METHODS IN EQUIVARIANT BIFURCATIONS AND DYNAMICAL SYSTEMS

Pascal Chossat
Reiner Lauterbach

Methods In Equivariant Bifurcation And Dynamical Systems With Applications

Henk Broer,Igor Hoveijn,Gerton Lunter,Gert Vegter

Methods In Equivariant Bifurcation And Dynamical Systems With Applications:

   Methods In Equivariant Bifurcations And Dynamical Systems Pascal Chossat,Reiner Lauterbach,2000-02-28 This invaluable book presents a comprehensive introduction to bifurcation theory in the presence of symmetry an applied mathematical topic which has developed considerably over the past twenty years and has been very successful in analysing and predicting pattern formation and other critical phenomena in most areas of science where nonlinear models are involved like fluid flow instabilities chemical waves elasticity and population dynamics The book has two aims One is to expound the mathematical methods of equivariant bifurcation theory Beyond the classical bifurcation tools such as center manifold and normal form reductions the presence of symmetry requires the introduction of the algebraic and geometric formalism of Lie group theory and transformation group methods For the first time all these methods in equivariant bifurcations are presented in a coherent and self consistent way in a book The other aim is to present the most recent ideas and results in this theory in relation to applications This includes bifurcations of relative equilibria and relative periodic orbits for compact and noncompact group actions heteroclinic cycles and forced symmetry breaking perturbations Although not all recent contributions could be included and a choice had to be made a rather complete description of these new developments is provided At the end of every chapter exercises are offered to the reader   **Computer Algebra Methods for Equivariant Dynamical Systems** Karin Gatermann,2007-05-06 This book starts with an overview of the research of Gr bner bases which have many applications in various areas of mathematics since they are a general tool for the investigation of polynomial systems The next chapter describes algorithms in invariant theory including many examples and time tables These techniques are applied in the chapters on symmetric bifurcation theory and equivariant dynamics This combination of different areas of mathematics will be interesting to researchers in computational algebra and or dynamics   **Handbook of Topological Fixed Point Theory** Robert F. Brown,2005-06-10 This book will be especially useful for post graduate students and researchers interested in the fixed point theory particularly in topological methods in nonlinear analysis differential equations and dynamical systems The content is also likely to stimulate the interest of mathematical economists population dynamics experts as well as theoretical physicists exploring the topological dynamics   **Perturbation Theory** Giuseppe Gaeta,2022-12-16 This volume in the Encyclopedia of Complexity and Systems Science Second Edition is devoted to the fundamentals of Perturbation Theory PT as well as key applications areas such as Classical and Quantum Mechanics Celestial Mechanics and Molecular Dynamics Less traditional fields of application such as Biological Evolution are also discussed Leading scientists in each area of the field provide a comprehensive picture of the landscape and the state of the art with the specific goal of combining mathematical rigor explicit computational methods and relevance to concrete applications New to this edition are chapters on Water Waves Rogue Waves Multiple Scales methods legged locomotion Condensed Matter among others while all other contributions have been revised and updated Coverage includes the theory of Poincare Birkhoff

Normal Forms aspects of PT in specific mathematical settings Hamiltonian KAM theory Nekhoroshev theory and symmetric systems technical problems arising in PT with solutions convergence of series expansions diagrammatic methods parametric resonance systems with nilpotent real part PT for non smooth systems and on PT for PDEs write out this acronym partial differential equations Another group of papers is focused specifically on applications to Celestial Mechanics Quantum Mechanics and the related semiclassical PT Quantum Bifurcations Molecular Dynamics the so called choreographies in the N body problem as well as Evolutionary Theory Overall this unique volume serves to demonstrate the wide utility of PT while creating a foundation for innovations from a new generation of graduate students and professionals in Physics Mathematics Mechanics Engineering and the Biological Sciences   **Numerical Methods for Bifurcations of Dynamical Equilibria** Willy J. F. Govaerts,2000-01-01 Dynamical systems arise in all fields of applied mathematics The author focuses on the description of numerical methods for the detection computation and continuation of equilibria and bifurcation points of equilibria of dynamical systems This subfield has the particular attraction of having links with the geometric theory of differential equations numerical analysis and linear algebra   **Handbook of Dynamical Systems** H. Broer,F. Takens,B. Hasselblatt,2010-11-10 In this volume the authors present a collection of surveys on various aspects of the theory of bifurcations of differentiable dynamical systems and related topics By selecting these subjects they focus on those developments from which research will be active in the coming years The surveys are intended to educate the reader on the recent literature on the following subjects transversality and generic properties like the various forms of the so called Kupka Smale theorem the Closing Lemma and generic local bifurcations of functions so called catastrophe theory and generic local bifurcations in 1 parameter families of dynamical systems and notions of structural stability and moduli Covers recent literature on various topics related to the theory of bifurcations of differentiable dynamical systems Highlights developments that are the foundation for future research in this field Provides material in the form of surveys which are important tools for introducing the bifurcations of differentiable dynamical systems   **Local Bifurcations, Center Manifolds, and Normal Forms in Infinite-Dimensional Dynamical Systems** Mariana Haragus,Gérard Iooss,2010-11-23 An extension of different lectures given by the authors Local Bifurcations Center Manifolds and Normal Forms in Infinite Dimensional Dynamical Systems provides the reader with a comprehensive overview of these topics Starting with the simplest bifurcation problems arising for ordinary differential equations in one and two dimensions this book describes several tools from the theory of infinite dimensional dynamical systems allowing the reader to treat more complicated bifurcation problems such as bifurcations arising in partial differential equations Attention is restricted to the study of local bifurcations with a focus upon the center manifold reduction and the normal form theory two methods that have been widely used during the last decades Through use of step by step examples and exercises a number of possible applications are illustrated and allow the less familiar reader to use this reduction method by checking some clear assumptions Written by recognised experts in the field

of center manifold and normal form theory this book provides a much needed graduate level text on bifurcation theory center manifolds and normal form theory It will appeal to graduate students and researchers working in dynamical system theory

Topics in Nonlinear Time Series Analysis Andreas Galka,2000 This book provides a thorough review of a class of powerful algorithms for the numerical analysis of complex time series data which were obtained from dynamical systems These algorithms are based on the concept of state space representations of the underlying dynamics as introduced by nonlinear dynamics In particular current algorithms for state space reconstruction correlation dimension estimation testing for determinism and surrogate data testing are presented algorithms which have been playing a central role in the investigation of deterministic chaos and related phenomena since 1980 Special emphasis is given to the much disputed issue whether these algorithms can be successfully employed for the analysis of the human electroencephalogram

Mathematical Sciences with Multidisciplinary Applications Bourama Toni,2016-08-19 This book is the fourth in a multidisciplinary series which brings together leading researchers in the STEAM H disciplines Science Technology Engineering Agriculture Mathematics and Health to present their perspective on advances in their own specific fields and to generate a genuinely interdisciplinary collaboration that transcends parochial subject matter boundaries All contributions are carefully edited peer reviewed reasonably self contained and pedagogically crafted for a multidisciplinary readership Contributions are drawn from a variety of fields including mathematics statistics game theory and behavioral sciences biomathematics and physical chemistry computer science and human centered computing This volume is dedicated to Professor Christiane Rousseau whose work inspires the STEAM H series in recognition of her passion for the mathematical sciences and her on going initiative the Mathematics of Planet Earth paradigm of interdisciplinarity The volume s primary goal is to enhance interdisciplinary understanding between these areas of research by showing how new advances in a particular field can be relevant to open problems in another and how many disciplines contribute to a better understanding of relevant issues at the interface of mathematics and the sciences The main emphasis is on important methods research directions and applications of analysis within and beyond each field As such the volume aims to foster student interest and participation in the STEAM H domain as well as promote interdisciplinary research collaborations The volume is valuable as a reference of choice and a source of inspiration for a broad spectrum of scientists mathematicians research students and postdoctoral fellows *Advances in Nonlinear Dynamics: Methods and Applications* Anil K. Bajaj,Steven W. Shaw,2012-12-06 This is the second and final issue of the collection of papers that were contributed by friends and colleagues of Late Professor P R Pat Sethna of the University of Minnesota to commemorate his 70th birthday on May 26 1993 The first set of contributions was published in Nonlinear Dynamics as the last issue no 6 of Vol 4 in 1993 As circumstances would have it Professor Sethna was diagnosed with cancer in the fall of 1992 and after an extended battle with the disease he passed away on November 4 1993 just a few days before the first set of contributed papers appeared in

print It is gratifying to report that the organizers of these vi Foreword commemorative issues in Nonlinear Dynamics were able to present to Professor Sethna on the occasion of his 70th birthday complete details of the planned commemorative issues This second set of contributions is dedicated in memoriam to Professor P R Sethna As many of you are well aware Professor Sethna was an active researcher in the field of nonlinear vibrations and dynamics for nearly forty years making many fundamental and significant contributions to both the theoretical and applied aspects of this field He was also recognized for his outstanding leadership and administrative abilities amply demonstrated through his position as the Head of the Department of Aerospace Engineering and Mechanics at the University of Minnesota for twenty six years 1966 1992

Symmetry and Perturbation Theory in Nonlinear Dynamics Giampaolo Cicogna,Guiseppe Gaeta,2003-07-01 has been in the of a Symmetry major ingredient development quantum perturba tion and it is a basic of the of theory ingredient theory integrable Hamiltonian and of the the use in context of non Hamiltonian systems yet symmetry gen eral is rather recent From the of view of nonlinear perturbation theory point the use of has become dynamics widespread only through equivariant symmetry bifurcation in this attention has been confined to linear even theory case mostly symmetries in recent the and of methods for dif Also theory practice symmetry years ferential has become and has been to a equations increasingly popular applied of the of the book Olver This by variety problems following appearance 2621 with is and deals of nature theory deeply geometrical symmetries general pro vided that described i e in this context there is are vector no they by fields to limit attention to linear reason symmetries In this look the basic tools of i e normal book we at perturbation theory introduced Poincar6 about and their inter a forms first by century ago study action with with no limitation to linear ones We focus on the most symmetries basic fixed the and i e a setting systems having point at origin perturbative around thus is local

Localization and Solitary Waves in Solid Mechanics A. R. Champneys,G. W. Hunt,J. M. T. Thompson,1999 This book is a collection of recent reprints and new material on fundamentally nonlinear problems in structural systems which demonstrate localized responses to continuous inputs It has two intended audiences For mathematicians and physicists it should provide useful new insights into a classical yet rapidly developing area of application of the rich subject of dynamical systems theory For workers in structural and solid mechanics it introduces a new methodology for dealing with structural localization and the related topic of the generation of solitary waves Applications range from classical problems such as the buckling of cylindrical shells twisted rods and pipelines to the folding of geological strata the failure of sandwich structures and the propagation of solitary waves in suspended beam systems   Time Reversibility, Computer Simulation, And Chaos William Graham Hoover,1999-11-30 A small army of physicists chemists mathematicians and engineers has joined forces to attack a classic problem the reversibility paradox with modern tools This book describes their work from the perspective of computer simulation emphasizing the author s approach to the problem of understanding the compatibility and even inevitability of the irreversible second law of thermodynamics with an underlying time reversible mechanics Computer simulation has made it

possible to probe reversibility from a variety of directions and chaos theory or nonlinear dynamics has supplied a useful vocabulary and set of concepts which allow a fuller explanation of irreversibility than that available to Boltzmann or to Green and Kubo and Onsager Clear illustration of concepts is emphasized throughout and reinforced with a glossary of technical terms from the specialized fields which have been combined here to focus on a common theme The book begins with a discussion contrasting the idealized reversibility of basic physics and the pragmatic irreversibility of real life Computer models and simulation are next discussed and illustrated Simulations provide the means to assimilate concepts through worked out examples State of the art analyses from the point of view of dynamical systems are applied to many body examples from nonequilibrium molecular dynamics and to chaotic irreversible flows from finite difference finite element and particle based continuum simulations Two necessary concepts from dynamical systems theory fractals and Lyapunov instability are fundamental to the approach Undergraduate level physics calculus and ordinary differential equations are sufficient background for a full appreciation of this book which is intended for advanced undergraduates graduates and research workers The generous assortment of examples worked out in the text will stimulate readers to explore the rich and fruitful field of study which links fundamental reversible laws of physics to the irreversibility surrounding us all <u>Nonlinear Dynamics and Stochastic Mechanics</u> Wolfgang Kliemann,2018-05-04 Engineering systems have played a crucial role in stimulating many of the modern developments in nonlinear and stochastic dynamics After 20 years of rapid progress in these areas this book provides an overview of the current state of nonlinear modeling and analysis for mechanical and structural systems This volume is a coherent compendium written by leading experts from the United States Canada Western and Eastern Europe and Australia The 22 articles describe the background recent developments applications and future directions in bifurcation theory chaos perturbation methods stochastic stability stochastic flows random vibrations reliability disordered systems earthquake engineering and numerics The book gives readers a sophisticated toolbox that will allow them to tackle modeling problems in mechanical systems that use stochastic and nonlinear dynamics ideas An extensive bibliography and index ensure this volume will remain a reference standard for years to come **Handbook of Differential Equations: Ordinary Differential Equations** Flaviano Battelli,Michal Feckan,2008-08-19 This handbook is the fourth volume in a series of volumes devoted to self contained and up to date surveys in the theory of ordinary differential equations with an additional effort to achieve readability for mathematicians and scientists from other related fields so that the chapters have been made accessible to a wider audience Covers a variety of problems in ordinary differential equations Pure mathematical and real world applications Written for mathematicians and scientists of many related fields **Numerical Continuation Methods for Dynamical Systems** Bernd Krauskopf,Hinke M. Osinga,Jorge Galan-Vioque,2007-11-06 Path following in combination with boundary value problem solvers has emerged as a continuing and strong influence in the development of dynamical systems theory and its application It is widely acknowledged that the

software package AUTO developed by Eusebius J Doedel about thirty years ago and further expanded and developed ever since plays a central role in the brief history of numerical continuation This book has been compiled on the occasion of Sebius Doedel s 60th birthday Bringing together for the first time a large amount of material in a single accessible source it is hoped that the book will become the natural entry point for researchers in diverse disciplines who wish to learn what numerical continuation techniques can achieve The book opens with a foreword by Herbert B Keller and lecture notes by Sebius Doedel himself that introduce the basic concepts of numerical bifurcation analysis The other chapters by leading experts discuss continuation for various types of systems and objects and showcase examples of how numerical bifurcation analysis can be used in concrete applications Topics that are treated include interactive continuation tools higher dimensional continuation the computation of invariant manifolds and continuation techniques for slow fast systems for symmetric Hamiltonian systems for spatially extended systems and for systems with delay Three chapters review physical applications the dynamics of a SQUID global bifurcations in laser systems and dynamics and bifurcations in electronic circuits **Continuation and Bifurcations: Numerical Techniques and Applications** Dirk Roose,Bart De Dier,Alastair Spence,2012-12-06 Proceedings of the NATO Advanced Research Workshop Leuven Belgium September 18 22 1989

Bifurcations in Hamiltonian Systems Henk Broer,Igor Hoveijn,Gerton Lunter,Gert Vegter,2003-01-01 The authors consider applications of singularity theory and computer algebra to bifurcations of Hamiltonian dynamical systems They restrict themselves to the case were the following simplification is possible Near the equilibrium or quasi periodic solution under consideration the linear part allows approximation by a normalized Hamiltonian system with a torus symmetry It is assumed that reduction by this symmetry leads to a system with one degree of freedom The volume focuses on two such reduction methods the planar reduction or polar coordinates method and the reduction by the energy momentum mapping The one degree of freedom system then is tackled by singularity theory where computer algebra in particular Gr bner basis techniques are applied The readership addressed consists of advanced graduate students and researchers in dynamical systems Mathematics of Complexity and Dynamical Systems Robert A. Meyers,2011-10-05 Mathematics of Complexity and Dynamical Systems is an authoritative reference to the basic tools and concepts of complexity systems theory and dynamical systems from the perspective of pure and applied mathematics Complex systems are systems that comprise many interacting parts with the ability to generate a new quality of collective behavior through self organization e g the spontaneous formation of temporal spatial or functional structures These systems are often characterized by extreme sensitivity to initial conditions as well as emergent behavior that are not readily predictable or even completely deterministic The more than 100 entries in this wide ranging single source work provide a comprehensive explication of the theory and applications of mathematical complexity covering ergodic theory fractals and multifractals dynamical systems perturbation theory solitons systems and control theory and related topics Mathematics of Complexity and Dynamical Systems is an

essential reference for all those interested in mathematical complexity from undergraduate and graduate students up through professional researchers *Hyperbolic and Kinetic Models for Self-organised Biological Aggregations* Raluca Eftimie,2019-01-07 This book focuses on the spatio temporal patterns generated by two classes of mathematical models of hyperbolic and kinetic types that have been increasingly used in the past several years to describe various biological and ecological communities Here we combine an overview of various modelling approaches for collective behaviours displayed by individuals cells bacteria that interact locally and non locally with analytical and numerical mathematical techniques that can be used to investigate the spatio temporal patterns produced by said individuals cells bacteria Richly illustrated the book offers a valuable guide for researchers new to the field and is also suitable as a textbook for senior undergraduate or graduate students in mathematics or related disciplines

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Table of Contents Methods In Equivariant Bifurcation And Dynamical Systems With Applications

1. Understanding the eBook Methods In Equivariant Bifurcation And Dynamical Systems With Applications
   - The Rise of Digital Reading Methods In Equivariant Bifurcation And Dynamical Systems With Applications
   - Advantages of eBooks Over Traditional Books
2. Identifying Methods In Equivariant Bifurcation And Dynamical Systems With Applications
   - Exploring Different Genres
   - Considering Fiction vs. Non-Fiction
   - Determining Your Reading Goals
3. Choosing the Right eBook Platform
   - Popular eBook Platforms
   - Features to Look for in an Methods In Equivariant Bifurcation And Dynamical Systems With Applications
   - User-Friendly Interface
4. Exploring eBook Recommendations from Methods In Equivariant Bifurcation And Dynamical Systems With Applications
   - Personalized Recommendations
   - Methods In Equivariant Bifurcation And Dynamical Systems With Applications User Reviews and Ratings

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