the connectedness and classification of self-affine tiles; **X.-z. Liang** and **M.-c. Liu**, Wavelet-Galerkin methods for second kind integral equations; **S. Li**, Convergence of cascade algorithms in $L_p(0 < p < 1)$; **I. Ya. Novikov**, Asymptotics of zeros of Bernstein polynomials that are related to modified Daubechies wavelets; **Q. Sun**, Homogeneous and nonhomogeneous refinable distributions in $F^{q,\gamma}$; **J. Tang**, **S. Kawato**, and **J. Ohya**, A wavelet transform based face recognition system and its applications; **J. Wang**, Spline wavelets in numerical resolution of partial differential equations; **M. V. Wickerhauser**, Basis and convergence properties of wavelet packets; **L. Yang** and **Y. Y. Tang**, A wavelet-based characterization of curves; **P. C. Yuen**, **G. C. Feng**, **J. H. Lai**, and **D. Q. Dai**, Face processing and recognition technology; **D.-X. Zhou**, The p-norm joint spectral radius and its applications in wavelet analysis.

AMS/IP Studies in Advanced Mathematics, Volume 25

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



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.

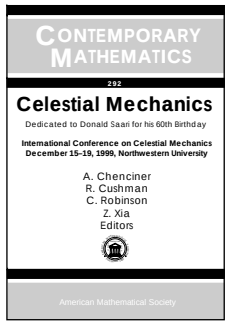
Based on audience feedback and questions, the written versions of the lectures have been greatly expanded, and supplementary material has been added. The book features an overview of relevant parts of quantum mechanics with an introduction to quantum computation, including many potential quantum mechanical 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.

Contents: *An invitation to quantum computation:* **S. J. Lomonaco, Jr.**, A Rosetta stone for quantum mechanics with an introduction to quantum computation; **H. E. Brandt**, Qubit devices; *Quantum algorithms and quantum complexity theory:* **S. J. Lomonaco, Jr.**, Introduction to quantum algorithms; **S. J. Lomonaco, Jr.**, Shor's quantum factoring algorithm; **U. V. Vazirani**, A survey of quantum complexity theory; **S. J. Lomonaco, Jr.**, Grover's quantum search algorithm; *Quantum error correcting codes and quantum cryptography:* **D. Gottesman**, An introduction to quantum error correction; **S. J. Lomonaco, Jr.**, A talk on quantum cryptography or how Alice outwits Eve; *More mathematical connections:* **A. Kitaev**, Topological quantum codes and anyons; **L. H. Kauffman**, Quantum topology and quantum computing; **S. J. Lomonaco, Jr.**, An entangled tale of quantum entanglement; Index.

Proceedings of Symposia in Applied Mathematics, Volume 58

February 2002, approximately 436 pages, Hardcover, ISBN 0-8218-2084-2, 2000 *Mathematics Subject Classification*: 81–01, 81–02, 81P68, 68Q05, 94A60; 22E70, 57M99, 81V80, 94A15, **Individual member $41**, List $69, Order code PSAPM/58N

Differential Equations



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.

Contents: A. Albouy and **J. Llibre**, Spatial central configurations for the 1 + 4 body problem; **E. Belbruno**, Analytic estimation of weak stability boundaries and low energy transfers; **F. Beukers** and **R. Cushman**, The complex geometry of the spherical pendulum; **A. Chenciner**, Action minimizing periodic orbits in the Newtonian n-body problem; **M. Corbera** and **J. Llibre**, On symmetric periodic orbits of the elliptic Sitnikov problem via the analytic continuation method; **W. S. Koon**, **J. E. Marsden**, **S. D. Ross**, and **M. W. Lo**, Constructing a low energy transfer between Jovian moons; **E. A. Lacomba**, **J. Llibre**, and **E. Perez-Chavela**, The generalized Sitnikov problem; **C. Marchal**, Reflexions on the future of celestial mechanics; **R. Moeckel**, Generic drift on Cantor sets of annuli; **R. Montgomery**, Action spectrum and collisions in the planar three-body problem; **P. H. Rabinowitz** and **E. W. Stredulinsky**, A variational shadowing method; **C. Robinson**, Symbolic dynamics for transition tori; **C. Simó**, Dynamical properties of the figure eight solution of the three-body problem; **Y.-S. Sun**, **J.-L. Zhou**, **J.-Q. Zheng**, and **M. Valtonen**, Diffusion in comet motion; **Q. Wang**, The Hill's region of the four-body problem; **Z. Xia**, Some of the problems that Saari didn't solve.

Contemporary Mathematics, Volume 292

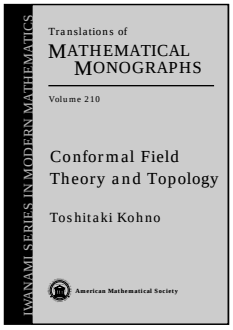
February 2002, approximately 238 pages, Softcover, ISBN 0-8218-2902-5, LC 2001055364, 2000 *Mathematics Subject Classification*: 70Fxx, 70Hxx, 37N05, 37Jxx, **Individual member $41**, List $69, Order code CONM/292N

Geometry and Topology

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.

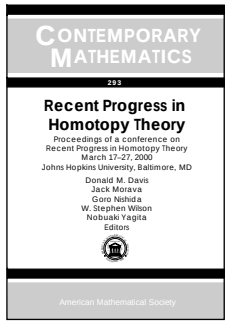
The book is organized as follows: The Introduction starts from classical mechanics and explains basic background materials in quantum field theory and geometry. Chapter 1 presents conformal field theory based on the geometry of loop groups. Chapter 2 deals with the holonomy of conformal field theory. 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.

Contents: Geometric aspects of conformal field theory; Jones-Witten theory; Chern-Simons perturbation theory; Further developments and prospects; Bibliography; Index.

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

March 2002, approximately 174 pages, Softcover, ISBN 0-8218-2130-X, 2000 *Mathematics Subject Classification*: 54C40, 14E20; 46E25, 20C20, **All AMS members $28**, List $35, Order code MMONO/210N



Recent Progress in Homotopy Theory

Donald M. Davis, *Lehigh University, Bethlehem, PA*, **Jack Morava**, *Johns Hopkins University, Baltimore, MD*, **Goro Nishida**, *Kyoto University, Japan*, **W. Stephen Wilson**, *Johns Hopkins University, Baltimore, MD*, and **Nobuaki Yagita**, *Ibaraki University, Japan*, Editors

This volume presents the proceedings from the month-long program held at Johns Hopkins University (Baltimore, MD) on homotopy theory, sponsored by the Japan-U.S. Mathematics Institute (JAMI). The book begins with historical accounts on the work of Professors Peter Landweber and Stewart Priddy. Central among the other topics are the following:

1. classical and nonclassical theory of H-spaces, compact groups, and finite groups,

2. classical and chromatic homotopy theory and localization,

3. classical and topological Hochschild cohomology,

4. elliptic cohomology and its relation to Moonshine and topological modular forms, and

5. motivic cohomology and Chow rings.

This volume surveys the current state of research in these areas and offers an overview of future directions.

Contents: *Two papers on the history of topology:* **H. Miller**, A marriage of manifolds and algebra: The mathematical work of Peter Landweber; **N. Minami**, Some mathematical influences of Stewart Priddy; *Research papers:* **M. Bendersky** and **R. D. Thompson**, Some properties of the K-theory completion; **R. R. Bruner**, **D. M. Davis**, and **M. Mahowald**, Nonimmersions of real projective spaces implied by tmf; **M. Brunetti**, High Euler characteristics for almost extraspecial p-groups; **Y. Hemmi**, Unstable p-th order operation and H-spaces; **M. Mahowald** and **M. Hopkins**, The structure of 24 dimensional manifolds having normal bundles which lift to $BO[8]$; **P. Hu** and **I. Kriz**, The homology of BPO; **M. Inoue**, $\mathcal{A}$-generators of the cohomology of the Steinberg summand $M(n)$; **J. P. Lin**, Commutators in the homology of H-spaces; **J. E. McClure** and **J. H. Smith**, A solution of Deligne's Hochschild cohomology conjecture; **M. Mimura** and **T. Nishimoto**, Hopf algebra structure of Morava K-theory of the exceptional Lie groups; **J. Martino** and **S. Priddy**, Minami-Webb type decompositions for compact Lie groups; **D. C. Ravenel**, The method of infinite descent in stable homotopy theory I; **K. Shimomura**, The homotopy groups $\pi_*(L_nT(m) \wedge V(n-2))$; **D. Tamaki**, The fiber of iterated Freudenthal suspension and Morava K-theory of $\Omega^k S^{2\ell+1}$; **M. Tanabe**, On K-flat and K-moonshine-like elements in elliptic cohomology; **T. Torii**, The geometric fixed point spectrum of $(\mathbf{Z}/p)^k$ Borel cohomology for E_n and its completion; **V. Voevodsky**, A possible new approach to the motivic spectral sequence for algebraic K-theory; **C. W. Wilkerson, Jr.**, Rings of invariants and inseparable forms of algebras over the Steenrod algebra; **N. Yagita**, Chow rings of classifying spaces of extraspecial p groups.

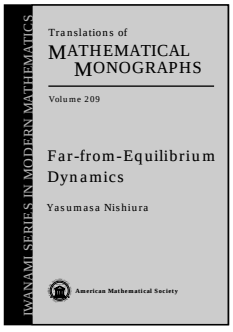
Contemporary Mathematics, Volume 293

March 2002, approximately 408 pages, Softcover, ISBN 0-8218-2801-0, 2000 *Mathematics Subject Classification*: 55–XX, 57–XX, **Individual member $59**, List $99, Order code CONM/293N

Mathematical Physics

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.

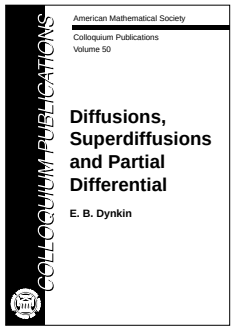
This item will also be of interest to those working in differential equations.

Contents: Separation and unification of scales; Amplitude equations; Marginal stability criterion and pattern selection; Pattern formation; Method of singular limit analysis; Transient dynamics; Future perspectives; Bibliography; Index.

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/209N

Probability



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.

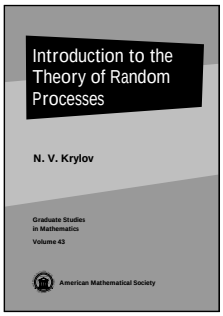
Similar to the other books by Dynkin, *Markov Processes* (Springer-Verlag), *Controlled Markov Processes* (Springer-Verlag), and *An Introduction to Branching Measure-Valued Processes* (American Mathematical Society), this book can become a classical account of the presented topics.

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

Contents: Introduction; *Parabolic equations and branching exit Markov systems:* Linear parabolic equations and diffusions; Branching exit Markov systems; Superprocesses; Semilinear parabolic equations and superdiffusions; *Elliptic equations and diffusions:* Linear elliptic equations and diffusions; Positive harmonic functions; Moderate solutions of $Lu = \psi(u)$; Stochastic boundary values of solutions; Rough trace; Fine trace; Martin capacity and classes $\mathcal{N}_1$ and $\mathcal{N}_0$; Null sets and polar sets; Survey of related results; Basic facts of Markov processes and Martingales; Facts on elliptic differential equations; Epilogue; Bibliography; Subject index; Notation index.

Colloquium Publications, Volume 50

March 2002, approximately 240 pages, Hardcover, ISBN 0-8218-3174-7, 2000 *Mathematics Subject Classification*: 60J60, 35Jxx; 35K55, 60J65, **All AMS members $39**, List $49, Order code COLL/50N



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*.

Contents: Generalities; The Wiener process; Martingales; Stationary processes; Infinitely divisible processes; Itô stochastic integral; Bibliography; Index.

Graduate Studies in Mathematics, Volume 43

March 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/43N

Previously Announced Publications

Assistantships and Graduate Fellowships 2001

Review of a previous edition:

This directory is a tool for undergraduate mathematics majors seeking information about graduate programs in mathematics. Although most of the information can be gleaned from the Internet, the usefulness of this directory for the prospective graduate student is the consistent format for comparing different mathematics graduate programs without the hype. Published annually, the information is up-to-date, which is more than can be said of some Websites. Support for graduate students in mathematics is a high priority of the American Mathematical Society, which also provides information for fellowships and grants they offer as well as support from other societies and foundations. The book is highly recommended for academic and public libraries.

—American Reference Books Annual

This publication is an indispensable source of information for students seeking support for graduate study in the mathematical sciences. Providing data from a broad range of academic institutions, it is also a valuable resource for mathematical sciences departments and faculty.

Assistantships and Graduate Fellowships brings together a wealth of information about resources available for graduate study in mathematical sciences departments in the U.S. and Canada. Information on the number of faculty, graduate students, and degrees awarded (bachelor's, master's, and doctoral) is listed for each department when available. Stipend amounts and the number of awards available are given, as well as information about foreign language requirements. Numerous display advertisements from mathematical sciences departments throughout the country provide additional information.

Also listed are sources of support for graduate study and travel, summer internships, and graduate study in the U.S. for foreign nationals. Finally, a list of reference publications for fellowship information makes *Assistantships and Graduate Fellowships* a centralized and comprehensive resource.

October 2001, approximately 144 pages, Softcover, ISBN 0-8218-2881-9, 2000 *Mathematics Subject Classification*: 00–XX, **Individual member $12**, List $21, Order code ASST/2001RT202

Combined Membership List 2001–2002

The *Combined Membership List* (CML) is a comprehensive directory of the membership of the American Mathematical Society, the American Mathematical Association of Two-Year Colleges, the Association for Women in Mathematics, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics.

There are two lists of individual members. The first is a complete alphabetical list of all members in all five organizations. For each member, the CML provides his or her address, title, department, institution, telephone number (if available), and electronic address (if indicated), and also indicates membership in the five participating societies. The second is a list of individual members according to their geographic locations. In addition, the CML lists academic, institutional, and corporate members of the five participating societies providing addresses and telephone numbers of mathematical sciences departments.

The CML is distributed on request to AMS members in even-numbered years. MAA members can request the CML in odd-numbered years from the MAA. The CML is an invaluable reference for keeping in touch with colleagues and for making connections in the mathematical sciences community in the United States and abroad.

February 2002, 304 pages, Softcover, ISBN 0-8218-2882-7, 2000 *Mathematics Subject Classification*: 00–XX, **Individual member $41**, List $68, Institutional member $54, Order code CML/2001/2002RT202

Mathematical Sciences Professional Directory, 2002

This annual directory provides a handy reference to various organizations in the mathematical sciences community. Listed in the directory are the following: officers and committee members of over thirty professional mathematical organizations (terms of office and other pertinent information are also provided in some cases); key mathematical sciences personnel of selected government agencies; academic departments in the mathematical sciences; mathematical units in nonacademic organizations; and alphabetic listings of colleges and universities. Current addresses, telephone numbers, and electronic addresses for individuals when provided are listed in the directory.

March 2002, approximately 241 pages, Softcover, ISBN 0-8218-2883-5, 2000 *Mathematics Subject Classification*: 00–XX, List $53, Institutional member $42, Order code PRODIR/2002RT202

Sub-Laplacians with Drift on Lie Groups of Polynomial Volume Growth

Georgios K. Alexopoulos, *University of Paris, Orsay, France*

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

Memoirs of the American Mathematical Society, Volume 155, Number 739

February 2002, 101 pages, Softcover, ISBN 0-8218-2764-2, LC 2001045834, 2000 *Mathematics Subject Classification*: 22E25, 22E30, 43A80, 22E15, **Individual member $29**, List $49, Institutional member $39, Order code MEMO/155/739RT202

Supplementary Reading

Lyapunov Exponents and Smooth Ergodic Theory

Luis Barreira, *Instituto Superior Técnico, Lisboa, Portugal*, and **Yakov B. Pesin**, *Pennsylvania State University, University Park*

This book is a systematic introduction to smooth ergodic theory. The topics discussed include the general (abstract) theory of Lyapunov exponents and its applications to the stability theory of differential equations, stable manifold theory, absolute continuity, and the ergodic theory of dynamical systems with nonzero Lyapunov exponents (including geodesic flows).

The authors consider several nontrivial examples of dynamical systems with nonzero Lyapunov exponents to illustrate some basic methods and ideas of the theory.

This book is self-contained. The reader needs a basic knowledge of real analysis, measure theory, differential equations, and topology. The authors present basic concepts of smooth ergodic theory and provide complete proofs of the main results. They also state some more advanced results to give readers a broader view of smooth ergodic theory. This volume may be used by those nonexperts who wish to become familiar with the field.

University Lecture Series, Volume 23

October 2001, 151 pages, Softcover, ISBN 0-8218-2921-1, LC 2001045882, 2000 *Mathematics Subject Classification*: 37D25, 37C40, **All AMS members $23**, List $29, Order code ULECT/23RT202

Sur Les Inégalités de Sobolev Logarithmiques

S Blanchere, **D Chafai**, **P Fougeres**, **I Gentil**, **F Malrieu**, **C Roberto**, and **G Scheffer**

A publication of the Société Mathématique de France.

This book is an overview of logarithmic Sobolev inequalities. These inequalities have been the subject of intense activity in recent years, from analysis and geometry in finite and infinite dimensions to probability theory and statistical mechanics. And many developments are still to come.

The book is a "pedestrian approach" to logarithmic Sobolev inequalities, accessible to a wide audience. It is divided into several chapters of independent interest. The fundamental example of the Bernoulli and Gaussian distributions is the starting point for logarithmic Sobolev inequalities, as they were defined by Gross in the mid-seventies. Hypercontractivity and tensorisation form two main aspects of these inequalities, which are actually part of the larger family of classical Sobolev inequalities in functional analysis.

A chapter is devoted to the curvature-dimension criterion, which is an efficient tool for establishing functional inequalities. Another chapter describes a characterization of measures which satisfy logarithmic Sobolev or Poincaré inequalities on the real line, using Hardy's inequalities.

Interactions with various domains in analysis and probability are developed. A first study deals with the concentration of measure phenomenon, which is useful in statistics as well as geometry. The relationships between logarithmic Sobolev inequalities and the transportation of measures are considered, in particular through their approach to concentration. A control of the speed of convergence to equilibrium of finite state Markov chains is described in terms of the spectral gap and the logarithmic Sobolev constants. The last part is a modern reading of the notion of entropy in information theory and of the several links between information theory and the Euclidean form of the Gaussian logarithmic Sobolev inequality. The genesis of these inequalities can be traced back to the early contributions of Shannon and Stam.

This book focuses on the specific methods and the characteristics of particular topics, rather than the most general fields of study. Chapters are mostly self-contained. The bibliography, without being encyclopedic, tries to give a rather complete state of the art on the topic, including some very recent references.

Panoramas et Synthèses, Number 10

July 2001, 213 pages, Softcover, ISBN 2-85629-105-8, 2000 *Mathematics Subject Classification*: 60J60, 26D10, 58D25, 39B72, 58J65, 47D07, 60J10, 94A15, 94A17, **Individual member $40**, List $44, Order code PASY/10RT202

Rotation C*-Algebras and Almost Mathieu Operators

Florin-Petre Boca

A publication of the Theta Foundation.

This book delivers a swift, yet concise, introduction to some aspects of rotation C^*-algebras and almost Mathieu operators.

The two topics come from different areas of analysis: operator algebras and the spectral theory of Schrödinger operators, but can be approached in a unified way. The book does not try to be the definitive treatise on the subject, but rather presents a survey highlighting the important results and demonstrating this unified approach.

For each real number α, the rotation C^*-algebra A_α can be abstractly defined as the universal C^*-algebra generated by two elements U and V subject to the relation $UV = e^{2\pi i\alpha}VU$. When α is an integer, A_α is isomorphic to the commutative C^*-algebra of continuous functions on a two-dimensional torus. When α is not an integer, the algebra is sometimes called a non-commutative 2-torus. In this respect, some of the methods you will find here can be regarded as a sort of non-commutative Fourier analysis. An almost Mathieu operator is a type of self-adjoint operator on the Hilbert space $\ell^2 = \ell^2(\mathbf{Z})$.

The exposition is geared toward a wide audience of mathematicians: researchers and advanced students interested in operator algebras, operator theory and mathematical physics. Readers are assumed to be acquainted with some functional analysis, such as definitions and basic properties of C^*-algebras and von Neumann algebras, some general results from ergodic theory, as well as the Fourier transform (harmonic analysis) on elementary abelian locally compact groups of the form $\mathbf{R}^d \times \mathbf{Z}^k \times \mathbf{T}^1 \times F$, where F is a finite group.

Much progress has been made on these topics in the last twenty years. The present book will introduce you to the subjects and to the significant results.

Distributed worldwide, except in Romania, by the AMS.

Number 2

June 2001, 172 pages, Hardcover, ISBN 973-99097-7-9, 2000 *Mathematics Subject Classification*: 46L35, 81Q15, 47B39; 46L85, 81Q10, 47B36, **All AMS members $22**, List $28, Order code THETA/2RT202

The Submanifold Geometries Associated to Grassmannian Systems

Martina Brück and **Xi Du**, **Joonsang Park**, *Dongguk University, Seoul, Korea*, and **Chuu-Lian Terng**, *Northeastern University, Boston, MA*

Memoirs of the American Mathematical Society, Volume 155, Number 735

February 2002, 95 pages, Softcover, ISBN 0-8218-2753-7, LC 2001045782, 2000 *Mathematics Subject Classification*: 53–XX, 35–XX, **Individual member $29**, List $48, Institutional member $38, Order code MEMO/155/735RT202

Homotopy Theory of Diagrams

Wojciech Chachólski, *Yale University, New Haven, CT*, and **Jérôme Scherer**, *Université de Lausanne, Switzerland*

Memoirs of the American Mathematical Society, Volume 155, Number 736

February 2002, 90 pages, Softcover, ISBN 0-8218-2759-6, LC 2001045783, 2000 *Mathematics Subject Classification*: 55U35, 18G55; 18G10, 18F05, 55U30, 55P65, **Individual member $29**, List $48, Institutional member $38, Order code MEMO/155/736RT202

A Stability Index Analysis of 1-D Patterns of the Gray-Scott Model

Arjen Doelman, *University of Amsterdam, Netherlands*, **Robert A. Gardner**, *University of Massachusetts, Amherst*, and **Tasso J. Kaper**, *Boston University, MA*

Memoirs of the American Mathematical Society, Volume 155, Number 737

February 2002, 64 pages, Softcover, ISBN 0-8218-2739-1, LC 2001045832, 2000 *Mathematics Subject Classification*: 35K57, 35B35, 35B25; 35B32, 34C37, 34E15, **Individual member $25**, List $42, Institutional member $34, Order code MEMO/155/737RT202

Global Differential Geometry: The Mathematical Legacy of Alfred Gray

Marisa Fernández, *University of the Basque Country, Bilbao, Spain*, and **Joseph A. Wolf**, *University of California at Berkeley*, Editors

Alfred Gray's work covered a great part of differential geometry. In September 2000, a remarkable International Congress on Differential Geometry was held in his memory in Bilbao, Spain. Mathematicians from all over the world, representing 24 countries, attended the event.

This volume includes major contributions by well known mathematicians (T. Banchoff, S. Donaldson, H. Ferguson, M. Gromov, N. Hitchin, A. Huckleberry, O. Kowalski, V. Miquel, E. Musso, A. Ros, S. Salamon, L. Vanhecke, P. Wellin and J.A. Wolf), the interesting discussion from the round table moderated by J.-P. Bourguignon, and a carefully selected and refereed selection of the Short Communications presented at the Congress.

This book represents the state of the art in modern differential geometry, with some general expositions of some of the more active areas: special Riemannian manifolds, Lie groups and homogeneous spaces, complex structures, symplectic manifolds, geometry of geodesic spheres and tubes and related problems, geometry of surfaces, and computer graphics in differential geometry.

Contemporary Mathematics, Volume 288

January 2002, 457 pages, Softcover, ISBN 0-8218-2750-2, LC 2001053300, 2000 *Mathematics Subject Classification*: 22E15, 53A10, 53A30, 53B35, 53C15, 53C20, 53C23, 53C25, 53C55, 53D05, **Individual member $71**, List $118, Institutional member $94, Order code CONM/288RT202

Multiparticle Quantum Scattering in Constant Magnetic Fields

Christian Gérard, *Ecole Polytechnique, Paris, France*, and **Izabella Łaba**, *University of British Columbia, Vancouver, BC, Canada*

This monograph offers a rigorous mathematical treatment of the scattering theory of quantum N-particle systems in an external constant magnetic field. In particular, it addresses the question of *asymptotic completeness*, a classification of all possible trajectories of such systems according to their asymptotic behaviour. The book adopts the so-called time-dependent approach to scattering theory, which relies on a direct study of the Schrödinger unitary group for large times. The modern methods of spectral and scattering theory introduced in the

1980's and 1990's, including the Mourre theory of positive commutators, propagation estimates, and geometrical techniques, are presented and heavily used. Additionally, new methods were developed by the authors in order to deal with the (much less understood) phenomena due to the presence of the magnetic field.

The book is a good starting point for graduate students and researchers in mathematical physics who wish to move into this area of research. It includes expository material, research work previously available only in the form of journal articles, as well as some new unpublished results. The treatment of the subject is comprehensive and largely self-contained, and the text is carefully written with attention to detail.

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

Mathematical Surveys and Monographs, Volume 90

January 2002, 242 pages, Hardcover, ISBN 0-8218-2919-X, LC 2001053521, 2000 *Mathematics Subject Classification*: 35P25, 35Q40, 34L25, 47A40, 81U10, **Individual member $38**, List $64, Institutional member $51, Order code SURV/90RT202

Generalized Whittaker Functions on $SU(2,2)$ with Respect to the Siegel Parabolic Subgroup

Yasuro Gon, *Saitama University, Japan*

Memoirs of the American Mathematical Society, Volume 155, Number 738

February 2002, 116 pages, Softcover, ISBN 0-8218-2763-4, LC 2001045784, 2000 *Mathematics Subject Classification*: 11F70; 22E45, **Individual member $29**, List $49, Institutional member $39, Order code MEMO/155/738RT202

Lectures on Algebraic Model Theory

Bradd Hart and **Matthew Valeriote**, *McMaster University, Hamilton, ON, Canada*, Editors

In recent years, model theory has had remarkable success in solving important problems as well as in shedding new light on our understanding of them. The three lectures collected here present recent developments in three such areas: Anand Pillay on differential fields, Patrick Speissegger on o-minimality and Matthias Clasen and Matthew Valeriote on tame congruence theory.

Fields Institute Monographs, Volume 15

December 2001, 111 pages, Hardcover, ISBN 0-8218-2705-7, LC 2001053718, 2000 *Mathematics Subject Classification*: 03C64; 12L12, 03C05, **Individual member $18**, List $30, Institutional member $24, Order code FIM/15RT202

Introduction to Quantum Groups and Crystal Bases

Jin Hong and **Seok-Jin Kang,** *Korea Institute for Advanced Study, Seoul*

The notion of a "quantum group" was introduced by V.G. Dinfeld and M. Jimbo, independently, in their study of the quantum Yang-Baxter equation arising from 2-dimensional solvable lattice models. Quantum groups are certain families of Hopf algebras that are deformations of universal enveloping algebras of Kac-Moody algebras. And over the past 20 years, they have turned out to be the fundamental algebraic structure behind many branches of mathematics and mathematical physics, such as solvable lattice models in statistical mechanics, topological invariant theory of links and knots, representation theory of Kac-Moody algebras, representation theory of algebraic structures, topological quantum field theory, geometric representation theory, and C^*-algebras.

In particular, the theory of "crystal bases" or "canonical bases" developed independently by M. Kashiwara and G. Lusztig provides a powerful combinatorial and geometric tool to study the representations of quantum groups. The purpose of this book is to provide an elementary introduction to the theory of quantum groups and crystal bases, focusing on the combinatorial aspects of the theory.

Graduate Studies in Mathematics, Volume 42

March 2002, approximately 328 pages, Hardcover, ISBN 0-8218-2874-6, LC 2001053274, 2000 *Mathematics Subject Classification*: 17B37, 17B65; 81R50, 82B23, **All AMS members $39**, List $49, Order code GSM/42RT202

Dynamical, Spectral, and Arithmetic Zeta Functions

Michel L. Lapidus, *University of California, Riverside*, and **Machiel van Frankenhuysen**, *Rutgers University, Piscataway, NJ*, Editors

The original zeta function was studied by Riemann as part of his investigation of the distribution of prime numbers. Other sorts of zeta functions were defined for number-theoretic purposes, such as the study of primes in arithmetic progressions. This led to the development of L-functions, which now have several guises. It eventually became clear that the basic construction used for number-theoretic zeta functions can also be used in other settings, such as dynamics, geometry, and spectral theory, with remarkable results.

This volume grew out of the special session on dynamical, spectral, and arithmetic zeta functions held at the annual meeting of the American Mathematical Society in San Antonio, but also includes four articles that were invited to be part of the collection. The purpose of the meeting was to bring together leading researchers, to find links and analogies between their fields, and to explore new methods. The papers discuss dynamical systems, spectral geometry on hyperbolic manifolds, trace formulas in geometry and in arithmetic, as well as computational work on the Riemann zeta function.

Each article employs techniques of zeta functions. The book unifies the application of these techniques in spectral geometry, fractal geometry, and number theory. It is a comprehensive volume, offering up-to-date research. It should be useful to both graduate students and confirmed researchers.

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

Contemporary Mathematics, Volume 290

January 2002, 195 pages, Softcover, ISBN 0-8218-2079-6, LC 2001053944, 2000 *Mathematics Subject Classification*: 11F67, 11Mxx, 11Y35, 11N05, 28A80, 30F40, 37Axx, 58J35, **Individual member $29**, List $49, Institutional member $39, Order code CONM/290RT202

The Geometrical Study of Differential Equations

Joshua A. Leslie and **Thierry P. Robart**, *Howard University, Washington, DC*, Editors

This volume contains papers based on some of the talks given at the NSF-CBMS conference on "The Geometrical Study of Differential Equations" held at Howard University (Washington, DC). The collected papers present important recent developments in this area, including the treatment of nontransversal group actions in the theory of group invariant solutions of PDEs, a method for obtaining discrete symmetries of differential equations, the establishment of a group-invariant version of the variational complex based on a general moving frame construction, the introduction of a new variational complex for the calculus of difference equations and an original structural investigation of Lie-Bäcklund transformations. The book opens with a modern and illuminating overview of Lie's line-sphere correspondence and concludes with several interesting open problems arising from symmetry analysis of PDEs. It offers a rich source of inspiration for new or established researchers in the field.

This book can serve nicely as a companion volume to a forthcoming book written by the principle speaker at the conference, Professor Niky Kamran, to be published in the AMS series, CBMS Regional Conference Series in Mathematics.

Contemporary Mathematics, Volume 285

November 2001, 205 pages, Softcover, ISBN 0-8218-2964-5, LC 2001045702, 2000 *Mathematics Subject Classification*: 17–XX, 20–XX, 22–XX, 34–XX, 35–XX, 39–XX, 51–XX, 53–XX, **Individual member $30**, List $50, Institutional member $40, Order code CONM/285RT202

Mathematical Physics in Mathematics and Physics

Quantum and Operator Algebraic Aspects

Roberto Longo, *University of Rome II, Italy*, Editor

The beauty and the mystery surrounding the interplay between mathematics and physics is captured by E. Wigner's famous expression, "The unreasonable effectiveness of mathematics". We don't know why, but physical laws are described by mathematics, and good mathematics sooner or later finds applications in physics, often in a surprising way.

In this sense, mathematical physics is a very old subject—as Egyptian, Phoenician, or Greek history tells us. But mathematical physics is a very modern subject, as any working mathematician or physicist can witness. It is a challenging discipline that has to provide results of interest for both mathematics and physics. Ideas and motivations from both these sciences give it a vitality and freshness that is difficult to find anywhere else.

One of the big physical revolutions in the twentieth century, quantum physics, opened a new magnificent era for this interplay. With the appearance of noncommutative analysis, the role of classical calculus has been taken by commutation relations, a subject still growing in an astonishing way.

A good example where mathematical physics showed its power, beauty, and interdisciplinary character is the Doplicher-Haag-Roberts analysis of superselection sectors in the late 1960s. Not only did this theory explain the origin of statistics and classify it, but year after year, new connections have merged, for example with Tomita-Takesaki modular theory, Jones theory of subfactors, and Doplicher-Roberts abstract duality for compact groups.

This volume contains the proceedings of the conference, "Mathematical Physics in Mathematics and Physics", dedicated to Sergio Doplicher and John E. Roberts held in Siena, Italy. The articles offer current research in various fields of mathematical physics, primarily concerning quantum aspects of operator algebras.

Fields Institute Communications, Volume 30

December 2001, 451 pages, Hardcover, ISBN 0-8218-2814-2, LC 2001045989, 2000 *Mathematics Subject Classification*: 81–06, 46–06; 81T05, 47L90, **Individual member $71**, List $119, Institutional member $95, Order code FIC/30RT202

Recommended Text

Lectures on Monte Carlo Methods

Neal Madras, *York University, Toronto, ON, Canada*

Monte Carlo methods form an experimental branch of mathematics that employs simulations driven by random number generators. These methods are often used when others fail, since they are much less sensitive to the "curse of dimensionality", which plagues deterministic methods in problems with a large number of variables. Monte Carlo methods are used in many fields: mathematics, statistics, physics, chemistry, finance, computer science, and biology, for instance.

This book is an introduction to Monte Carlo methods for anyone who would like to use these methods to study various kinds of mathematical models that arise in diverse areas of application. The book is based on lectures in a graduate course given by the author. It examines theoretical properties of Monte Carlo methods as well as practical issues concerning their computer implementation and statistical analysis. The only formal prerequisite is an undergraduate course in probability.

The book is intended to be accessible to students from a wide range of scientific backgrounds. Rather than being a detailed treatise, it covers the key topics of Monte Carlo methods to the depth necessary for a researcher to design, implement, and analyze a full Monte Carlo study of a mathematical or scientific problem. The ideas are illustrated with diverse running examples. There are exercises sprinkled throughout the text. The topics covered include computer generation of random variables, techniques and examples for variance reduction of Monte Carlo estimates, Markov chain Monte Carlo, and statistical analysis of Monte Carlo output.

Fields Institute Monographs, Volume 16

January 2002, 103 pages, Hardcover, ISBN 0-8218-2978-5, LC 2001053551, 2000 *Mathematics Subject Classification*: 65C05, 60–01; 60J10, 65C10, 82B80, **All AMS members $24**, List $30, Order code FIM/16RT202

Independent Study

A Tour of Subriemannian Geometries, Their Geodesics and Applications

Richard Montgomery, *University of California, Santa Cruz*

Subriemannian geometries, also known as Carnot-Caratheodory geometries, can be viewed as limits of Riemannian geometries. They also arise in physical phenomenon involving "geometric phases" or holonomy. Very roughly speaking, a subriemannian geometry consists of a manifold endowed with a distribution

(meaning a k-plane field, or subbundle of the tangent bundle), called *horizontal* together with an inner product on that distribution. If $k = n$, the dimension of the manifold, we get the usual Riemannian geometry. Given a subriemannian geometry, we can define the distance between two points just as in the Riemannin case, except we are only allowed to travel along the horizontal lines between two points.

The book is devoted to the study of subriemannian geometries, their geodesics, and their applications. It starts with the simplest nontrivial example of a subriemannian geometry: the two-dimensional isoperimetric problem reformulated as a problem of finding subriemannian geodesics. Among topics discussed in other chapters of the first part of the book we mention an elementary exposition of Gromov's surprising idea to use subriemannian geometry for proving a theorem in discrete group theory and Cartan's method of equivalence applied to the problem of understanding invariants (diffeomorphism types) of distributions. There is also a chapter devoted to open problems.

The second part of the book is devoted to applications of subriemannian geometry. In particular, the author describes in detail the following four physical problems: Berry's phase in quantum mechanics, the problem of a falling cat righting herself, that of a microorganism swimming, and a phase problem arising in the N-body problem. He shows that all these problems can be studied using the same underlying type of subriemannian geometry: that of a principal bundle endowed with G-invariant metrics.

Reading the book requires introductory knowledge of differential geometry, and it can serve as a good introduction to this new exciting area of mathematics.

Mathematical Surveys and Monographs, Volume 91

December 2001, 259 pages, Hardcover, ISBN 0-8218-1391-9, LC 2001053538, 2000 *Mathematics Subject Classification*: 58E10, 53C17, 53C23, 49Q20, 58A30, 53C22, 58A15, 58D15, 58E30, **Individual member $41**, List $69, Institutional member $55, Order code SURV/91RT202

Independent Study

Operators, Functions, and Systems: An Easy Reading

Volume 1: Hardy, Hankel, and Toeplitz

Nikolai K. Nikolski, *University of Bordeaux I, Talence, France, and Steklov Institute of Mathematics, St. Petersburg, Russia*

This unique book combines 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

This volume, Volume I, contains Parts A and B; 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 ζ-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 the best rational approximations are considered to illustrate the power of Hankel and Toeplitz operators.

Function models for linear operators and free interpolations: 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.

The book is geared toward a wide audience of readers, from graduate students to professional mathematicians. It develops an elementary approach while retaining an expert level that can be applied in advanced analysis and selected applications.

Mathematical Surveys and Monographs, Volume 92

January 2002, 461 pages, Hardcover, ISBN 0-8218-1083-9, 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/92RT202

Supplementary Reading

Convex Polyhedra with Regularity Conditions and Hilbert's Third Problem

A R Rajwade

A publication of the Hindustan Book Agency.

Since antiquity, people knew that there are only five regular solids, i.e. polyhedra whose all faces are regular polygons and all solid angles are also regular. These solids are, of course, the tetrahedron, the octahedron, the cube, the icosahedron, and the dodecahedron. Later, much attention was drawn to the question of how to describe polyhedra with other types of regularity conditions. The author puts together many facts known in this direction. He formulates four regularity conditions (two for faces and two for solid angles) and for any combination of their conditions lists all the corresponding polyhedra. In this way, he obtains such very interesting classes of solids as 13 semiregular solids, or 8 deltahedra, or 92 regularly faces polyhedra, etc. In later chapters the author presents some related topics of geometry of solids, like star polyhedra and plane tessellations. In the concluding chapter, a complete solution of the Hilbert 3rd problem is given.

Supplied with many figures, the book can be easily read by anyone interested in this beautiful classical geometry.

Distributed worldwide except in India by the American Mathematical Society.

Number 8

August 2001, 120 pages, Hardcover, ISBN 81-85931-28-3, 2000 *Mathematics Subject Classification*: 13–XX, 14–XX, **All AMS members $26**, List $32, Order code HIN/8RT202

Introduction to the Theory of Differential Inclusions

Georgi V. Smirnov, *University of Porto, Portugal*

A differential inclusion is a relation of the form $\dot{x} \in F(x)$, where F is a set-valued map associating any point $x \in R^n$ with a set $F(x) \subset R^n$. As such, the notion of a differential inclusion generalizes the notion of an ordinary differential equation of the form $\dot{x} = f(x)$. Therefore, all problems usually studied in the theory of ordinary differential equations (existence and continuation of solutions, dependence on initial conditions and parameters, etc.) can be studied for differential inclusions as well. Since a differential inclusion usually has many solutions starting at a given point, new types of problems arise, such as investigation of topological properties of the set of solutions, selection of solutions with given properties, and many others.

Differential inclusions play an important role as a tool in the study of various dynamical processes described by equations with a discontinuous or multivalued right-hand side, occurring, in particular, in the study of dynamics of economical, social, and biological macrosystems. They also are very useful in proving existence theorems in control theory.

This text provides an introductory treatment to the theory of differential inclusions. The reader is only required to know ordinary differential equations, theory of functions, and functional analysis on the elementary level.

Chapter 1 contains a brief introduction to convex analysis. Chapter 2 considers set-valued maps. Chapter 3 is devoted to the Mordukhovich version of nonsmooth analysis. Chapter 4 contains the main existence theorems and gives an idea of the approximation techniques used throughout the text. Chapter 5 is devoted to the viability problem, i.e., the problem of selection of a solution to a differential inclusion that is contained in a given set. Chapter 6 considers the controllability problem. Chapter 7 discusses extremal problems for differential inclusions. Chapter 8 presents stability theory, and Chapter 9 deals with the stabilization problem.

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

Graduate Studies in Mathematics, Volume 41

December 2001, 226 pages, Hardcover, ISBN 0-8218-2977-7, LC 2001053414, 2000 *Mathematics Subject Classification*: 34A60, 34D20, 49K24; 49J24, 49J52, 93D15, **All AMS members $27**, List $34, Order code GSM/41RT202

Winter School on Mirror Symmetry, Vector Bundles and Lagrangian Submanifolds

Cumrun Vafa and **S.-T. Yau**, *Harvard University, Cambridge, MA*, Editors

The collection of articles in this volume are based on lectures presented during the Winter School on Mirror Symmetry held at Harvard University. There are many new directions suggested by mirror symmetry which could potentially have very rich connections in physics and mathematics.

This book brings together the latest research in a major area of mathematical physics, including the recent progress in mirror manifolds and Lagrangian submanifolds. In particular, several articles describing homological approach and related topics are included.

Other AMS titles edited by S.-T Yau published in the AMS/IP Studies in Advanced Mathematics series include, *Mirror Symmetry III*, Volume 10, *Mirror symmetry II*, Volume 1, and *Mirror Symmetry I*, Volume 9.

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

AMS/IP Studies in Advanced Mathematics, Volume 23

December 2001, 377 pages, Softcover, ISBN 0-8218-2159-8, LC 2001045675, 2000 *Mathematics Subject Classification*: 14–06, 32–06, 81–06, 53D12, 14F05, 14J32, **All AMS members $34**, List $42, Order code AMSIP/23RT202

Algebraic Methods in Statistics and Probability

Marlos A. G. Viana, *University of Illinois at Chicago*, and **Donald St. P. Richards**, *University of Virginia, Charlottesville*, Editors

Algebraic methods and arguments in statistics and probability are well known, from Gauss's least squares principle through Fisher's method of variance decomposition. The relevance of group-theoretic arguments, for example, became evident in the 1980s. Such techniques continue to be of interest today, along with other developments, such as the use of graph theory in modelling complex stochastic systems.

This volume is based on lectures presented at the AMS Special Session on Algebraic Methods and Statistics held at the University of Notre Dame (Indiana) and on contributed articles solicited for this volume. The articles are intended to foster communication between representatives of the diverse scientific areas in which these functions are utilized and to further the trend of utilizing algebraic methods in the areas of statistics and probability.

This is one of few volumes devoted to the subject of algebraic methods in statistics and probability. The wide range of topics covered in this volume demonstrates the vigorous level of research and opportunities ongoing in these areas.

Contemporary Mathematics, Volume 287

December 2001, 340 pages, Softcover, ISBN 0-8218-2687-5, LC 2001045884, 2000 *Mathematics Subject Classification*: 05B20, 60F05, 62A01, 62C10, 62H15; 13P10, 15A52, 20B30, 30E20, 62G08, **Individual member $48**, List $80, Institutional member $64, Order code CONM/287RT202