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IUTAM Symposium on Hamiltonian Dynamics, Vortex Structures, Turbulence - Alexey V. Borisov 2007-12-22

This work brings together previously unpublished notes contributed by participants of the IUTAM Symposium on Hamiltonian

Dynamics, Vortex Structures, Turbulence (Moscow, 25-30 August 2006). The study of vortex motion is of great interest to fluid and gas dynamics: since all real flows are vortical in nature, applications of the vortex theory are extremely diverse, many of them (e.g. aircraft dynamics, atmospheric and ocean phenomena) being especially important.

Control Theory from the Geometric Viewpoint - M. I. Zelikin 2004-04-15

This book presents some facts and methods of Mathematical Control Theory treated from the geometric viewpoint. It is devoted to finite-dimensional deterministic control systems governed by smooth ordinary differential equations. The problems of controllability, state and feedback equivalence, and optimal control are studied. Some of the topics treated by the authors are covered in monographic or textbook literature for the first time while others are presented in a more general and flexible setting than elsewhere. Although being fundamentally written for mathematicians, the authors make an attempt to reach both the practitioner and the theoretician by blending the theory with applications. They maintain a good balance between the mathematical integrity of the text and the conceptual simplicity that might be required by engineers. It can be used as a text for graduate courses and will become most valuable as a reference work for graduate students and researchers.

Analysis and Geometry in Several Complex Variables - Shiferaw Berhanu 2017-01-17

This volume contains the proceedings of the workshop on Analysis and Geometry in Several Complex Variables, held from January 4–8, 2015, at Texas A&M University at Qatar, Doha, Qatar. This volume covers many topics of current interest in several complex variables, CR geometry, and the related area of overdetermined systems of complex vector fields, as well as emerging trends in these areas. Papers feature original research on diverse

topics such as the rigidity of CR mappings, normal forms in CR geometry, the d-bar Neumann operator, asymptotic expansion of the Bergman kernel, and hypoellipticity of complex vector fields. Also included are two survey articles on complex Brunn-Minkowski theory and the regularity of systems of complex vector fields and their associated Laplacians.

The Geometry of Infinite-Dimensional Groups - Boris Khesin 2008-09-28

This monograph gives an overview of various classes of infinite-dimensional Lie groups and their applications in Hamiltonian mechanics, fluid dynamics, integrable systems, gauge theory, and complex geometry. The text includes many exercises and open questions.

A Tour of Subriemannian Geometries, Their Geodesics and Applications - Richard Montgomery 2006-08-08

Subriemannian geometries can be viewed as limits of Riemannian geometries. They arise naturally in many areas of pure (algebra, geometry, analysis) and applied (mechanics, control theory, mathematical physics) mathematics, as well as in applications (e.g., robotics). This 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 are an elementary exposition of Gromov's 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 of distributions. The second part of the book is devoted to applications of subriemannian geometry. In particular, the author describes in detail 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. The reader is assumed to have an introductory knowledge of differential geometry. This book that also has a chapter devoted to open problems can serve as a good introduction to this new, exciting area of mathematics.

The Geometry of Filtering - K. David Elworthy 2010-11-27

Filtering is the science of nding the law of a process given a partial observation of it. The main objects we study here are di usion processes. These are naturally associated with second-order linear di erential operators which are semi-elliptic and so introduce a possibly degenerate Riemannian structure on the state space. In fact, much of what we discuss is simply about two such operators intertwined by a smooth map, the \projection from the state space to the observations space", and does not involve any stochastic analysis. From the point of view of stochastic processes, our purpose is to present and to study the underlying geometric structure which allows us to perform the ltering in a Markovian framework with the resulting conditional law being that of a Markov process which is time inhomogeneous in general. This geometry is determined by the symbol of the operator on the state space which projects to a symbol on the observation space. The projectible symbol induces a (possibly non-linear and partially de ned) connection which lifts the observation process to the state space and gives a decomposition of the operator on the state space and of the noise. As is standard we can recover the classical ltering theory in which the observations are not usually Markovian by application of the Girsanov- Maruyama-Cameron-Martin Theorem. This structure we have is examined in relation to a number of geometrical topics.

Geometric Control Theory and Sub-Riemannian Geometry - Gianna Stefani

2014-06-05

Honoring Andrei Agrachev's 60th birthday, this volume presents recent advances in the interaction between Geometric Control Theory and sub-Riemannian geometry. On the one hand, Geometric Control Theory used the differential geometric and Lie algebraic language for studying controllability, motion planning, stabilizability and optimality for control systems. The geometric approach turned out to be fruitful in applications to robotics, vision modeling, mathematical physics etc. On the other hand, Riemannian geometry and its generalizations, such as sub-Riemannian, Finslerian geometry etc., have been actively adopting methods developed in the scope of geometric control. Application of these methods has led to important results regarding geometry of sub-Riemannian spaces, regularity of sub-Riemannian distances, properties of the group of diffeomorphisms of sub-Riemannian manifolds, local geometry and equivalence of distributions and sub-Riemannian structures, regularity of the Hausdorff volume, etc.

Introduction to Geometric Control - Yuri Sachkov 2022-09-01

This text is an enhanced, English version of the Russian edition, published in early 2021 and is appropriate for an introductory course in geometric control theory. The concise presentation provides an accessible treatment of the subject for advanced undergraduate and graduate students in theoretical and applied mathematics, as well as to experts in classic control theory for whom geometric methods may be introduced. Theory is accompanied by characteristic examples such as stopping a train, motion of mobile robot, Euler elasticae, Dido's problem, and rolling of the sphere on the plane. Quick foundations to some recent topics of interest like control on Lie groups and sub-Riemannian geometry are included. Prerequisites include only a basic knowledge of calculus, linear algebra, and ODEs; preliminary

knowledge of control theory is not assumed. The applications problems-oriented approach discusses core subjects and encourages the reader to solve related challenges independently. Highly-motivated readers can acquire working knowledge of geometric control techniques and progress to studying control problems and more comprehensive books on their own. Selected sections provide exercises to assist in deeper understanding of the material. Controllability and optimal control problems are considered for nonlinear nonholonomic systems on smooth manifolds, in particular, on Lie groups. For the controllability problem, the following questions are considered: controllability of linear systems, local controllability of nonlinear systems, Nagano–Sussmann Orbit theorem, Rashevskii–Chow theorem, Krener's theorem. For the optimal control problem, Filippov's theorem is stated, invariant formulation of Pontryagin maximum principle on manifolds is given, second-order optimality conditions are discussed, and the sub-Riemannian problem is studied in detail. Pontryagin maximum principle is proved for sub-Riemannian problems, solution to the sub-Riemannian problems on the Heisenberg group, the group of motions of the plane, and the Engel group is described.

Analysis and Geometry in Control Theory and its Applications - Piernicola Bettiol 2015-09-01

Since the 1950s control theory has established itself as a major mathematical discipline, particularly suitable for application in a number of research fields, including advanced engineering design, economics and the medical sciences. However, since its emergence, there has been a need to rethink and extend fields such as calculus of variations, differential geometry and nonsmooth analysis, which are closely tied to research on applications. Today control theory is a rich source of basic abstract problems arising from applications, and provides

an important frame of reference for investigating purely mathematical issues. In many fields of mathematics, the huge and growing scope of activity has been accompanied by fragmentation into a multitude of narrow specialties. However, outstanding advances are often the result of the quest for unifying themes and a synthesis of different approaches. Control theory and its applications are no exception. Here, the interaction between analysis and geometry has played a crucial role in the evolution of the field. This book collects some recent results, highlighting geometrical and analytical aspects and the possible connections between them. Applications provide the background, in the classical spirit of mutual interplay between abstract theory and problem-solving practice.

A Comprehensive Introduction to Sub-Riemannian Geometry - Andrei Agrachev 2019-10-31

Provides a comprehensive and self-contained introduction to sub-Riemannian geometry and its applications. For graduate students and researchers.

Applications of Contact Geometry and Topology in Physics - Arkady Leonidovich Kholodenko 2013

Although contact geometry and topology is briefly discussed in V I Arnol''d''s book Mathematical Methods of Classical Mechanics (Springer-Verlag, 1989, 2nd edition), it still remains a domain of research in pure mathematics, e.g. see the recent monograph by H Geiges An Introduction to Contact Topology (Cambridge U Press, 2008). Some attempts to use contact geometry in physics were made in the monograph Contact Geometry and Nonlinear Differential Equations (Cambridge U Press, 2007). Unfortunately, even the excellent style of this monograph is not sufficient to attract the attention of the physics community to this type of problems. This book is the first serious attempt to change the existing status quo. In it

we demonstrate that, in fact, all branches of theoretical physics can be rewritten in the language of contact geometry and topology: from mechanics, thermodynamics and electrodynamics to optics, gauge fields and gravity; from physics of liquid crystals to quantum mechanics and quantum computers, etc. The book is written in the style of famous Landau-Lifshitz (L-L) multivolume course in theoretical physics. This means that its readers are expected to have solid background in theoretical physics (at least at the level of the L-L course). No prior knowledge of specialized mathematics is required. All needed new mathematics is given in the context of discussed physical problems. As in the L-L course some problems/exercises are formulated along the way and, again as in the L-L course, these are always supplemented by either solutions or by hints (with exact references). Unlike the L-L course, though, some definitions, theorems, and remarks are also presented. This is done with the purpose of stimulating the interest of our readers in deeper study of subject matters discussed in the text.

Sub-Riemannian Geometry - Andre Bellaiche 2012-12-06

Sub-Riemannian geometry (also known as Carnot geometry in France, and non-holonomic Riemannian geometry in Russia) has been a full research domain for fifteen years, with motivations and ramifications in several parts of pure and applied mathematics, namely: control theory classical mechanics Riemannian geometry (of which sub-Riemannian geometry constitutes a natural generalization, and where sub-Riemannian metrics may appear as limit cases) diffusion on manifolds analysis of hypoelliptic operators Cauchy-Riemann (or CR) geometry. Although links between these domains had been foreseen by many authors in the past, it is only in recent years that sub-Riemannian geometry has been recognized as a possible common framework for all these topics.

This book provides an introduction to sub-Riemannian geometry and presents the state of the art and open problems in the field. It consists of five coherent and original articles by the leading specialists: Andr Bellache: The tangent space in sub-Riemannian geometry Mikhael Gromov: Carnot-Carathodory spaces seen from within Richard Montgomery: Survey of singular geodesics Hctor J. Sussmann: A cornucopia of four-dimensional abnormal sub-Riemannian minimizers Jean-Michel Coron: Stabilization of controllable systems.

Geometric Methods in Physics XXXVI - Piotr Kielanowski 2019-03-11

This book collects papers based on the XXXVI Białowieża Workshop on Geometric Methods in Physics, 2017. The Workshop, which attracts a community of experts active at the crossroads of mathematics and physics, represents a major annual event in the field. Based on presentations given at the Workshop, the papers gathered here are previously unpublished, at the cutting edge of current research, and primarily grounded in geometry and analysis, with applications to classical and quantum physics. In addition, a Special Session was dedicated to S. Twareque Ali, a distinguished mathematical physicist at Concordia University, Montreal, who passed away in January 2016. For the past six years, the Białowieża Workshops have been complemented by a School on Geometry and Physics, comprising a series of advanced lectures for graduate students and early-career researchers. The extended abstracts of this year's lecture series are also included here. The unique character of the Workshop-and-School series is due in part to the venue: a famous historical, cultural and environmental site in the Białowieża forest, a UNESCO World Heritage Centre in eastern Poland. Lectures are given in the Nature and Forest Museum, and local traditions are interwoven with the scientific activities.

Sub-Riemannian Geometry and Optimal Transport - Ludovic Rifford 2014-04-03

The book provides an introduction to sub-Riemannian geometry and optimal transport and presents some of the recent progress in these two fields. The text is completely self-contained: the linear discussion, containing all the proofs of the stated results, leads the reader step by step from the notion of distribution at the very beginning to the existence of optimal transport maps for Lipschitz sub-Riemannian structure. The combination of geometry presented from an analytic point of view and of optimal transport, makes the book interesting for a very large community. This set of notes grew from a series of lectures given by the author during a CIMPA school in Beirut, Lebanon.

Fundamental Algebraic Geometry - Barbara Fantechi 2005

Alexander Grothendieck introduced many concepts into algebraic geometry; they turned out to be astoundingly powerful and productive and truly revolutionized the subject. Grothendieck sketched his new theories in a series of talks at the Seminaire Bourbaki between 1957 and 1962 and collected his write-ups in a volume entitled ``Fondements de la Geometrie Algebrique,'' known as FGA. Much of FGA is now common knowledge; however, some of FGA is less well known, and its full scope is familiar to few. The present book resulted from the 2003 ``Advanced School in Basic Algebraic Geometry'' at the ICTP in Trieste, Italy. The book aims to fill in Grothendieck's brief sketches. There are four themes: descent theory, Hilbert and Quot schemes, the formal existence theorem, and the Picard scheme. Most results are proved in full detail; furthermore, newer ideas are introduced to promote understanding, and many connections are drawn to newer developments. The main prerequisite is a thorough acquaintance with basic scheme theory. Thus this book is a valuable resource for anyone doing algebraic geometry.

Trends in Control Theory and Partial Differential Equations - Fatiha Alabau-

Boussouira 2019-07-04
This book presents cutting-edge contributions in the areas of control theory and partial differential equations. Over the decades, control theory has had deep and fruitful interactions with the theory of partial differential equations (PDEs). Well-known examples are the study of the generalized solutions of Hamilton-Jacobi-Bellman equations arising in deterministic and stochastic optimal control and the development of modern analytical tools to study the controllability of infinite dimensional systems governed by PDEs. In the present volume, leading experts provide an up-to-date overview of the connections between these two vast fields of mathematics. Topics addressed include regularity of the value function associated to finite dimensional control systems, controllability and observability for PDEs, and asymptotic analysis of multiagent systems. The book will be of interest for both researchers and graduate students working in these areas.

Geometric Measure Theory and Real Analysis - Luigi Ambrosio 2015-04-09
In 2013, a school on Geometric Measure Theory and Real Analysis, organized by G. Alberti, C. De Lellis and myself, took place at the Centro De Giorgi in Pisa, with lectures by V. Bogachev, R. Monti, E. Spadaro and D. Vittone. The book collects the notes of the courses. The courses provide a deep and up to date insight on challenging mathematical problems and their recent developments: infinite-dimensional analysis, minimal surfaces and isoperimetric problems in the Heisenberg group, regularity of sub-Riemannian geodesics and the regularity theory of minimal currents in any dimension and codimension.

Systolic Geometry and Topology - Mikhail Gersh Katz 2007
The systole of a compact metric space X is a metric invariant of X, defined as the least length of a noncontractible loop in X. When X is a graph, the invariant is usually referred

to as the girth, ever since the 1947 article by W. Tutte. The first nontrivial results for systoles of surfaces are the two classical inequalities of C. Loewner and P. Pu, relying on integral-geometric identities, in the case of the two-dimensional torus and real projective plane, respectively. Currently, systolic geometry is a rapidly developing field, which studies systolic invariants in their relation to other geometric invariants of a manifold. This book presents the systolic geometry of manifolds and polyhedra, starting with the two classical inequalities, and then proceeding to recent results, including a proof of M. Gromov's filling area conjecture in a hyperelliptic setting. It then presents Gromov's inequalities and their generalisations, as well as asymptotic phenomena for systoles of surfaces of large genus, revealing a link both to ergodic theory and to properties of congruence subgroups of arithmetic groups. The author includes results on the systolic manifestations of Massey products, as well as of the classical Lusternik-Schnirelmann category.

Points and Curves in the Monster Tower - Richard Montgomery 2010-01-15

Cartan introduced the method of prolongation which can be applied either to manifolds with distributions (Pfaffian systems) or integral curves to these distributions. Repeated application of prolongation to the plane endowed with its tangent bundle yields the Monster tower, a sequence of manifolds, each a circle bundle over the previous one, each endowed with a rank 2 distribution. In an earlier paper (2001), the authors proved that the problem of classifying points in the Monster tower up to symmetry is the same as the problem of classifying Goursat distribution flags up to local diffeomorphism. The first level of the Monster tower is a three-dimensional contact manifold and its integral curves are Legendrian curves. The philosophy driving the current work is that all questions regarding the Monster tower (and hence regarding Goursat distribution germs) can

be reduced to problems regarding Legendrian curve singularities.

Geometric Science of Information - Frank Nielsen 2015-10-24

This book constitutes the refereed proceedings of the Second International Conference on Geometric Science of Information, GSI 2015, held in Palaiseau, France, in October 2015. The 80 full papers presented were carefully reviewed and selected from 110 submissions and are organized into the following thematic sessions: Dimension reduction on Riemannian manifolds; optimal transport; optimal transport and applications in imagery/statistics; shape space and diffeomorphic mappings; random geometry/homology; Hessian information geometry; topological forms and Information; information geometry optimization; information geometry in image analysis; divergence geometry; optimization on manifold; Lie groups and geometric mechanics/thermodynamics; computational information geometry; Lie groups: novel statistical and computational frontiers; geometry of time series and linear dynamical systems; and Bayesian and information geometry for inverse problems.

Manifolds, Tensors and Forms - Paul Renteln 2014

Comprehensive treatment of the essentials of modern differential geometry and topology for graduate students in mathematics and the physical sciences.

Parabolic Geometries: Background and general theory - Andreas Cap 2009

Parabolic geometries encompass a very diverse class of geometric structures, including such important examples as conformal, projective, and almost quaternionic structures, hypersurface type CR-structures and various types of generic distributions. The characteristic feature of parabolic geometries is an equivalent description by a Cartan geometry modeled on a generalized flag manifold (the quotient of a semisimple Lie group by a parabolic subgroup).

Background on differential geometry, with a view towards Cartan connections, and on semisimple Lie algebras and their representations, which play a crucial role in the theory, is collected in two introductory chapters. The main part discusses the equivalence between Cartan connections and underlying structures, including a complete proof of Kostant's version of the Bott - Borel - Weil theorem, which is used as an important tool. For many examples, the complete description of the geometry and its basic invariants is worked out in detail. The constructions of correspondence spaces and twistor spaces and analogs of the Fefferman construction are presented both in general and in several examples. The last chapter studies Weyl structures, which provide classes of distinguished connections as well as an equivalent description of the Cartan connection in terms of data associated to the underlying geometry. Several applications are discussed throughout the text.

Tame Geometry with Application in Smooth Analysis - Yosef Yomdin 2004-02-10

The Morse-Sard theorem is a rather subtle result and the interplay between the high-order analytic structure of the mappings involved and their geometry rarely becomes apparent. The main reason is that the classical Morse-Sard theorem is basically qualitative. This volume gives a proof and also an "explanation" of the quantitative Morse-Sard theorem and related results, beginning with the study of polynomial (or tame) mappings. The quantitative questions, answered by a combination of the methods of real semialgebraic and tame geometry and integral geometry, turn out to be nontrivial and highly productive. The important advantage of this approach is that it allows the separation of the role of high differentiability and that of algebraic geometry in a smooth setting: all the geometrically relevant phenomena appear already for polynomial mappings. The geometric properties obtained are "stable with respect to

approximation", and can be imposed on smooth functions via polynomial approximation.

Noncommutative Geometry and Optimal Transport - Pierre Martinetti 2016-10-26

The distance formula in noncommutative geometry was introduced by Connes at the end of the 1980s. It is a generalization of Riemannian geodesic distance that makes sense in a noncommutative setting, and provides an original tool to study the geometry of the space of states on an algebra. It also has an intriguing echo in physics, for it yields a metric interpretation for the Higgs field. In the 1990s, Rieffel noticed that this distance is a noncommutative version of the Wasserstein distance of order 1 in the theory of optimal transport. More exactly, this is a noncommutative generalization of Kantorovich dual formula of the Wasserstein distance. Connes distance thus offers an unexpected connection between an ancient mathematical problem and the most recent discovery in high energy physics. The meaning of this connection is far from clear. Yet, Rieffel's observation suggests that Connes distance may provide an interesting starting point for a theory of optimal transport in noncommutative geometry. This volume contains several review papers that will give the reader an extensive introduction to the metric aspect of noncommutative geometry and its possible interpretation as a Wasserstein distance on a quantum space, as well as several topic papers.

Around the Research of Vladimir Maz'ya I - Ari Laptev 2009-12-02

The fundamental contributions of Professor Maz'ya to the theory of function spaces and especially Sobolev spaces are well known and often play a key role in the study of different aspects of the theory, which is demonstrated, in particular, by presented new results and reviews from world-recognized specialists. Sobolev type spaces, extensions, capacities, Sobolev inequalities, pseudo-Poincare inequalities,

optimal Hardy-Sobolev-Maz'ya inequalities, Maz'ya's isocapacitary inequalities in a measure-metric space setting and many other actual topics are discussed.

The Geometry of Heisenberg Groups - Ernst Binz 2008

This book presents basic geometric and algebraic properties of the Heisenberg group and its relation to the skew field of quaternions, symplectic structures and representations, and describes some of its applications. It offers a clear exposition of mathematical topics referring to applications in signal theory, physics and information theory. It has relevance for undergraduate and graduate students, a variety of researchers, and specialists in data processing.

Quantization, PDEs, and Geometry - Dorothea Bahns 2016-02-11

This book presents four survey articles on different topics in mathematical analysis that are closely linked to concepts and applications in physics. Specifically, it discusses global aspects of elliptic PDEs, Berezin-Toeplitz quantization, the stability of solitary waves, and sub-Riemannian geometry. The contributions are based on lectures given by distinguished experts at a summer school in Göttingen. The authors explain fundamental concepts and ideas and present them clearly. Starting from basic notions, these course notes take the reader to the point of current research, highlighting new challenges and addressing unsolved problems at the interface between mathematics and physics. All contributions are of interest to researchers in the respective fields, but they are also accessible to graduate students.

From Physics to Control Through an Emergent View - Luigi Fortuna 2010

The book is a compilation of selected papers from the conference on Physics and Control 2009, presenting a unified perspective underlying the thematics and strategies related to the control of physical systems with emerging

applications in physics, engineering, chemistry, biology and other natural sciences. The selected papers reflect the state-of-the-art of the more advanced theoretical and practical studies in the field of control of complex systems. The contributions provide a comprehensive view on some selected topics of particular importance at the disciplinary borderline between Physics and Control.

Mathematical Challenges of Zero-Range Physics - Luigi Alessandro Michelangeli 2021
Since long over the decades there has been a large transversal community of mathematicians grappling with the sophisticated challenges of the rigorous modelling and the spectral and scattering analysis of quantum systems of particles subject to an interaction so much localised to be considered with zero range. Such a community is experiencing fruitful and inspiring exchanges with experimental and theoretical physicists. This volume reflects such spirit, with a diverse range of original contributions by experts, presenting an up-to-date collection of most relevant results and challenging open problems. It has been conceived with the deliberate two-fold purpose of serving as an updated reference for recent results, mathematical tools, and the vast related literature on the one hand, and as a bridge towards several key open problems that will surely form the forthcoming research agenda in this field.

Hodge Theory, Complex Geometry, and Representation Theory - Robert S. Doran 2014
This volume contains the proceedings of an NSF/Conference Board of the Mathematical Sciences (CBMS) regional conference on Hodge theory, complex geometry, and representation theory, held on June 18, 2012, at the Texas Christian University in Fort Worth, TX. Phillip Griffiths, of the Institute for Advanced Study, gave 10 lectures describing now-classical work concerning how the structure of Shimura varieties as quotients of Mumford-Tate domains

by arithmetic groups had been used to understand the relationship between Galois representations and automorphic forms. He then discussed recent breakthroughs of Carayol that provide the possibility of extending these results beyond the classical case. His lectures will appear as an independent volume in the CBMS series published by the AMS. This volume, which is dedicated to Phillip Griffiths, contains carefully written expository and research articles. Expository papers include discussions of Noether-Lefschetz theory, algebraicity of Hodge loci, and the representation theory of SL2(R). Research articles concern the Hodge conjecture, Harish-Chandra modules, mirror symmetry, Hodge representations of Q-algebraic groups, and compactifications, distributions, and quotients of period domains. It is expected that the book will be of interest primarily to research mathematicians, physicists, and upper-level graduate students.

An Introduction to the Geometry of Stochastic Flows - Fabrice Baudoin 2004

This book aims to provide a self-contained introduction to the local geometry of the stochastic flows. It studies the hypoelliptic operators, which are written in HArmanderOCOs form, by using the connection between stochastic flows and partial differential equations. The book stresses the authorOCOs view that the local geometry of any stochastic flow is determined very precisely and explicitly by a universal formula referred to as the Chen-Strichartz formula. The natural geometry associated with the Chen-Strichartz formula is the sub-Riemannian geometry, and its main tools are introduced throughout the text."

Geometric Control and Nonsmooth Analysis -

Elements of Neurogeometry - Jean Petitot 2017-11-08

This book describes several mathematical models of the primary visual cortex, referring them to a vast ensemble of experimental data

and putting forward an original geometrical model for its functional architecture, that is, the highly specific organization of its neural connections. The book spells out the geometrical algorithms implemented by this functional architecture, or put another way, the "neurogeometry" immanent in visual perception. Focusing on the neural origins of our spatial representations, it demonstrates three things: firstly, the way the visual neurons filter the optical signal is closely related to a wavelet analysis; secondly, the contact structure of the 1-jets of the curves in the plane (the retinal plane here) is implemented by the cortical functional architecture; and lastly, the visual algorithms for integrating contours from what may be rather incomplete sensory data can be modelled by the sub-Riemannian geometry associated with this contact structure. As such, it provides readers with the first systematic interpretation of a number of important neurophysiological observations in a well-defined mathematical framework. The book's neuromathematical exploration appeals to graduate students and researchers in integrative-functional-cognitive neuroscience with a good mathematical background, as well as those in applied mathematics with an interest in neurophysiology.

An Introduction to the Heisenberg Group and the Sub-Riemannian Isoperimetric Problem - Luca Capogna 2007-08-08

This book gives an up-to-date account of progress on Pansu's celebrated problem on the sub-Riemannian isoperimetric profile of the Heisenberg group. It also serves as an introduction to the general field of sub-Riemannian geometric analysis. It develops the methods and tools of sub-Riemannian differential geometry, nonsmooth analysis, and geometric measure theory suitable for attacks on Pansu's problem.

Tunneling Estimates and Approximate Controllability for Hypoelliptic Equations -

Camille Laurent 2022-04-08
View the abstract.

Foliations in Cauchy-Riemann Geometry - Elisabetta Barletta 2007
The authors study the relationship between foliation theory and differential geometry and analysis on Cauchy-Riemann (CR) manifolds. The main objects of study are transversally and tangentially CR foliations, Levi foliations of CR manifolds, solutions of the Yang-Mills equations, tangentially Monge-Ampere foliations, the transverse Beltrami equations, and CR orbifolds. The novelty of the authors' approach consists in the overall use of the methods of foliation theory and choice of specific applications. Examples of such applications are Rea's holomorphic extension of Levi foliations, Stanton's holomorphic degeneracy, Boas and Straube's approximately commuting vector fields method for the study of global regularity of Neumann operators and Bergman projections in multi-dimensional complex analysis in several complex variables, as well as various applications to differential geometry. Many open problems proposed in the monograph may attract the mathematical community and lead to further applications of

New Trends in Image Analysis and Processing – ICIAP 2017 - Sebastiano Battiato 2018-01-02
This book constitutes the refereed proceedings of seven workshops held at the 19th International Conference on Image Analysis and Processing, ICIAP 2017, in Catania, Italy, in September 2017: First International Workshop on Brain-Inspired Computer Vision – WBICV 2017; Social Signal Processing and Beyond - SSPandBE 2017; Automatic affect analysis and synthesis - 3AS 2017; Background learning for detection and tracking from RGBD Videos - RGBD 2017; Natural human-computer Interaction and ecological perception in immersive Virtual and Augmented Reality - NIVAR 2017; 1st International Workshop on

Biometrics as-a-service: cloud-based technology, systems and applications - IWBAAS 2017; 3rd International Workshop on Multimedia Assisted Dietary Management - MADiMa 2017.

Dynamics, Games and Science - Jean-Pierre Bourguignon 2015-07-24

The focus of this volume is research carried out as part of the program Mathematics of Planet Earth, which provides a platform to showcase the essential role of mathematics in addressing problems of an economic and social nature and creating a context for mathematicians and applied scientists to foster mathematical and interdisciplinary developments that will be necessary to tackle a myriad of issues and meet future global economic and social challenges. Earth is a planet with dynamic processes in its mantle, oceans and atmosphere creating climate, causing natural disasters and influencing fundamental aspects of life and life-supporting systems. In addition to these natural processes, human activity has developed highly complex systems, including economic and financial systems; the World Wide Web; frameworks for resource management, transportation, energy production and utilization; health care delivery, and social organizations. This development has increased to the point where it impacts the stability and equilibrium in human societies. Issues such as financial and economic crisis, sustainability, management of resources, risk analysis, and global integration have come to the fore. Written by some of the world's leading specialists, this book presents the proceedings of the International Conference and Advanced School Planet Earth, Dynamics, Games and Science II, held in Lisbon, Portugal, 28 August -6 September 2013, which was organized by the International Center of Mathematics (CIM) as a partner institution of the international program Mathematics of Planet Earth 2013. The book describes the state of the art in advanced research and ultimate techniques in modeling

natural, economic and social phenomena. It constitutes a tool and a framework for researchers and graduate students, both in mathematics and applied sciences, focusing mainly on dynamical systems, game theory and applied sciences.

Geometry, Mechanics, and Control in Action for the Falling Cat - Toshihiro Iwai 2021-04-23

The falling cat is an interesting theme to pursue, in which geometry, mechanics, and control are in action together. As is well known, cats can almost always land on their feet when tossed into the air in an upside-down attitude. If cats are not given a non-vanishing angular momentum at an initial instant, they cannot rotate during their motion, and the motion they can make in the air is vibration only. However, cats accomplish a half turn without rotation when landing on their feet. In order to solve this apparent mystery, one needs to thoroughly understand rotations and vibrations. The connection theory in differential geometry can provide rigorous definitions of rotation and vibration for many-body systems. Deformable bodies of cats are not easy to treat mechanically. A feasible way to approach the question of the falling cat is to start with many-body systems and then proceed to rigid bodies and, further, to jointed rigid bodies, which can approximate the body of a cat. In this book, the connection theory is applied first to a many-body system to show that vibrational motions of the many-body system can result in rotations without performing rotational motions and then to the cat model consisting of jointed rigid bodies. On the basis of this geometric setting, mechanics of many-body systems and of jointed rigid bodies must be set up. In order to take into account the fact that cats can deform their bodies, three torque inputs which may give a twist to the cat model are applied as control inputs under the condition of the vanishing angular momentum. Then, a control is designed according to the port-controlled Hamiltonian method for the

model cat to perform a half turn and to halt the motion upon landing. The book also gives a brief review of control systems through simple examples to explain the role of control inputs.

Curvature: A Variational Approach - A. Agrachev 2019-01-08

The curvature discussed in this paper is a far reaching generalization of the Riemannian sectional curvature. The authors give a unified definition of curvature which applies to a wide class of geometric structures whose geodesics arise from optimal control problems, including Riemannian, sub-Riemannian, Finsler and sub-Finsler spaces. Special attention is paid to the sub-Riemannian (or Carnot–Carathéodory) metric spaces. The authors' construction of curvature is direct and naive, and similar to the original approach of Riemann. In particular, they extract geometric invariants from the asymptotics of the cost of optimal control problems. Surprisingly, it works in a very general setting and, in particular, for all sub-Riemannian spaces.