An Introduction To Symplectic Geometry

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MOODY BIANCA

Symplectic Invariants and Hamiltonian Dynamics Springer
This book highlights a number of recent research advances in the field of symplectic and contact geometry and topology, and related areas in low-dimensional topology. This field has experienced significant and exciting growth in the past few decades, and this volume provides an accessible introduction into many active research problems in this area. The papers were written with a broad audience in mind so as to reach a wide range of mathematicians at various levels. Aside from teaching readers about developing research areas, this book will inspire researchers to ask further questions to continue to advance the field. The volume contains both original results and survey articles, presenting the results of collaborative research on a wide range of topics. These projects began at the Research Collaboration Conference for Women in Symplectic and Contact Geometry and Topology (WiSCon) in July 2019 at ICERM, Brown University. Each group of authors included female and nonbinary mathematicians at different career levels in mathematics and with varying areas of expertise. This paved the way for new connections between mathematicians at all career levels, spanning multiple continents, and resulted in the new collaborations and directions that are featured in this work.
Gauge Theory and Symplectic Geometry Birkhäuser
The goal of these notes is to provide a fast introduction to symplectic geometry for graduate students with some knowledge of differential geometry, de Rham theory and classical Lie groups. This text addresses symplectomorphisms, local forms, contact manifolds, compatible almost complex structures, Kaehler manifolds, hamiltonian mechanics, moment maps, symplectic reduction and symplectic toric manifolds. It contains guided problems, called homework, designed to complement the exposition or extend the reader's understanding. There are by now excellent references on symplectic geometry, a subset of which is in the bibliography of this book. However, the most efficient introduction to a subject is often a short elementary treatment, and these notes attempt to serve that purpose. This text provides a taste of areas of current research and will prepare the reader to explore recent papers and extensive books on symplectic geometry where the pace is much faster. For this reprint numerous corrections and clarifications have been made, and the layout has been improved.
Symplectic Geometry Springer Nature
The book introduces the basic notions in Symplectic and Contact Geometry at the level of the second year graduate student. It also contains many exercises, some of which are solved only in the last chapter.We begin with the linear theory, then give the definition of symplectic manifolds and some basic examples, review advanced calculus, discuss Hamiltonian systems, tour rapidly group and the basics of contact geometry, and solve problems in chapter 8. The material just described can be used as a one semester course on Symplectic and Contact Geometry.The book contains also more advanced material, suitable to advanced graduate students and researchers.
Introduction to Symplectic Topology Oxford University Press
Symplectic geometry is a central topic of current research in mathematics. Indeed, symplectic methods are key ingredients in the study of dynamical systems, differential equations, algebraic geometry, topology, mathematical physics and representations of Lie groups. This book is a true introduction to symplectic geometry, assuming only a general background in analysis and familiarity with linear algebra. It starts with the basics of the geometry of symplectic vector spaces. Then, symplectic manifolds are defined and explored. In addition to the essential classic results, such as Darboux's theorem, more recent results and ideas are also included here, such as symplectic capacity and pseudoholomorphic curves. These ideas have revolutionized the subject. The main examples of symplectic manifolds are given, including the cotangent bundle, Kähler manifolds, and coadjoint orbits. Further principal ideas are carefully examined, such as Hamiltonian vector fields, the Poisson bracket, and connections with contact manifolds. Berndt describes some of the close connections between symplectic geometry and mathematical physics in the last two chapters of the book. In particular, the moment map is defined and explored, both mathematically and in its relation to physics. He also introduces symplectic reduction, which is an important tool for reducing the number of variables in a physical system and for constructing new symplectic manifolds from old. The final chapter is on quantization, which uses symplectic methods to take classical mechanics to quantum mechanics. This section includes a discussion of the Heisenberg group and the Weil (or metaplectic) representation of the symplectic group. Several appendices provide background material on vector bundles, on cohomology, and on Lie groups and Lie algebras and their representations. Berndt's presentation of symplectic geometry is a clear and concise introduction to the major methods and applications of the subject, and requires only a minimum of prerequisites. This book would be an excellent text for a graduate course or as a source for anyone who wishes to learn about symplectic geometry.
Symplectic Geometry and Quantum Mechanics Springer
Among all the Hamiltonian systems, the integrable ones have special geometric properties; in particular, their solutions are very regular and quasi-periodic. This book serves as an introduction to symplectic and contact geometry for graduate students, exploring the underlying geometry of integrable Hamiltonian systems. Includes exercises designed to complement the expositiont, and up-to-date references.
Symplectic Geometry and Fourier Analysis Birkhäuser
The seminar Symplectic Geometry at the University of Berne in summer 1992 showed that the topic of this book is a very active field, where many different branches of mathematics come tog9ther: differential geometry, topology, partial differential equations, variational calculus, and complex analysis. As usual in such a situation, it may be tedious to collect all the necessary ingredients. The present book is intended to give the nonspecialist a solid introduction to the recent developments in symplectic and contact geometry. Chapter 1 gives a review of the symplectic group Sp(n,R),

sympkctic manifolds, and Hamiltonian systems (last but not least to fix the notations). The 1\laslov index for closed curves as well as arcs in Sp(n, R) is discussed. This index will be used in chapters 5 and 8. Chapter 2 contains a more detailed account of symplectic manifolds start ing with a proof of the Darboux theorem saying that there are no local in variants in symplectic geometry. The most important examples of symplectic manifolds will be introduced: cotangent spaces and Kahler manifolds. Finally we discuss the theory of coadjoint orbits and the Kostant-Souriau theorem, which are concerned with the question of which homogeneous spaces carry a symplectic structure.

Function Theory on Symplectic Manifolds Walter de Gruyter

This book is devoted to pseudo-holomorphic curve methods in symplectic geometry. It contains an introduction to symplectic geometry and relevant techniques of Riemannian geometry, proofs of Gromov's compactness theorem, an investigation of local properties of holomorphic curves, including positivity of intersections, and applications to Lagrangian embeddings problems. The chapters are based on a series of lectures given previously by the authors M. Audin, A. Banyaga, P. Gauduchon, F. Labourie, J. Lafontaine, F. Lalonde, Gang Liu, D. McDuff, M.-P. Muller, P. Pansu, L. Polterovich, J.C. Sikorav. In an attempt to make this book accessible also to graduate students, the authors provide the necessary examples and techniques needed to understand the applications of the theory. The exposition is essentially self-contained and includes numerous exercises.

Lectures on Symplectic Geometry Springer Science & Business Media

"Symplectic Geometric Algorithms for Hamiltonian Systems" will be useful not only for numerical analysts, but also for those in theoretical physics, computational chemistry, celestial mechanics, etc. The book generalizes and develops the generating function and Hamilton-Jacobi equation theory from the perspective of the symplectic geometry and symplectic algebra. It will be a useful resource for engineers and scientists in the fields of quantum theory, astrophysics, atomic and molecular dynamics, climate prediction, oil exploration, etc. Therefore a systematic research and development of numerical methodology for Hamiltonian systems is well motivated. Were it successful, it would imply wide-ranging applications.

An Introduction to Symplectic Geometry, Hamilton Systems, and Complex Geometry American Mathematical Soc.

Symplectic geometry is very useful for formulating clearly and concisely problems in classical physics and also for understanding the link between classical problems and their quantum counterparts. It is thus a subject of interest to both mathematicians and physicists, though they have approached the subject from different viewpoints. This is the first book that attempts to reconcile these approaches. The authors use the uncluttered, coordinate-free approach to symplectic geometry and classical mechanics that has been developed by mathematicians over the course of the past thirty years, but at the same time apply the apparatus to a great number of concrete problems. Some of the themes emphasized in the book include the pivotal role of completely integrable systems, the importance of symmetries, analogies between classical dynamics and optics, the importance of symplectic tools in classical variational theory, symplectic features of classical field theories, and the principle of general covariance.

Introduction to Symplectic Geometry Springer Science & Business Media

This volume presents some of the lectures and research during the special programme held at the Newton Institute in 1994. The two parts each contain a mix of substantial expository articles and research papers that outline important and topical ideas. Many of the results have not been presented before, and the lectures on Floer homology is the first avaliable in book form.Symplectic methods are one of the most active areas of research in mathematics currently, and this volume will attract much attention.

Contact and Symplectic Geometry World Scientific

Analysis of an old variational principal in classical mechanics has established global periodic phenomena in Hamiltonian systems. One of the links is a class of sympletic invariants, called sympletic capacities, and these invariants are the main theme of this book. Topics covered include basic sympletic geometry, sympletic capacities and rigidity, sympletic fixed point theory, and a survey on Floer homology and sympletic homology.

Symmetry in Mechanics Springer Nature

"And what is the use," thought Alice, "of a book without pictures or conversations in it?" -Lewis Carroll This book is written for modem undergraduate students - not the ideal stu dents that mathematics professors wish for (and who occasionally grace our campuses), but the students like many the author has taught: talented but ap preciating review and reinforcement of past course work; willing to work hard, but demanding context and motivation for the mathematics they are learning. To suit this audience, the author eschews density of topics and efficiency of presentation in favor of a gentler tone, a coherent story, digressions on mathe maticians, physicists and their notations, simple examples worked out in detail, and reinforcement of the basics. Dense and efficient texts play a crucial role in the education of budding (and budded) mathematicians and physicists. This book does not presume to improve on the classics in that genre. Rather, it aims to provide those classics with a large new generation of appreciative readers. This text introduces some basic constructs of modern symplectic geometry in the context of an old celestial mechanics problem, the two-body problem. We present the derivation of Kepler's laws of planetary motion from Newton's laws of gravitation, first in the style of an undergraduate physics course, and x Preface then again in the language of symplectic geometry. No previous exposure to symplectic geometry is required: we introduce and illustrate all necessary con structs.

Holomorphic Curves in Symplectic Geometry American Mathematical Soc.

This introductory book offers a unique and unified overview of symplectic geometry, highlighting the differential properties of symplectic manifolds. It consists of six chapters: Some Algebra Basics, Symplectic Manifolds, Cotangent Bundles, Symplectic G-spaces, Poisson Manifolds, and A Graded Case, concluding with a discussion of the differential properties of graded symplectic manifolds of dimensions (0,n). It is a useful reference resource for students and researchers interested in geometry, group theory, analysis and differential equations.This book is also inspiring in the emerging field of Geometric Science of Information, in particular the chapter on Symplectic G-spaces, where Jean-Louis Koszul develops Jean-Marie Souriau's tools related to the non-equivariant case of co-adjoint action on Souriau’s moment map through Souriau’s Cocycle, opening the door to Lie Group Machine Learning with Souriau-Fisher metric.

Symplectic Geometry and Analytical Mechanics Birkhäuser

This is a book on symplectic topology, a rapidly developing field of mathematics which originated as

a geometric tool for problems of classical mechanics. Since the 1980s, powerful methods such as Gromov's pseudo-holomorphic curves and Morse-Floer theory on loop spaces gave rise to the discovery of unexpected symplectic phenomena. The present book focuses on function spaces associated with a symplectic manifold. A number of recent advances show that these spaces exhibit intriguing properties and structures, giving rise to an alternative intuition and new tools in symplectic topology. The book provides an essentially self-contained introduction into these developments along with applications to symplectic topology, algebra and geometry of symplectomorphism groups, Hamiltonian dynamics and quantum mechanics. It will appeal to researchers and students from the graduate level onwards.

An Introduction to Symplectic Geometry Springer

The main goal of this book is to establish the fundamental theorems of the subject in full and rigourous detail. In particular, the book contains complete proofs of Gromov's compactness theorem for spheres, of the gluing theorem for spheres, and of the associatively of quantum multiplication in the semipositive case. The book can also serve as an introduction to current work in symplectic topology.

Symplectic Geometry and Mathematical Physics Cambridge University Press

Symplectic geometry is a central topic of current research in mathematics. Indeed, symplectic methods are key ingredients in the study of dynamical systems, differential equations, algebraic geometry, topology, mathematical physics and representations of Lie groups. This book is a true introduction to symplectic geometry, assuming only a general background in analysis and familiarity with linear algebra. It starts with the basics of the geometry of symplectic vector spaces. Then, symplectic manifolds are defined and explored. In addition to the essential classic results, such as Darboux's theorem, more recent results and ideas are also included here, such as symplectic capacity and pseudoholomorphic curves. These ideas have revolutionized the subject. The main examples of symplectic manifolds are given, including the cotangent bundle, Kähler manifolds, and coadjoint orbits. Further principal ideas are carefully examined, such as Hamiltonian vector fields, the Poisson bracket, and connections with contact manifolds. Berndt describes some of the close connections between symplectic geometry and mathematical physics in the last two chapters of the book. In particular, the moment map is defined and explored, both mathematically and in its relation to physics. He also introduces symplectic reduction, which is an important tool for reducing the number of variables in a physical system and for constructing new symplectic manifolds from old. The final chapter is on quantization, which uses symplectic methods to take classical mechanics to quantum mechanics. This section includes a discussion of the Heisenberg group and the Weil (or metaplectic) representation of the symplectic group. Several appendices provide background material on vector bundles, on cohomology, and on Lie groups and Lie algebras and their representations. Berndt's presentation of symplectic geometry is a clear and concise introduction to the major methods and applications of the subject, and requires only a minimum of prerequisites. This book would be an excellent text for a graduate course or as a source for anyone who wishes to learn about symplectic geometry.

Symplectic Geometry and Topology CRC Press

This book offers a complete discussion of techniques and topics intervening in the mathematical treatment of quantum and semi-classical mechanics. It starts with a very readable introduction to symplectic geometry. Many topics are also of genuine interest for pure mathematicians working in geometry and topology.

Symplectic Geometry and Quantum Mechanics American Mathematical Soc.

This text on contact topology is a comprehensive introduction to the subject, including recent striking applications in geometric and differential topology: Eliashberg's proof of Cerf's theorem via the classification of tight contact structures on the 3-sphere, and the Kronheimer-Mrowka proof of property P for knots via symplectic fillings of contact 3-manifolds. Starting with the basic differential topology of contact manifolds, all aspects of 3-dimensional contact manifolds are treated in this book. One notable feature is a detailed exposition of Eliashberg's classification of overtwisted contact structures. Later chapters also deal with higher-dimensional contact topology. Here the focus is on contact surgery, but other constructions of contact manifolds are described, such as open books or fibre connected sums. This book serves both as a self-contained introduction to the subject for advanced graduate students and as a reference for researchers.

An Introduction to Contact Topology American Mathematical Soc.

Symplectic and contact geometry naturally emerged from the mathematical description of classical physics. The discovery of new rigidity phenomena and properties satisfied by these geometric structures launched a new research field worldwide. The intense activity of many European research groups in this field is reflected by the ESF Research Networking Programme "Contact And Symplectic Topology" (CAST). The lectures of the Summer School in Nantes (June 2011) and of the CAST Summer School in Budapest (July 2012) provide a nice panorama of many aspects of the present status of contact and symplectic topology. The notes of the minicourses offer a gentle introduction to topics which have developed in an amazing speed in the recent past. These topics include 3-dimensional and higher dimensional contact topology, Fukaya categories, asymptotically holomorphic methods in contact topology, bordered Floer homology, embedded contact homology, and flexibility results for Stein manifolds.

Symplectic Geometry of Integrable Hamiltonian Systems Birkhäuser

Over the last number of years powerful new methods in analysis and topology have led to the development of the modern global theory of symplectic topology, including several striking and important results. This new third edition of a classic book in the feild includes updates and new material to bring the material right up-to-date.