Stochastic Representations And A Geometric Parametrization

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FAULKNER JOSHUA

Geometric, Control and Numerical Aspects of Nonholonomic Systems Springer Science & Business Media
Starting in the middle of the 80s, there has been a growing and fruitful interaction between algebraic geometry and certain areas of theoretical high-energy physics, especially the various versions of string theory. Physical heuristics have provided inspiration for new mathematical definitions (such as that of Gromov-Witten invariants) leading in turn to the solution of problems in enumerative geometry. Conversely, the availability of mathematically rigorous definitions and theorems has benefited the physics research by providing the required evidence in fields where experimental testing seems problematic. The aim of this volume, a result of the CIME Summer School held in Cetraro, Italy, in 2005, is to cover part of the most recent and interesting findings in this subject.
Continuous-Time Random Walks for the Numerical Solution of Stochastic Differential Equations Springer
This book grew out of the Random Transformations and Invariance in Stochastic Dynamics conference held in Verona from the 25th to the 28th of March 2019 in honour of Sergio Albeverio. It presents the new area of studies concerning invariance and symmetry properties of finite and infinite dimensional stochastic differential equations.This area constitutes a natural, much needed, extension of the theory of classical ordinary and partial differential equations, where the reduction theory based on symmetry and invariance of such classical equations has historically proved to be very important both for theoretical and numerical studies and has given rise to important applications. The purpose of the present book is to present the state of the art of the studies on stochastic systems from this point of view, present some of the underlying fundamental ideas and methods involved, and to outline the main lines for future developments. The main focus is on bridging the gap between deterministic and stochastic approaches, with the goal of contributing to the elaboration of a unified theory that will have a great impact both from the theoretical point of view and the point of view of applications. The reader is a mathematician or a theoretical physicist. The main discipline is stochastic analysis with profound ideas coming from Mathematical Physics and Lie's Group Geometry. While the audience consists essentially of academicians, the reader can also be a practitioner with Ph.D., who is interested in efficient stochastic modelling.
Geometric Control Theory Springer Science & Business Media
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.
Handbook of Differential Equations: Evolutionary Equations
Springer Science & Business Media
This volume and "IStochastic Processes, Physics and Geometry: New Interplays II" 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. Members of the Canadian Mathematical Society may order at the AMS member price.
Elsevier
The treatment of uncertainties in the analysis of engineering

structures remains one of the premium challenges in modern structural mechanics. It is only in recent years that the developments in stochastic and deterministic computational mechanics began to be synchronized. To foster these developments, novel computational procedures for the uncertainty assessment of large finite element systems are presented in this monograph. The stochastic input is modeled by the so-called Karhunen-Loève expansion, which is formulated in this context both for scalar and vector stochastic processes as well as for random fields. Particularly for strongly non-linear structures and systems the direct Monte Carlo simulation technique has proven to be most advantageous as method of solution. The capabilities of the developed procedures are demonstrated by showing some practical applications.

Aspects of Mathematical Finance Springer Nature

This book presents a self-contained introduction to the analytic foundation of a level set approach for various surface evolution equations including curvature flow equations. These equations are important in many applications, such as material sciences, image processing and differential geometry. The goal is to introduce a generalized notion of solutions allowing singularities, and to solve the initial-value problem globally-in-time in a generalized sense. Various equivalent definitions of solutions are studied. Several new results on equivalence are also presented. Moreover, structures of level set equations are studied in detail. Further, a rather complete introduction to the theory of viscosity solutions is contained, which is a key tool for the level set approach. Although most of the results in this book are more or less known, they are scattered in several references, sometimes without proofs. This book presents these results in a synthetic way with full proofs. The intended audience are graduate students and researchers in various disciplines who would like to know the applicability and detail of the theory as well as its flavour. No familiarity with differential geometry or the theory of viscosity solutions is required. Only prerequisites are calculus, linear algebra and some basic knowledge about semicontinuous functions.

Cartanian Geometry, Nonlinear Waves, and Control Theory Springer

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.

Hydro-Environmental Analysis Springer Nature

Geometric control theory is concerned with the evolution of systems subject to physical laws but having some degree of freedom through which motion is to be controlled. This book describes the mathematical theory inspired by the irreversible nature of time evolving events. The first part of the book deals with the issue of being able to steer the system from any point of departure to any desired destination. The second part deals with optimal control, the question of finding the best possible course. An overlap with mathematical physics is demonstrated by the Maximum principle, a fundamental principle of optimality arising from geometric control, which is applied to time-evolving systems governed by physics as well as to man-made systems governed by controls. Applications are drawn from geometry, mechanics, and control of dynamical systems. The geometric language in which the results are expressed allows clear visual interpretations and makes the book accessible to physicists and engineers as well as to mathematicians.

Optimal Stochastic Control, Stochastic Target Problems, and Backward SDE Springer

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.

Stochastic Geometric Mechanics Springer

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

Calculus of Variations and Geometric Evolution Problems American Mathematical Soc.

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.

Factorization Calculus and Geometric Probability Springer Science & Business Media

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.

Computer Performance Engineering Springer

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.

Stochastic Numerics for Mathematical Physics Springer Science & Business Media

Topics include matrix-geometric invariant vectors, buffer models, queues in a random environment and more.

Stochastic Processes, Physics and Geometry: New Interplays. I Springer Science & Business Media

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.

Computer-Aided Mechanical Assembly Planning Cambridge University Press

Collecting together contributed lectures and mini-courses, this book details the research presented in a special semester titled “Geometric mechanics – variational and stochastic methods” run in the first half of 2015 at the Centre Interfacultaire Bernoulli (CIB) of the Ecole Polytechnique Fédérale de Lausanne. The aim of the semester was to develop a common language needed to handle the wide variety of problems and phenomena occurring in stochastic geometric mechanics. It gathered mathematicians and scientists from several different areas of mathematics (from analysis, probability, numerical analysis and statistics, to algebra, geometry, topology, representation theory, and dynamical systems theory) and also areas of mathematical physics, control theory, robotics, and the life sciences, with the aim of developing the new research area in a concentrated joint effort, both from the theoretical and applied points of view. The lectures were given by leading specialists in different areas of mathematics and its applications, building bridges among the various communities involved and working jointly on developing the envisaged new interdisciplinary subject of stochastic geometric mechanics.

Geometry and Invariance in Stochastic Dynamics Math Science Press

Focusing on fundamental principles, Hydro-Environmental

Analysis: Freshwater Environments presents in-depth information about freshwater environments and how they are influenced by regulation. It provides a holistic approach, exploring the factors that impact water quality and quantity, and the regulations, policy and management methods that are necessary to maintain this vital resource. It offers a historical viewpoint as well as an overview and foundation of the physical, chemical, and biological characteristics affecting the management of freshwater environments. The book concentrates on broad and general concepts, providing an interdisciplinary foundation. The author covers the methods of measurement and classification; chemical, physical, and biological characteristics; indicators of ecological health; and management and restoration. He also considers common indicators of environmental health; characteristics and operations of regulatory control structures; applicable laws and regulations; and restoration methods. The text delves into rivers and streams in the first half and lakes and reservoirs in the second half. Each section centers on the characteristics of those systems and methods of classification, and then moves on to discuss the physical, chemical, and biological characteristics of each. In the section on lakes and reservoirs, it examines the characteristics and operations of regulatory structures, and presents the methods commonly used to assess the environmental health or integrity of these water bodies. It also introduces considerations for restoration, and presents two unique aquatic environments: wetlands and reservoir tailwaters. Written from an engineering perspective, the book is an ideal introduction to the aquatic and limnological sciences for students of environmental science, as well as students of environmental engineering. It also serves as a reference for engineers and scientists involved in the management, regulation, or restoration of freshwater environments.

Handbook of Mathematical Models in Computer Vision Springer Science & Business Media

This book grew out of the Random Transformations and Invariance in Stochastic Dynamics conference held in Verona from the 25th to the 28th of March 2019 in honour of Sergio Albeverio. It presents the new area of studies concerning invariance and symmetry properties of finite and infinite dimensional stochastic differential equations.This area constitutes a natural, much needed, extension of the theory of classical ordinary and partial differential equations, where the reduction theory based on symmetry and invariance of such classical equations has historically proved to be very important both for theoretical and numerical studies and has given rise to important applications. The purpose of the present book is to present the state of the art of the studies on stochastic systems from this point of view, present some of the underlying fundamental ideas and methods involved, and to outline the main lines for future developments. The main focus is on bridging the gap between deterministic and stochastic approaches, with the goal of contributing to the elaboration of a unified theory that will have a great impact both from the theoretical point of view and the point of view of applications. The reader is a mathematician or a theoretical physicist. The main discipline is stochastic analysis with profound ideas coming from Mathematical Physics and Lies Group Geometry. While the audience consists essentially of academicians, the reader can also be a practitioner with Ph.D., who is interested in efficient stochastic modelling.

Lecture Notes on Mean Curvature Flow: Barriers and Singular Perturbations Springer Science & Business Media

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.

On the Geometry of Diffusion Operators and Stochastic Flows Psychology Press

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.