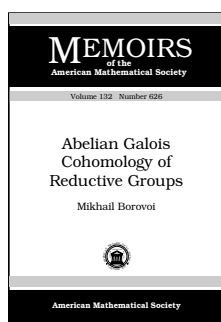


New Publications Offered by the AMS

Algebra and Algebraic Geometry



Abelian Galois Cohomology of Reductive Groups

Mikhail Borovoi, *Tel Aviv University, Israel*

In this volume, a new functor $H_{ab}^2(K, G)$ of abelian Galois cohomology is introduced from the category of connected reductive groups G over a field K of characteristic 0 to the category of abelian

groups. The abelian Galois cohomology and the abelianization map $ab^1: H^1(K, G) \rightarrow H_{ab}^2(K, G)$ are used to give a functorial, almost explicit description of the usual Galois cohomology set $H^1(K, G)$ when K is a number field.

Contents: Introduction; The algebraic fundamental group of a reductive group; Abelian Galois cohomology; The abelianization maps; Computation of abelian Galois cohomology; Galois cohomology over local fields and number fields; References.

Memoirs of the American Mathematical Society, Volume 132, Number 626

February 1998, 50 pages, Softcover, ISBN 0-8218-0650-5, LC 97-47116, 1991 *Mathematics Subject Classification:* 20G10; 14E20, 18G50, **Individual member \$21**, List \$35, Institutional member \$28, Order code MEMO/132/626N

Independent Study



Algebras of Functions on Quantum Groups: Part I

Leonid I. Korogodski and Yan S. Soibelman, *Institute for Advanced Study, Princeton, NJ*

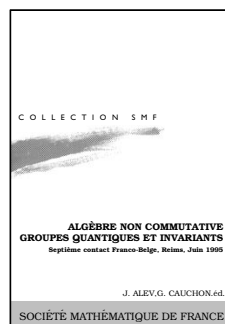
The book is devoted to the study of algebras of functions on quantum groups. The authors' approach to the

subject is based on the parallels with symplectic geometry, allowing the reader to use geometric intuition in the theory of quantum groups. The book includes the theory of Poisson-Lie algebras (quasi-classical version of algebras of functions on quantum groups), a description of representations of algebras of functions and the theory of quantum Weyl groups. This book can serve as a text for an introduction to the theory of quantum groups.

Contents: Introduction; Poisson Lie groups; Quantized universal enveloping algebras; Quantized algebras of functions; Quantum Weyl group and the universal quantum R -matrix; Bibliography.

Mathematical Surveys and Monographs

April 1998, approximately 167 pages, Hardcover, ISBN 0-8218-0336-0, 1991 *Mathematics Subject Classification:* 17B37; 16W30, 81R50, **All AMS members \$39**, List \$49, Order code SURV-SOIBELMANN



Algèbre Non Commutative, Groupes Quantiques et Invariants

J. Alev and G. Cauchon, Editors

The seventh meeting of the Contact Franco-Belge was held in Reims in June 1995. The goal of the meeting was the presentation of recent advances in several related areas

where a non-commutative algebraic approach is necessary.

The first part of the book contains five articles on new progress in classical problems; the second part, five papers on Hopf algebras, quantum groups and their representations; and the third part, six papers on invariant theory and representation theory. Two chapters are in French, remaining chapters are in English.

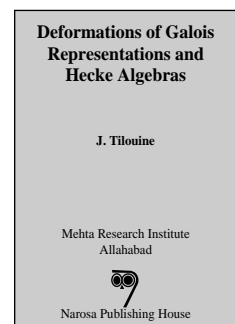
Titles in this series are published by the Société Mathématique de France and distributed by the AMS in the United States, Canada, and Mexico. Orders from other countries should be sent to the SMF, Maison de la SMF, B.P. 67, 13274 Marseille cedex 09, France, or to Institut Henri Poincaré, 11 rue Pierre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

Contents: S. S. Abhyankar, Hilbert's Thirteenth Problem; B. Keller, Basculement et homologie cyclique; A. A. Kirillov

and **A. Melnikov**, On a remarkable sequence of polynomials; **M. Van den Bergh**, Division algebras on \mathbb{P}^2 of odd index, ramified along a smooth elliptic curve are cyclic; **A. van den Essen**, Polynomial automorphisms and the Jacobian conjecture; **S. Caenepeel**, Harrison cocycles and the group of Galois coobjects; **J. Donin**, **D. Gurevich**, and **V. Rubtsov**, Quantum hyperboloid and braided modules; **S. M. Khoroshkin**, Central extension of the Yangian double; **C. M. Ringel**, Quantum Serre relations; **L. Willaert**, Schematic algebras and the Auslander-Gorenstein property; **M. Brion**, Sur certains modules gradués associés aux produits symétriques; **A. Joseph**, Coxeter structure and finite group action; **H. Derksen** and **H. Kraft**, Constructive invariant theory; **L. Le Bruyn**, Orbits of matrix tuples; **O. Mathieu**, Some conjectures about invariant theory and their applications; **A. Melnikov**, Dense orbits in orbital varieties in \mathfrak{sl}_n .

Séminaires et Congrès, Number 2

December 1997, 294 pages, Softcover, ISBN 2-85629-052-3, 1991 *Mathematics Subject Classification*: 05A15, 12F10, 13A20, 13A50, 13B05, 13P99, 14A15, 14A22, 14E07, 14E09, 14H30, 14L30, 14M99, 15A57, 16E40, 16G20, 16K20, 16R30, 16W30, 16W50, 17B20, 17B35, 17B37, 18E30, 18R50, 20C30, 20D06, 20E22, 20G05, 20E25, **Individual member \$59**, List \$66, Order code SECO/2N



Deformations of Galois Representations and Hecke Algebras

J. Tilouine, *Université de Paris Nord, Villetaneuse, France*

This book presents an expanded version of a course delivered at Hokkaido University (Sapporo, Japan) and at the Mehta Research Institute

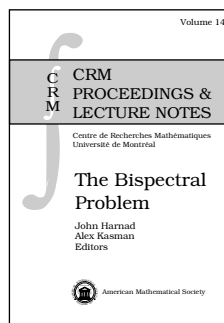
(Allahabad, India). Its aim is to examine aspects of the relationship connecting the local moduli space of deformations of a mod p “modular” Galois representation $\bar{\rho}$ to the corresponding local component of a p -adic Hecke algebra.

Published by Narosa Publishing House and distributed by the AMS exclusively in North America and Europe and non-exclusively elsewhere.

Contents: In guise of introduction: GL_1 and class-field theory; Deformation theory; Deformations of Galois representations; The universal ring, functorialities; Obstructions, estimates on dimension; Nearly ordinary Galois representations and their deformations; The Krull dimension of $R^{n,o}$; The Hida-Iwasawa algebra; Classical groups; Universal nearly ordinary Hecke algebra; References.

October 1996, 108 pages, Softcover, ISBN 81-7319-106-9, 1991 *Mathematics Subject Classification*: 11FX, **All AMS members \$19**, List \$24, Order code DGRN

Analysis



The Bispectral Problem

John Harnad and **Alex Kasman**, *Centre de Recherches Mathématiques, Université de Montréal, PQ, Canada*, Editors

Although originally posed in the context of mathematical problems related to medical imaging, the

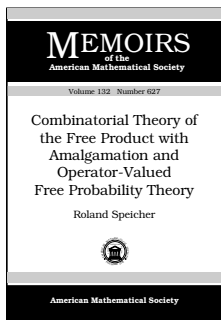
bispectral problem is now closely related to other topics and has connections to many areas of pure and applied mathematics. The central theme of this book is the search for solutions to eigenvalue problems that satisfy additional equations in the spectral parameter, for example, pairs of eigenvalue equations. This problem, which looks very simple at first, has turned out to be both deep and difficult. Moreover, this concept of bispectrality has been shown to be useful in many active areas of current research in mathematics and physics.

Following several years of exciting new results on the subject, in March 1997 the Centre de Recherches Mathématiques held the first scientific meeting devoted exclusively to the bispectral problem. Collected in this volume are contributions from the speakers at this meeting. The participants at this workshop included a majority of those researchers who have made significant contributions to the subject and many others working on related problems.

Contents: Part 1: **B. Bakalov**, **E. Horozov**, and **M. Yakimov**, Automorphisms of the Weyl algebra and bispectral operators; **Y. Berest**, Huygens' principle and the bispectral problem; **F. A. Grünbaum**, Some bispectral musings; **L. Haine**, Beyond the classical orthogonal polynomials; **J. Harnad**, Bispectral operators, dual isomonodromic deformations, and the Riemann-Hilbert dressing method; **A. Kasman**, Darboux transformations and the bispectral problem; **F. Levstein** and **L. F. Matusevich**, The discrete version of the bispectral problem; **M. Rothstein**, Explicit formulas for the Airy and Bessel bispectral involutions in terms of Calogero-Moser pairs; **V. Spiridonov**, **L. Vinet**, and **A. Zhedanov**, Bispectrality and Darboux transformations in the theory of orthogonal polynomials; **A. P. Veselov**, Baker-Akhiezer functions and the bispectral problem in many dimensions; **G. Wilson**, Bispectral algebras of ordinary differential operators; **J. P. Zubelli**, The bispectral problem, rational solutions of the master symmetry flows, and bihamiltonian systems; **Part 2:** **V. Kac** and **J. van de Leur**, The geometry of spinors and the multicomponent BKP and DKP hierarchies; **F. Magri**, The Hamiltonian route to Sato Grassmannian; **V. B. Matveev**, Darboux transformations in associative rings and functional-difference equations; **A. Yu. Orlov**, Remarks about the Calogero-Moser system and the KP equation; Subject index.

CRM Proceedings & Lecture Notes, Volume 14

March 1998, 235 pages, Softcover, ISBN 0-8218-0949-0, LC 97-44028, 1991 *Mathematics Subject Classification*: 34L95, 33C45; 58F07, 13N10, 34L99, 35Q53, 70H05, **Individual member \$39**, List \$65, Institutional member \$52, Order code CRMP/14N



Combinatorial Theory of the Free Product with Amalgamation and Operator-Valued Free Probability Theory

Roland Speicher, *University of Heidelberg, Germany*

Free probability theory, introduced by Voiculescu, has developed very actively in the last few years and has had an increasing impact on quite different fields in mathematics and physics. Whereas the subject arose out of the field of von Neumann algebras, presented here is a quite different view of Voiculescu's amalgamated free product. This combinatorial description not only allows re-proving of most of Voiculescu's results in a concise and elegant way, but also opens the way for many new results.

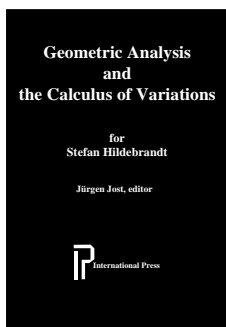
Unlike other approaches, this book emphasizes the combinatorial structure of the concept of "freeness". This gives an elegant and easily accessible description of freeness and leads to new results in unexpected directions. Specifically, a mathematical framework for otherwise quite ad hoc approximations in physics emerges.

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

Contents: Preliminaries on non-crossing partitions; Operator-valued multiplicative functions on the lattice of non-crossing partitions; Amalgamated free products; Operator-valued free probability theory; Operator-valued stochastic processes and stochastic differential equations; Bibliography.

Memoirs of the American Mathematical Society, Volume 132, Number 627

February 1998, 88 pages, Softcover, ISBN 0-8218-0693-9, LC 97-46539, 1991 *Mathematics Subject Classification*: 46L50; 60-XX, 06-XX, **Individual member \$23**, List \$39, Institutional member \$31, Order code MEMO/132/627N



Geometric Analysis and the Calculus of Variations

for Stefan Hildebrandt

Jürgen Jost, Editor

This text is dedicated to S. Hildebrandt on his 60th birthday and includes current works by his students, colleagues, and friends.

After fleeing East Germany in 1958, Hildebrandt met again his former academic teacher Ernst Hölder in Mainz. This reunion allowed Hildebrandt to continue his mathematics education, which was based on the Leipzig tradition of mathematical analysis of L. Lichtenstein, O. Hölder (father of Ernst), E. Hopf and others.

A frequent visitor at the Courant Institute in New York during the time at which the regularity theory for elliptic systems and minimal surfaces were prominent research topics, Hildebrandt formed lasting friendships with other brilliant analysts of his generation: Rabinowitz, Trudinger, Wentle, and Widman.

At Courant, he also met the grand masters of the time: Courant, Lewy, Moser and, Nirenberg. In the 30s, when Douglas, Radó, and Courant founded the modern theory of minimal surfaces, the question of boundary regularity for minimal surfaces remained unsettled. Hildebrandt achieved a complete solution of the problem. His result not only completed the classical theory, but also was a basis for subsequent new developments. The result brought Hildebrandt immediate fame. He was made a full professor in Mainz in 1967 and in Bonn in 1970. This theorem was only the first in an impressive series of fundamental results by Hildebrandt on various geometrically defined variational problems.

His contributions continued to be fundamental for later research. He achieved a lasting and formative influence on the geometric calculus of variations through his scientific contributions, and also through his direction of several research projects at the German Research Foundation (DFG) and his systematic education and support of a younger generation of German analysts. This book is a compilation of contributed works by those who wish to express their gratitude for the generous support Hildebrandt provided.

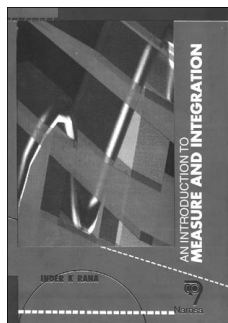
International Press publications are distributed worldwide, except in Japan, by the American Mathematical Society.

Contents: U. Dierkes and G. Huisken, The N -dimensional analogue of the catenary; F. Duzaar and K. Steffen, The plateau problem for parametric surfaces; C. Gerhardt, Closed Weingarten hypersurfaces in space forms; M.-C. Hong, J. Jost, and M. Struwe, Asymptotic limits of a Ginzburg-Landau type functional; N. M. Ivchikina, M. Lin, and N. S. Trudinger, The Dirichlet problem for the prescribed curvature quotient equations; J. Jost, Generalized harmonic maps between metric spaces; N. Korevaar and L. Simon, Equations of mean curvature type; E. Kuwert, Weak limits in the free boundary problem; F. H. Lin, Asymptotically conic elliptic operators and Liouville type theorems; S. Müller and V. Šverák, Attainment results for the two-well problem by convex integration; B. Nelli and J. Spruck, Constant mean curvature hypersurfaces; P. H. Rabinowitz, Homoclinics for a singular Hamiltonian system; F. Sauvigny, Uniqueness of Plateau's problem for certain contours; A. J. Tromba, Dirichlet's energy on Teichmüller's space is strictly pluri-subharmonic; H. C. Wentle, The Plateau problem for boundary curves with connectors; B. White, Half of Enneper's surface minimizes area; R. Ye, Foliation by constant mean curvature spheres.

International Press

December 1997, 383 pages, Hardcover, ISBN 1-57146-037-3, 1991 *Mathematics Subject Classification*: 35-06, 53-06, **All AMS members \$34**, List \$42, Order code INPR/26N

Supplementary Reading



An Introduction to Measure and Integration

Inder K. Rana, *Indian Institute of Technology, Pawai, India*

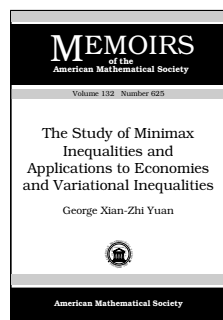
This volume presents a motivated introduction to a subject that goes under various headings such as real analysis, Lebesgue measure and integration, measure theory, modern analysis, advanced analysis, etc.

Prerequisite for the text is a first course in mathematical analysis. The text can be used for a one-year course in the topic as indicated by the title. Due to the lecture-notes style of the text, it would also be appropriate to use for individual self-study. Included is a chart depicting the logical interdependence of the chapters.

Published by Narosa Publishing House and distributed by the AMS exclusively in North America and Europe and non-exclusively elsewhere.

Contents: Prologue: The length function; Riemann integration; Recipes for extending the Riemann integral; Extending the length function; general extension theory; The Lebesgue measure on \mathbb{R} and its properties; Integration; Fundamental theorem of the integral calculus for Lebesgue integrals; Measure and integration on product spaces; Modes of convergence and L_p -spaces; The Radon-Nikodym theorem and its applications; Signed measures and complex measures; Appendix; References; Symbol index; Subject index.

March 1997, 380 pages, Hardcover, ISBN 81-7319-120-4, 1991 *Mathematics Subject Classification*: 28-01, All AMS members \$39, List \$49, Order code IMIN



The Study of Minimax Inequalities and Applications to Economics and Variational Inequalities

George Xian-Zhi Yuan, *University of Queensland, Brisbane, Australia*

This book provides a unified treatment for the study of the existence of equilibria of abstract economics in topological vector spaces from the viewpoint of Ky Fan minimax inequalities, which strongly depend on his infinite dimensional version of the classical Knaster, Kuratowski and Mazurkiewicz Lemma (KKM Lemma) in 1961. Studied are applications of general system versions of minimax inequalities and generalized quasi-variational inequalities, and random abstract economics and its applications to the system of random quasi-variational inequalities are given.

Features:

- Presents new results and recent development of KKM theory.

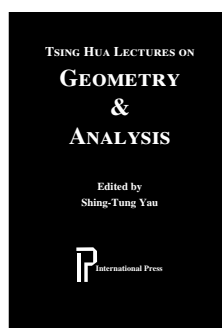
- Offers an overview of modern and up-to-date treatment of the KKM theory, including related articles covering theory and applications.
- Uses an interdisciplinary approach with specific applications in mathematics and economics.
- Includes a comprehensive bibliography.

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

Contents: The KKM principle related to Ky Fan minimax inequalities and fixed point theorems; Equilibria of abstract economics in Hausdorff topological vector spaces; Equilibria of abstract economics in locally convex topological vector spaces; Equilibria in Frechet spaces; Equilibria in topological spaces and some applications; Maximal elements and coincidence theorems in product topological spaces; Random abstract economics and applications.

Memoirs of the American Mathematical Society, Volume 132, Number 625

February 1998, 140 pages, Softcover, ISBN 0-8218-0747-1, LC 97-47117, 1991 *Mathematics Subject Classification*: 46H03, 47H04, 47H10, 47N10, 49J35, 49J40, 90A14, 90D06, 90D13, Individual member \$26, List \$43, Institutional member \$34, Order code MEMO/132/625N



Tsing Hua Lectures on Geometry & Analysis

Shing-Tung Yau, *Harvard University, Cambridge, MA*, Editor

This book presents lectures given during a seminar organized by S.-T. Yau at Tsing Hua University (Taiwan). Included are lectures by experts in the

field and students who studied under Yau. Contributions by guest lecturers and students made this a lively and successful seminar.

International Press publications are distributed worldwide, except in Japan, by the American Mathematical Society.

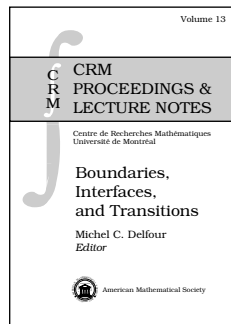
Contents: R. Bartnik, Energy in general relativity; S.-C. Chang, The Calabi flow $\frac{\partial \lambda}{\partial t} = \Delta R$ on Einstein manifolds; S.-C. Chang, Existence and convergence of solutions; C.-C. Chen and J.-F. Hwang, Closed geodesics; S. Y. Cheng, On the Chern conjecture for minimal hypersurface; F. R. K. Chung, A. Grigor'yan, and S.-T. Yau, Eigenvalues and diameters for manifolds and graphs; F. R. K. Chung and S.-T. Yau, A combinatorial trace formula; G. Huysken, Lecture one: Mean curvature evolution; G. Huysken, Lecture two: Singularities of the mean curvature flow; G. Huysken, Lecture three: an evolution equation for isoperimetric problem; G. Huysken, Lecture four: an evolution of metrics by the Ricci curvature; Y.-J. Hong, On the estimate of the gap between the first two eigenvalues; J. Jost, Minimal surfaces and Teichmüller theory; J. Jost and S.-T. Yau, Harmonic maps and superrigidity; N. C. Lee, Estimates for heat kernel and Green's function; P. Li, Harmonic maps of complete manifolds; P. Li, Harmonic functions on complete Riemannian manifolds; C.-H. Lin and M.-T. Wang, A note on the exhaustion function for complete manifolds; L. Simon, Lectures on singularities of variational problems; S.-T. Yau, Sobolev inequality for measure spaces; S. T. Yau, A note on the

distribution of critical points of eigenfunctions; **M. Dafermos**, Exhaustions of complete manifolds of bounded curvature.

International Press

December 1997, 322 pages, Hardcover, ISBN 1-57146-042-X, 1991 *Mathematics Subject Classification*: 35-06, 53-06, 83-06, All AMS members \$34, List \$42, Order code INPR/25N

Applications



Boundaries, Interfaces, and Transitions

Michel C. Delfour, *Centre de Recherches Mathématiques, Montréal, PQ, Canada*, Editor

There is currently considerable mathematical interest and very real potential for applications in using geometry in the design, identification

and control of technological processes. Geometry plays the role of a design variable in the shape optimization of mechanical parts. It also appears as a control variable in optimal swimming, shape control of aircraft wings or stabilization of membranes and plates by periodic variations of the boundary. As it is used as a design or control variable, it often undergoes “mutations” as in the microstructures of materials, crystal growth, image processing or the texture of objects which involve relaxations of classical geometry and geometrical entities. In other areas, such as free and moving boundary problems, the understanding of the underlying phenomena is very much related to the geometric properties of the fronts and the nature of the nonlinearities involved.

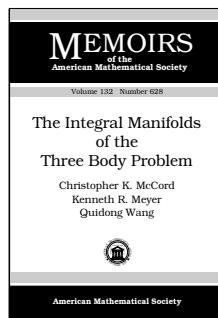
This book brings together tools that have been developed in a priori distant areas of mathematics, mechanics and physics. It provides coverage of selected contemporary problems in the areas of optimal design, mathematical models in material sciences, hysteresis, superconductivity, phase transition, crystal growth, moving boundary problems, thin shells and some of the associated numerical issues.

Contents: **K. Coughlin**, The transition to turbulence via turbulent bursts; **M. C. Delfour**, Intrinsic differential geometric methods in the asymptotic analysis of linear thin shells; **M. C. Delfour** and **J.-P. Zolésio**, Shape analysis via distance functions: Local theory; **I. Müller**, Six lectures on shape memory; **J. Rubinstein**, Six lectures on superconductivity; **H. M. Soner**, Front propagation; **A. Visintin**, Six talks on hysteresis; **M. J. Ward**, Dynamic metastability and singular perturbations; **J.-J. Xu**, Dendrites, fingers, interfaces and free boundaries.

CRM Proceedings & Lecture Notes, Volume 13

April 1998, approximately 352 pages, Softcover, ISBN 0-8218-0505-3, LC 97-52240, 1991 *Mathematics Subject Classification*: 35Kxx, 73Kxx, 73Bxx, 82Dxx, 49Qxx, 76Fxx; 76Exx, 35Qxx, 73Exx, 35Dxx, 47Hxx, **Individual member \$57**, List \$95, Institutional member \$76, Order code CRMP/13N

Mathematical Physics



The Integral Manifolds of the Three Body Problem

Christopher K. McCord and **Kenneth R. Meyer**, *University of Cincinnati, OH*, and **Quidong Wang**, *University of California, Los Angeles*

The phase space of the spatial three-body problem is an open subset in

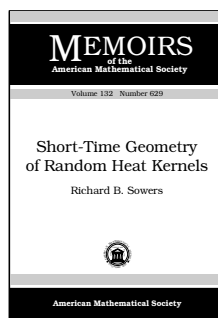
\mathbb{R}^{18} . Holding the ten classical integrals of energy, center of mass, linear and angular momentum fixed defines an eight dimensional submanifold. For fixed nonzero angular momentum, the topology of this manifold depends only on the energy. This volume computes the homology of this manifold for all energy values. This table of homology shows that for negative energy, the integral manifolds undergo seven bifurcations. Four of these are the well-known bifurcations due to central configurations, and three are due to “critical points at infinity”. This disproves Birkhoff’s conjecture that the bifurcations occur only at central configurations.

Contents: Introduction; The decomposition of the spaces; The cohomology; The analysis of $\mathfrak{R}(c, h)$ for equal masses; The analysis of $\mathfrak{R}(c, h)$ for general masses; Bibliography.

Memoirs of the American Mathematical Society, Volume 132, Number 628

February 1998, 92 pages, Softcover, ISBN 0-8218-0692-0, LC 97-47115, 1991 *Mathematics Subject Classification*: 70F07, 58F05, 57R57; 58F14, **Individual member \$24**, List \$40, Institutional member \$32, Order code MEMO/132/628N

Probability



Short-Time Geometry of Random Heat Kernels

Richard B. Sowers, *University of Illinois, Urbana*

This volume studies the behavior of the random heat kernel associated with the stochastic partial differential equation $du = \frac{1}{2}\Delta udt = (\sigma, \nabla u) \circ dW_t$,

on some Riemannian manifold M . Here Δ is the Laplace-Beltrami operator, σ is some vector field on M , and ∇ is the gradient operator. Also, W is a standard Wiener process and \circ denotes Stratonovich integration. The author gives short-time expansion of this heat kernel. He finds that the dominant exponential term is classical and depends only on the Riemannian distance function. The second exponential term is a work term and also has classical meaning. There is also a third non-negligible exponential term which blows up. The

author finds an expression for this third exponential term which involves a random translation of the index form and the equations of Jacobi fields. In the process, he develops a method to approximate the heat kernel to any arbitrary degree of precision.

Contents: Introduction; Guessing the dominant asymptotics; Initial condition and evolution of the approximate kernel; The Minakshisundaram-Pleijel coefficients; Error estimates, proof of the main theorem, and extensions; Appendices; Bibliography.

Memoirs of the American Mathematical Society, Volume 132, Number 629

February 1998, 130 pages, Softcover, ISBN 0-8218-0649-1, LC 97-47114, 1991 *Mathematics Subject Classification*: 35A08, 35K05, 60H15, 93E11; 35A30, 35R60, 58G11, 58G18, 58G32, 60G35, **Individual member \$25**, List \$41, Institutional member \$33, Order code MEMO/132/629N