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Spinning Tops

A Course on
Integrable Systems

MICHELE AUDIN



Spinning Tops A Course On Integrable Systems

Raffaella Di Napoli



Spinning Tops A Course On Integrable Systems:

Spinning Tops M. Audin, 1999-11-13 Since the time of Lagrange and Euler it has been well known that an understanding of algebraic curves can illuminate the picture of rigid bodies provided by classical mechanics A modern view of the role played by algebraic geometry has been established by many mathematicians This book presents some of these techniques which fall within the orbit of finite dimensional integrable systems The main body of the text presents a rich assortment of methods and ideas from algebraic geometry prompted by classical mechanics whilst in appendices the general abstract theory is described The methods are given a topological application to the study of Liouville tori and their bifurcations The book is based on courses for graduate students given by the author at Strasbourg University but the wealth of original ideas will make it also appeal to researchers

Spinning Tops Michèle Audin, 1996 *Elements of Classical and Quantum Integrable Systems* Gleb Arutyunov, 2019-07-23 Integrable models have a fascinating history with many important discoveries that dates back to the famous Kepler problem of planetary motion Nowadays it is well recognised that integrable systems play a ubiquitous role in many research areas ranging from quantum field theory string theory solvable models of statistical mechanics black hole physics quantum chaos and the AdS CFT correspondence to pure mathematics such as representation theory harmonic analysis random matrix theory and complex geometry Starting with the Liouville theorem and finite dimensional integrable models this book covers the basic concepts of integrability including elements of the modern geometric approach based on Poisson reduction classical and quantum factorised scattering and various incarnations of the Bethe Ansatz Applications of integrability methods are illustrated in vast detail on the concrete examples of the Calogero Moser Sutherland and Ruijsenaars Schneider models the Heisenberg spin chain and the one dimensional Bose gas interacting via a delta function potential This book has intermediate and advanced topics with details to make them clearly comprehensible

Integrable Systems in the Realm of Algebraic Geometry Pol Vanhaecke, 2001-07-31 This book treats the general theory of Poisson structures and integrable systems on affine varieties in a systematic way Special attention is drawn to algebraic completely integrable systems Several integrable systems are constructed and studied in detail and a few applications of integrable systems to algebraic geometry are worked out In the second edition some of the concepts in Poisson geometry are clarified by introducing Poisson cohomology the Mumford systems are constructed from the algebra of pseudo differential operators which clarifies their origin a new explanation of the multi Hamiltonian structure of the Mumford systems is given by using the loop algebra of $sl(2)$ and finally Geodesic flow on $SO(4)$ is added to illustrate the linearization algorithm and to give another application of integrable systems to algebraic geometry

Integrable Systems, Topology, and Physics Martin A. Guest, Reiko Miyaoka, Yoshihiro Ohnita, 2002 Ideas and techniques from the theory of integrable systems are playing an increasingly important role in geometry Thanks to the development of tools from Lie theory algebraic geometry symplectic geometry and topology classical problems are investigated more systematically New problems

are also arising in mathematical physics A major international conference was held at the University of Tokyo in July 2000 It brought together scientists in all of the areas influenced by integrable systems This book is the second of three collections of expository and research articles This volume focuses on topology and physics The role of zero curvature equations outside of the traditional context of differential geometry has been recognized relatively recently but it has been an extraordinarily productive one and most of the articles in this volume make some reference to it Symplectic geometry Floer homology twistor theory quantum cohomology and the structure of special equations of mathematical physics such as the Toda field equations all of these areas have gained from the integrable systems point of view and contributed to it Many of the articles in this volume are written by prominent researchers and will serve as introductions to the topics It is intended for graduate students and researchers interested in integrable systems and their relations to differential geometry topology algebraic geometry and physics The first volume from this conference also available from the AMS is Differential Geometry and Integrable Systems Volume 308 CONM 308 in the Contemporary Mathematics series The forthcoming third volume will be published by the Mathematical Society of Japan and will be available outside of Japan from the AMS in the Advanced Studies in Pure Mathematics series

Geometry and Dynamics of Integrable Systems Alexey Bolsinov, Juan J. Morales-Ruiz, Nguyen Tien Zung, 2016-10-27 Based on lectures given at an advanced course on integrable systems at the Centre de Recerca Matemàtica in Barcelona these lecture notes address three major aspects of integrable systems obstructions to integrability from differential Galois theory the description of singularities of integrable systems on the basis of their relation to bi Hamiltonian systems and the generalization of integrable systems to the non Hamiltonian settings All three sections were written by top experts in their respective fields Native to actual problem solving challenges in mechanics the topic of integrable systems is currently at the crossroads of several disciplines in pure and applied mathematics and also has important interactions with physics The study of integrable systems also actively employs methods from differential geometry Moreover it is extremely important in symplectic geometry and Hamiltonian dynamics and has strong correlations with mathematical physics Lie theory and algebraic geometry including mirror symmetry As such the book will appeal to experts with a wide range of backgrounds

Hamiltonian Systems and Their Integrability Michèle Audin, 2008 Hamiltonian systems began as a mathematical approach to the study of mechanical systems As the theory developed it became clear that the systems that had a sufficient number of conserved quantities enjoyed certain remarkable properties These are the completely integrable systems In time a rich interplay arose between integrable systems and other areas of mathematics particularly topology geometry and group theory This book presents some modern techniques in the theory of integrable systems viewed as variations on the theme of action angle coordinates These techniques include analytical methods coming from the Galois theory of differential equations as well as more classical algebro geometric methods related to Lax equations Audin has included many examples and exercises Most of the exercises build on the material in the text None of the important proofs

have been relegated to the exercises Many of the examples are classical rather than abstract This book would be suitable for a graduate course in Hamiltonian systems *Integrability and Nonintegrability of Dynamical Systems* Alain Goriely, 2001

This invaluable book examines qualitative and quantitative methods for nonlinear differential equations as well as integrability and nonintegrability theory Starting from the idea of a constant of motion for simple systems of differential equations it investigates the essence of integrability its geometrical relevance and dynamical consequences Integrability theory is approached from different perspectives first in terms of differential algebra then in terms of complex time singularities and finally from the viewpoint of phase geometry for both Hamiltonian and non Hamiltonian systems As generic systems of differential equations cannot be exactly solved the book reviews the different notions of nonintegrability and shows how to prove the nonexistence of exact solutions and or a constant of motion Finally nonintegrability theory is linked to dynamical systems theory by showing how the property of complete integrability partial integrability or nonintegrability can be related to regular and irregular dynamics in phase space **Symplectic Geometry of Integrable Hamiltonian**

Systems Michèle Audin, Ana Cannas da Silva, Eugene Lerman, 2012-12-06 Among all the Hamiltonian systems the integrable ones have special geometric properties in particular their solutions are very regular and quasi periodic The quasi periodicity of the solutions of an integrable system is a result of the fact that the system is invariant under a semi global torus action It is thus natural to investigate the symplectic manifolds that can be endowed with a global torus action This leads to symplectic toric manifolds Part B of this book Physics makes a surprising come back in Part A to describe Mirror Symmetry one looks for a special kind of Lagrangian submanifolds and integrable systems the special Lagrangians Furthermore integrable Hamiltonian systems on punctured cotangent bundles are a starting point for the study of contact toric manifolds Part C of this book *Differential Algebra and Related Topics* Li Guo, 2002 Differential algebra explores properties of solutions of systems of ordinary or partial linear or non linear differential equations from an algebraic point of view It includes as special cases algebraic systems as well as differential systems with algebraic constraints This algebraic theory of Joseph F Ritt and Ellis R Kolchin is further enriched by its interactions with algebraic geometry Diophantine geometry differential geometry model theory control theory automatic theorem proving combinatorics and difference equations Differential algebra now plays an important role in computational methods such as symbolic integration and symmetry analysis of differential equations These proceedings consist of tutorial and survey papers presented at the Second International Workshop on Differential Algebra and Related Topics at Rutgers University Newark in April 2007 As a sequel to the proceedings of the First International Workshop this volume covers more related subjects and provides a modern and introductory treatment to many facets of differential algebra including surveys of known results open problems and new emerging directions of research It is therefore an excellent companion and reference text for graduate students and researchers

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