

Numerical Methods for Bifurcations of Dynamical Equilibria

Willy J. F. Govaerts



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T. Asada, T. Ishikawa



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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

Numerical methods for equilibrium bifurcations of dynamical systems Willy J. Govaerts, 2000 **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 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

Handbook of Dynamical Systems B. Fiedler, 2002-02-21 This handbook is volume II in a series collecting mathematical state of the art surveys in the field of dynamical systems Much of this field has developed from interactions with other areas of science and this volume shows how concepts of dynamical systems further the understanding of mathematical issues that arise in applications Although modeling issues are addressed the central theme is the mathematically rigorous investigation of the resulting differential equations and their dynamic behavior However the authors and editors have made an effort to ensure readability on a non technical level for mathematicians from other fields and for other scientists and engineers The eighteen surveys collected here do not aspire to encyclopedic completeness but present selected paradigms The surveys are grouped into those emphasizing finite dimensional methods numerics topological methods and partial differential equations Application areas include the dynamics of neural networks fluid flows nonlinear optics and many others While the survey articles can be read independently they deeply share recurrent themes from dynamical systems Attractors bifurcations center manifolds dimension reduction ergodicity homoclinicity hyperbolicity invariant and inertial manifolds normal forms recurrence shift dynamics stability to name just a few are ubiquitous dynamical concepts throughout the articles

Nonlinear Structures & Systems, Vol. 1 Matthew R.W. Brake, Ludovic Renson, Robert J. Kuether, Paolo Tiso, 2025-08-07 Nonlinear Structures Systems Volume 1 Proceedings of the 42nd IMAC A Conference and Exposition on Structural Dynamics 2024 the first volume of ten from the Conference brings together contributions to this important area of research and engineering The collection presents early findings and case studies on fundamental and applied aspects of Nonlinear Dynamics including papers on Experimental Nonlinear Dynamics Jointed Structures Identification Mechanics Dynamics Nonlinear Damping Nonlinear Modeling and Simulation Nonlinear Reduced Order Modeling Nonlinearity and System Identification

Nonlinear Dynamics and Chaos J Hogan, A.R Krauskopf, Mario di Bernardo, R. Eddie Wilson, Hinke. M Osinga, Martin. E Homer, Alan. R Champneys, 2002-08-01 Nonlinear dynamics has been successful in explaining complicated phenomena in well defined low dimensional systems Now it is time to focus on real life problems that are high dimensional or ill defined for example due to delay spatial extent stochasticity or the limited nature of available data How can one understand the dynamics of such sys

Parallel Computational Technologies Leonid Sokolinsky, Mikhail Zymbler, 2017-10-01 This book constitutes the refereed proceedings of the 11th International Conference on Parallel Computational Technologies PCT 2017 held in Kazan Russia in April 2017 The 24 revised full papers presented were carefully reviewed and selected from 167 submissions The papers are organized in topical sections on high performance architectures tools and technologies parallel numerical algorithms supercomputer simulation

Focus on Combustion Research Sung Z. Jiang, 2006 Combustion or burning is an exothermic reaction between a substance and a gas

to release heat Combustion normally occurs in oxygen often in the form of gaseous O_2 to form oxides However combustion can also take place in other gases like chlorine The products of such reactions usually include water H_2O as well as carbon monoxide CO or carbon dioxide CO_2 or both Other by products such as partially reacted fuel and elemental carbon C may generate visible smoke and soot This book presents leading research from around the world in this frontal field

Nonlinear Targeted Energy Transfer in Mechanical and Structural Systems Alexander F. Vakakis, Oleg V. Gendelman, Lawrence A. Bergman, D. Michael McFarland, Gaëtan Kerschen, Young Sup Lee, 2008-12-24 This monograph evolved over a period of nine years from a series of papers and presentations addressing the subject of passive vibration control of mechanical systems subjected to broadband transient inputs The unifying theme is Targeted Energy Transfer TET which represents a new and unique approach to the passive control problem in which a strongly nonlinear fully passive local attachment the Nonlinear Energy Sink NES is employed to drastically alter the dynamics of the primary system to which it is attached The intrinsic capacity of the properly signed NES to promote rapid localization of externally applied narrowband vibration or broadband shock energy to itself where it can be captured and dissipated provides a powerful strategy for vibration control and the opens the possibility for a wide range of applications of TET such as vibration and shock isolation passive energy harvesting aeroelastic instability utter suppression seismic mitigation vortex shedding control enhanced reliability designs for example in power grids and others The monograph is intended to provide a thorough explanation of the analytical computational and experimental methods needed to formulate and study TET in mechanical and structural systems Several practical engineering applications are examined in detail and experimental verification and validation of the theoretical predictions are provided as well The authors also suggest a number of possible future applications where application of TET seems promising The authors are indebted to a number of sponsoring agencies

Algorithms in Algebraic Geometry Alicia Dickenstein, Frank-Olaf Schreyer, Andrew J. Sommese, 2010-07-10 In the last decade there has been a burgeoning of activity in the design and implementation of algorithms for algebraic geometric computation The workshop on Algorithms in Algebraic Geometry that was held in the framework of the IMA Annual Program Year in Applications of Algebraic Geometry by the Institute for Mathematics and Its Applications on September 2006 is one tangible indication of the interest This volume of articles captures some of the spirit of the IMA workshop

PDE Dynamics Christian Kuehn, 2019-04-10 This book provides an overview of the myriad methods for applying dynamical systems techniques to PDEs and highlights the impact of PDE methods on dynamical systems Also included are many nonlinear evolution equations which have been benchmark models across the sciences and examples and techniques to strengthen preparation for research PDE Dynamics An Introduction is intended for senior undergraduate students beginning graduate students and researchers in applied mathematics theoretical physics and adjacent disciplines Structured as a textbook or seminar reference it can be used in courses titled Dynamics of PDEs PDEs 2 Dynamical Systems 2 Evolution Equations or Infinite Dimensional Dynamics

Dynamics of the Chemostat

Abdelhamid Ajbar, Khalid Alhumaizi, 2011-08-09 A ubiquitous tool in mathematical biology and chemical engineering the chemostat often produces instabilities that pose safety hazards and adversely affect the optimization of bioreactive systems Singularity theory and bifurcation diagrams together offer a useful framework for addressing these issues Based on the authors extensive work in this *Multiple Time Scale Dynamics* Christian Kuehn, 2015-02-25 This book provides an introduction to dynamical systems with multiple time scales The approach it takes is to provide an overview of key areas particularly topics that are less available in the introductory form The broad range of topics included makes it accessible for students and researchers new to the field to gain a quick and thorough overview The first of its kind this book merges a wide variety of different mathematical techniques into a more unified framework The book is highly illustrated with many examples and exercises and an extensive bibliography The target audience of this book are senior undergraduates graduate students as well as researchers interested in using the multiple time scale dynamics theory in nonlinear science either from a theoretical or a mathematical modeling perspective **Elements of Applied Bifurcation Theory** Yuri Kuznetsov, 2013-03-09 The years that have passed since the publication of the first edition of this book proved that the basic principles used to select and present the material made sense The idea was to write a simple text that could serve as a serious introduction to the subject Of course the meaning of simplicity varies from person to person and from country to country The word introduction contains even more ambiguity To start reading this book only a moderate knowledge of linear algebra and calculus is required Other preliminaries qualified as elementary in modern mathematics are explicitly formulated in the book These include the Fredholm Alternative for linear systems and the multidimensional Implicit Function Theorem Using these very limited tools a framework of notions results and methods is gradually built that allows one to read and possibly write scientific papers on bifurcations of nonlinear dynamical systems Among other things progress in the sciences means that mathematical results and methods that once were new become standard and routinely used by the research and development community Hopefully this edition of the book will contribute to this process The books structure has been kept intact Most of the changes introduced reflect recent theoretical and software developments in which the author was involved Important changes in the third edition can be summarized as follows A new section devoted to the fold flip bifurcation for maps has appeared in Chapter 9 **Emerging Frontiers in Nonlinear Science** Panayotis G. Kevrekidis, Jesús Cuevas-Maraver, Avadh Saxena, 2020-05-29 This book explores the impact of nonlinearity on a broad range of areas including time honored fields such as biology geometry and topology but also modern ones such as quantum mechanics networks metamaterials and artificial intelligence The concept of nonlinearity is a universal feature in mathematics physics chemistry and biology and is used to characterize systems whose behavior does not amount to a superposition of simple building blocks but rather features complex and often chaotic patterns and phenomena Each chapter of the book features a synopsis that not only recaps the recent progress in each field but also charts the challenges that lie ahead This interdisciplinary book presents

contributions from a diverse group of experts from various fields to provide an overview of each field's past, present and future. It will appeal to both beginners and seasoned researchers in nonlinear science, numerous areas of physics, optics, quantum physics, biophysics and applied mathematics, ODEs, PDEs, dynamical systems, machine learning as well as engineering.

Time and Space in Economics T. Asada, T. Ishikawa, 2007-05-31 In August 2005 a small but important conference took place at Chuo University in Tokyo, Japan. The Chuo Meeting on Economics of Time and Space 2005 (Chuo METS 05) aimed to enrich the respective disciplines of the economics of time, dynamic economics and the economics of space, spatial economics and to expand their applicability in the real world. The chapters contained herein are based on the papers presented at that conference.

Numerical Bifurcation Analysis of Maps Yuri A. Kuznetsov, Hil G. E. Meijer, 2019-03-28 This book combines a comprehensive state-of-the-art analysis of bifurcations of discrete-time dynamical systems with concrete instruction on implementations and example applications in the free MATLAB software MatContM developed by the authors. While self-contained and suitable for independent study, the book is also written with users in mind and is an invaluable reference for practitioners. Part I focuses on theory, providing a systematic presentation of bifurcations of fixed points and cycles of finite-dimensional maps up to and including cases with two control parameters. Several complementary methods, including Lyapunov exponents, invariant manifolds and homoclinic structures and parts of chaos theory, are presented. Part II introduces MatContM through step-by-step tutorials on how to use the general numerical methods described in Part I for simple dynamical models defined by one and two-dimensional maps. Further examples in Part III show how MatContM can be used to analyze more complicated models from modern engineering, ecology and economics.

Imperfect Bifurcation in Structures and Materials Kiyohiro Ikeda, Kazuo Murota, 2019-09-25 Most physical systems lose or gain stability through bifurcation behavior. This book explains a series of experimentally found bifurcation phenomena by means of the methods of static bifurcation theory.

Computational Science - ICCS 2003 Peter M.A. Sloot, David Abramson, Alexander V. Bogdanov, Jack J. Dongarra, Albert Y. Zomaya, Yuriy E. Gorbachev, 2003-05-22 The four-volume set LNCS 2657, LNCS 2658, LNCS 2659 and LNCS 2660 constitutes the refereed proceedings of the Third International Conference on Computational Science (ICCS 2003) held concurrently in Melbourne, Australia and in St. Petersburg, Russia, in June 2003. The four volumes present more than 460 reviewed contributed and invited papers and span the whole range of computational science from foundational issues in computer science and algorithmic mathematics to advanced applications in virtually all application fields making use of computational techniques. These proceedings give a unique account of recent results in the field.

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