Stochastic Representations And A Geometric Parametrization

This 1995 book introduces the reader to Drinfeld modular varieties, and is pitched at graduate students.
The subject of this book is Osserman semi-Riemannian manifolds, and in particular, the Osserman conjecture in semi-Riemannian geometry. The treatment is pitched at the intermediate graduate level and requires some intermediate knowledge of differential geometry. The notation is mostly coordinate-free and the terminology is that of modern differential geometry. Known results toward the complete proof of Riemannian Osserman conjecture are given and the Osserman conjecture in Lorentzian geometry is proved completely. Counterexamples to the Osserman conjuncture in generic semi-Riemannian signature are provided and properties of semi-Riemannian Osserman manifolds are investigated.
?This book collects some recent developments in stochastic control theory with applications to financial mathematics. We first address standard stochastic control problems from the viewpoint of the recently developed weak dynamic programming principle. A special emphasis is put on the regularity issues and, in particular, on the behavior of the value function near the boundary. We then provide a quick review of the main tools from viscosity solutions which allow to overcome all regularity problems. We next address the class of stochastic target problems which extends in a nontrivial way the standard stochastic control problems. Here the theory of viscosity solutions plays a crucial role in the derivation of the dynamic programming equation as the infinitesimal counterpart of the corresponding geometric dynamic programming equation. The various developments of this theory have been stimulated by applications in finance and by relevant connections with geometric flows. Namely, the second order extension was motivated by illiquidity modeling, and the controlled loss version was introduced following the problem of quantile hedging. The third part specializes to an overview of Backward stochastic differential equations, and their extensions to the quadratic case.?
This volume bears on wireless network modeling and performance analysis. The aim is to show how stochastic geometry can be used in a more or less systematic way to analyze the phenomena that arise in this context. It first focuses on medium access control mechanisms used in ad hoc networks and in cellular networks. It then discusses the use of stochastic geometry for the quantitative analysis of routing algorithms in mobile ad hoc networks. The appendix also contains a concise summary of wireless communication principles and of the network architectures considered in the two volumes.
This unique two-volume set presents the subjects of stochastic processes, information theory, and Lie groups in a unified setting, thereby building bridges between fields that are rarely studied by the same people. Unlike the many excellent formal treatments available for each of these subjects individually, the emphasis in both of these volumes is on the use of stochastic, geometric, and group-theoretic concepts in the modeling of physical phenomena. Stochastic Models, Information Theory, and Lie Groups will be of interest to advanced undergraduate and graduate students, researchers, and practitioners working in applied mathematics, the physical sciences, and engineering. Extensive exercises and motivating examples make the work suitable as a textbook for use in courses that emphasize applied stochastic processes or differential geometry.
Concerned with probability theory, Elton Hsu's study focuses primarily on the relations between Brownian motion on a manifold and analytical aspects of differential geometry. A key theme is the probabilistic interpretation of the curvature of a manifold
This book constitutes the refereed proceedings of the 16th European Workshop on Computer Performance Engineering, EPEW 2019, held in Milan, Italy, in November 2019. The 10 papers presented in this volume together with one invited talk were carefully reviewed and selected from 13 submissions. The papers presented at the workshop reflect the diversity of modern performance engineering, with topics ranging from modeling and analysis of network/control protocols and high performance/BigData information systems, analysis of scheduling, blockchain technology, analytical modeling and simulation of computer/network systems.
Some twenty years have elapsed since the first attempts at planning were made by researchers in artificial intelligence. These early programs concentrated on the development of plans for the solution of puzzles or toy problems, like the rearrangement of stacks of blocks. These early programs provided the foundation for the work described in this book, the automatic generation of plans for industrial assembly. As one reads about the complex and sophisticated planners in the current gen eration, it is important to keep in mind that they are addressing real-world problems. Although these systems may become the "toy" systems of tomor row, they are providing a solid foundation for future, more general and more advanced planning tools. As demonstrated by the papers in this book, the field of computer-aided mechanical assembly planning is maturing. It now may include: • geometric descriptions of parts extracted from or compatible with CAD programs; • constraints related to part interference and the use of tools; • fixtures and jigs required for the assembly; • the nature of connectors, matings and other relations between parts; • number of turnovers required during the assembly; • handling and gripping requirements for various parts; • automatic identification of subassemblies. This is not an exhaustive list, but it serves to illustrate the complexity of some of the issues which are discussed in this book. Such issues must be considered in the design of the modern planners, as they produce desirable assembly sequences and precedence relations for assembly.
Noncommutative Geometry is one of the most deep and vital research subjects of present-day Mathematics. Its development, mainly due to Alain Connes, is providing an increasing number of applications and deeper insights for instance in Foliations, K-Theory, Index Theory, Number Theory but also in Quantum Physics of elementary particles. The purpose of the Summer School in Martina Franca was to offer a fresh invitation to the subject and closely related topics; the contributions in this volume include the four main lectures, cover advanced developments and are delivered by prominent specialists.
Stochastic geometry deals with models for random geometric structures. Its early beginnings are found in playful geometric probability

questions, and it has vigorously developed during recent decades, when an increasing number of real-world applications in various sciences required solid mathematical foundations. Integral geometry studies geometric mean values with respect to invariant measures and is, therefore, the appropriate tool for the investigation of random geometric structures that exhibit invariance under translations or motions. Stochastic and Integral Geometry provides the mathematically oriented reader with a rigorous and detailed introduction to the basic stationary models used in stochastic geometry – random sets, point processes, random mosaics – and to the integral geometry that is needed for their investigation. The interplay between both disciplines is demonstrated by various fundamental results. A chapter on selected problems about geometric probabilities and an outlook to non-stationary models are included, and much additional information is given in the section notes.
In July 1987, an AMS-IMS-SIAM Joint Summer Research Conference on Geometry of Random Motion was held at Cornell University. The initial impetus for the meeting came from the desire to further explore the now-classical connection between diffusion processes and second-order (hypo)elliptic differential operators. To accomplish this goal, the conference brought together leading researchers with varied backgrounds and interests: probabilists who have proved results in geometry, geometers who have used probabilistic methods, and probabilists who have studied diffusion processes. Focusing on the interplay between probability and differential geometry, this volume examines diffusion processes on various geometric structures, such as Riemannian manifolds, Lie groups, and symmetric spaces. Some of the articles specifically address analysis on manifolds, while others center on (nongeometric) stochastic analysis. The majority of the articles deal simultaneously with probabilistic and geometric techniques. Requiring a knowledge of the modern theory of diffusion processes, this book will appeal to mathematicians, mathematical physicists, and other researchers interested in Brownian motion, diffusion processes, Laplace-Beltrami operators, and the geometric applications of these concepts. The book provides a detailed view of the leading edge of research in this rapidly moving field.
The international summer school on Calculus of Variations and Geometric Evolution Problems was held at Cetraro, Italy, 1996. The contributions to this volume reflect quite closely the lectures given at Cetraro which have provided an image of a fairly broad field in analysis where in recent years we have seen many important contributions. Among the topics treated in the courses were variational methods for Ginzburg-Landau equations, variational models for microstructure and phase transitions, a variational treatment of the Plateau problem for surfaces of prescribed mean curvature in Riemannian manifolds - both from the classical point of view and in the setting of geometric measure theory.
The aim of the book is to study some aspects of geometric evolutions, such as mean curvature flow and anisotropic mean curvature flow of hypersurfaces. We analyze the origin of such flows and their geometric and variational nature. Some of the most important aspects of mean curvature flow are described, such as the comparison principle and its use in the definition of suitable weak solutions. The anisotropic evolutions, which can be considered as a generalization of mean curvature flow, are studied from the view point of Finsler geometry. Concerning singular perturbations, we discuss the convergence of the Allen–Cahn (or Ginsburg–Landau) type equations to (possibly anisotropic) mean curvature flow before the onset of singularities in the limit problem. We study such kinds of asymptotic problems also in the static case, showing convergence to prescribed curvature-type problems.
This book constitutes the thoroughly refereed joint post-proceedings of the 6th International Workshop on Mathematics Mechanization, IWMM 2004, held in Shanghai, China in May 2004 and the International Workshop on Geometric Invariance and Applications in Engineering, GIAE 2004, held in Xian, China in May 2004. The 30 revised full papers presented were rigorously reviewed and selected from 65 presentations given at the two workshops. The papers are devoted to topics such as applications of computer algebra in celestial and engineering multibody systems, differential equations, computer vision, computer graphics, and the theory and applications of geometric algebra in geometric reasoning, robot vision, and computer graphics.
Topics include matrix-geometric invariant vectors, buffer models, queues in a random environment and more.
Unlike much of the existing literature, Stochastic Finance: A Numeraire Approach treats price as a number of units of one asset needed for an acquisition of a unit of another asset instead of expressing prices in dollar terms exclusively. This numeraire approach leads to simpler pricing options for complex products, such as barrier, lookback, quant
This book presents a treatise on the theory and modeling of second-order stationary processes, including an exposition on selected application areas that are important in the engineering and applied sciences. The foundational issues regarding stationary processes dealt with in the beginning of the book have a long history, starting in the 1940s with the work of Kolmogorov, Wiener, Cramér and his students, in particular Wold, and have since been refined and complemented by many others. Problems concerning the filtering and modeling of stationary random signals and systems have also been addressed and studied, fostered by the advent of modern digital computers, since the fundamental work of R.E. Kalman in the early 1960s. The book offers a unified and logically consistent view of the subject based on simple ideas from Hilbert space geometry and coordinate-free thinking. In this framework, the concepts of stochastic state space and state space modeling, based on the notion of the conditional independence of past and future flows of the relevant signals, are revealed to be fundamentally unifying ideas. The book, based on over 30 years of original research, represents a valuable contribution that will inform the fields of stochastic modeling, estimation, system identification, and time series analysis for decades to come. It also provides the mathematical tools needed to grasp and analyze the structures of algorithms in stochastic systems theory.
Surface topography is, generally, composed of many length scales starting from its physical geometry, to its microscopic or atomic scales known by roughness. The spatial and geometrical evolution of the roughness topography of engineered surfaces avail comprehensive understanding, and interpretation of many physical and engineering problems such as friction, and wear mechanisms during the mechanical contact between adjoined surfaces. Obviously, the topography of rough surfaces is of random nature. It is composed of irregular hills/valleys being spatially correlated. The relation between their densities and their geometric properties are the fundamental topics that have been developed, in this research study, using the theory of random fields and their geometry.
A modern version of the calculus of variations, encompassing geometric mechanics, differential geometry, and optimal control.
This book provides a self-contained exposition of the theory of plane Cremona maps, reviewing the classical theory. The book updates, correctly proves and generalises a number of classical results by allowing any configuration of singularities for the base points of the plane Cremona maps. It also presents some material which has only appeared in research papers and includes new, previously unpublished results. This book will be useful as a reference text for any researcher who is interested in the topic of plane birational maps.
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This volume and Stochastic Processes, Physics and Geometry: New Interplays. I present state-of-the-art research currently unfolding at the interface between mathematics and physics. Included are select articles from the international conference held in

Leipzig (Germany) in honor of Sergio Albeverio's sixtieth birthday. The theme of the conference, ``Infinite Dimensional (Stochastic) Analysis and Quantum Physics'', was chosen to reflect Albeverio's wide-ranging scientific interests. The articles in these books reflect that broad range of interests and provide a detailed overview highlighting the deep interplay among stochastic processes, mathematical physics, and geometry. The contributions are written by internationally recognized experts in the fields of stochastic analysis, linear and nonlinear (deterministic and stochastic) PDEs, infinite dimensional analysis, functional analysis, commutative and noncommutative probability theory, integrable systems, quantum and statistical mechanics, geometric quantization, and neural networks. Also included are applications in biology and other areas. Most of the contributions are high-level research papers. However, there are also some overviews on topics of general interest. The articles selected for publication in these volumes were specifically chosen to introduce readers to advanced topics, to emphasize interdisciplinary connections, and to stress future research directions. Volume I contains contributions from invited speakers; Volume II contains additional contributed papers.

Geometric Mechanics here means mechanics on a pseudo-riemannian manifold and the main goal is the study of some mechanical models and concepts, with emphasis on the intrinsic and geometric aspects arising in classical problems. The first seven chapters are written in the spirit of Newtonian Mechanics while the last two ones as well as two of the four appendices describe the foundations and some aspects of Special and General Relativity. All the material has a coordinate free presentation but, for the sake of motivation, many examples and exercises are included in order to exhibit the desirable flavor of physical applications.

This Special Issue of the journal Entropy, titled “Information Geometry I”, contains a collection of 17 papers concerning the foundations and applications of information geometry. Based on a geometrical interpretation of probability, information geometry has become a rich mathematical field employing the methods of differential geometry. It has numerous applications to data science, physics, and neuroscience. Presenting original research, yet written in an accessible, tutorial style, this collection of papers will be useful for scientists who are new to the field, while providing an excellent reference for the more experienced researcher. Several papers are written by authorities in the field, and topics cover the foundations of information geometry, as well as applications to statistics, Bayesian inference, machine learning, complex systems, physics, and neuroscience.

Based on a conference held in honor of Professor Tarow Indow, this volume is organized into three major topics concerning the use of geometry in perception: * space -- referring to attempts to represent the subjective space within which we locate ourselves and perceive objects to reside; * color -- dealing with attempts to represent the structure of color percepts as revealed by various experimental procedures; and * scaling -- focusing on the organization of various bodies of data -- in this case perceptual -- through scaling techniques, primarily multidimensional ones. These topics provide a natural organization of the work in the field, as well as one that corresponds to the major aspects of Indow's contributions. This book's goal is to provide the reader with an overview of the issues in each of the areas, and to present current results from the laboratories of leading researchers in these areas.

The material collected in this volume reflects the active present of this area of mathematics, ranging from the abstract theory of gradient flows to stochastic representations of non-linear parabolic PDE's. Articles will highlight the present as well as expected future directions of development of the field with particular emphasis on applications. The article by Ambrosio and Savaré discusses the most recent development in the theory of gradient flow of probability measures. After an introduction reviewing the properties of the Wasserstein space and corresponding subdifferential calculus, applications are given to evolutionary partial differential equations. The contribution of Herrero provides a description of some mathematical approaches developed to account for quantitative as well as qualitative aspects of chemotaxis. Particular attention is paid to the limits of cell's capability to measure external cues on the one hand, and to provide an overall description of aggregation models for the slim mold Dictyostelium discoideum on the other. The chapter written by Masmoudi deals with a rather different topic - examples of singular limits in hydrodynamics. This is nowadays a well-studied issue given the amount of new results based on the development of the existence theory for rather general systems of equations in hydrodynamics. The paper by DeLellis addreses the most recent results for the transport equations with regard to possible applications in the theory of hyperbolic systems of conservation laws. Emphasis is put on the development of the theory in the case when the governing field is only a BV function. The chapter by Rein represents a comprehensive survey of results on the Poisson-Vlasov system in astrophysics. The question of global stability of steady states is addressed in detail. The contribution of Soner is devoted to different representations of non-linear parabolic equations in terms of Markov processes. After a brief introduction on the linear theory, a class of non-linear equations is investigated, with applications to stochastic control and differential games. The chapter written by Zuazua presents some of the recent progresses done on the problem of controllabilty of partial differential equations. The applications include the linear wave and heat equations,parabolic equations with coefficients of low regularity, and some fluid-structure interaction models. - Volume 1 focuses on the abstract theory of evolution - Volume 2 considers more concrete probelms relating to specific applications - Volume 3 reflects the active present of this area of mathematics, ranging from the abstract theory of gradient flows to stochastic representations of non-linear PDEs

Abstract Biological vision is a rather fascinating domain of research. Scientists of various origins like biology, medicine, neurophysiology, engineering, math ematics, etc. aim to understand the processes leading to visual perception process and at reproducing such systems. Understanding the environment is most of the time done through visual perception which appears to be one of the most fundamental sensory abilities in humans and therefore a significant amount of research effort has been dedicated towards modelling and repro ducing human visual abilities. Mathematical methods play a central role in this endeavour. Introduction David Marr's theory v^as a pioneering step tov^ards understanding visual percep tion. In his view human vision was based on a complete surface reconstruction of the environment that was then used to address visual subtasks. This approach was proven to be insufficient by neuro-biologists and complementary ideas from statistical pattern recognition and artificial intelligence were introduced to bet ter address the visual perception problem. In this framework visual perception is represented by a set of actions and rules connecting these actions. The emerg ing concept of active vision consists of a selective visual perception paradigm that is basically equivalent to recovering from the environment the minimal piece information required to address a particular task of interest.

Statistical physics seeks to explain macroscopic properties of matter in terms of microscopic interactions. Of particular interest is the phenomenon of phase transition: the sudden changes in macroscopic properties as external conditions are varied. Two models in particular are of great interest to mathematicians, namely the Ising model of a magnet and the percolation model of a porous solid. These models in turn are part of the unifying framework of the random-cluster representation, a model for random graphs which was first studied by Fortuin and Kasteleyn in the 1970's. The random-cluster representation has proved extremely useful in proving important facts about the Ising model and similar models. In this work we study the corresponding graphical framework for two related models. The first model is the transverse field quantum Ising model, an extension of the original Ising model which was introduced by Lieb, Schultz and Mattis in the 1960's. The second model is the space-time percolation process, which is closely related to the contact model for the spread of disease. In Chapter 2 we define the appropriate 'space-time' random-cluster model and explore a range of useful probabilistic techniques for studying it. The space-time Potts model emerges as a natural generalization of the quantum Ising model. The basic properties of the phase transitions in these models are treated in this chapter, such as the fact that there is at most one unbounded fk-cluster, and the resulting lower bound on the critical value in Z. In Chapter 3 we develop an alternative graphical representation of the quantum Ising model, called the random-parity representation. This representation is based on the random-current representation of the classical Ising model, and allows us to study in much greater detail the phase transition and critical behaviour. A major aim of this chapter is to prove sharpness of the phase transition in the quantum Ising model - a central issue in the theory - and to establish bounds on some critical exponents. We address these issues by using the random-parity representation to establish certain differential inequalities, integration of which give the results. In Chapter 4 we explore some consequences and possible extensions of the results established in Chapters 2 and 3. For example, we determine the critical point for the quantum Ising model in Z and in 'star-like' geometries.

Nonholonomic systems are a widespread topic in several scientific and commercial domains, including robotics, locomotion and space exploration. This work sheds new light on this interdisciplinary character through the investigation of a variety of aspects coming from several disciplines. The main aim is to illustrate the idea that a better understanding of the geometric structures of mechanical systems unveils new and unknown aspects to them, and helps both analysis and design to solve standing problems and identify new challenges. In this way, separate areas of research such as Classical Mechanics, Differential Geometry, Numerical Analysis or Control Theory are brought together in this study of nonholonomic systems.

This monograph contributes to the existence theory of difference sets, cyclic irreducible codes and similar objects. The new method of field descent for cyclotomic integers of presribed absolute value is developed. Applications include the first substantial progress towards the Circulant Hadamard Matrix Conjecture and Ryser`s conjecture since decades. It is shown that there is no Barker sequence of length l with 13

Stochastic differential equations, and Hoermander form representations of diffusion operators, can determine a linear connection associated to the underlying (sub)-Riemannian structure. This is systematically described, together with its invariants, and then exploited to discuss qualitative properties of stochastic flows, and analysis on path spaces of compact manifolds with diffusion measures. This should be useful to stochastic analysts, especially those with interests in stochastic flows, infinite dimensional analysis, or geometric analysis, and also to researchers in sub-Riemannian geometry. A basic background in differential geometry is assumed, but the construction of the connections is very direct and itself gives an intuitive and concrete introduction. Knowledge of stochastic analysis is also assumed for later chapters.

The present volume is an extensive monograph on the analytic and geometric aspects of Markov diffusion operators. It focuses on the geometric curvature properties of the underlying structure in order to study convergence to equilibrium, spectral bounds, functional inequalities such as Poincaré, Sobolev or logarithmic Sobolev inequalities, and various bounds on solutions of evolution equations. At the same time, it covers a large class of evolution and partial differential equations. The book is intended to serve as an introduction to the subject and to be accessible for beginning and advanced scientists and non-specialists. Simultaneously, it covers a wide range of results and techniques from the early developments in the mid-eighties to the latest achievements. As such, students and researchers interested in the modern aspects of Markov diffusion operators and semigroups and their connections to analytic functional inequalities, probabilistic convergence to equilibrium and geometric curvature will find it especially useful. Selected chapters can also be used for advanced courses on the topic.

Asymptotic Geometric Analysis is concerned with the geometric and linear properties of finite dimensional objects, normed spaces, and convex bodies, especially with the asymptotics of their various quantitative parameters as the dimension tends to infinity. The deep geometric, probabilistic, and combinatorial methods developed here are used outside the field in many areas of mathematics and mathematical sciences. The Fields Institute Thematic Program in the Fall of 2010 continued an established tradition of previous large-scale programs devoted to the same general research direction. The main directions of the program included: * Asymptotic theory of convexity and normed spaces * Concentration of measure and isoperimetric inequalities, optimal transportation approach * Applications of the concept of concentration * Connections with transformation groups and Ramsey theory * Geometrization of probability * Random matrices * Connection with asymptotic combinatorics and complexity theory These directions are represented in this volume and reflect the present state of this important area of research. It will be of benefit to researchers working in a wide range of mathematical sciences—in particular functional analysis, combinatorics, convex geometry, dynamical systems, operator algebras, and computer science.

This paper introduces time-continuous numerical schemes to simulate stochastic differential equations (SDEs) arising in mathematical finance, population dynamics, chemical kinetics, epidemiology, biophysics, and polymeric fluids. These schemes are obtained by spatially discretizing the Kolmogorov equation associated with the SDE in such a way that the resulting semi-discrete equation generates a Markov jump process that can be realized exactly using a Monte Carlo method. In this construction the jump size of the approximation can be bounded uniformly in space, which often guarantees that the schemes are numerically stable for both finite and long time simulation of SDEs.

The classical subjects of geometric probability and integral geometry, and the more modern one of stochastic geometry, are developed here in a novel way to provide a framework in which they can be studied. The author focuses on factorization properties of measures and probabilities implied by the assumption of their invariance with respect to a group, in order to investigate nontrivial factors. The study of these properties is the central theme of the book. Basic facts about integral geometry and random point process theory are developed in a simple geometric way, so that the whole approach is suitable for a nonspecialist audience. Even in the later chapters, where the factorization principles are applied to geometrical processes, the only prerequisites are standard courses on probability and analysis. The main ideas presented have application to such areas as stereology and geometrical statistics and this book will be a useful reference book for university students studying probability theory and stochastic geometry, and research mathematicians interested in this area.