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Bifurcations of Planar Vector Fields

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Nilpotent Singularities and Abelian Integrals

 Springer

Bifurcations Of Planar Vector Fields H

Robert Roussarie



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Bifurcations of Planar Vector Fields and Hilbert's Sixteenth Problem Robert Roussarie,1998-05-19 In a coherent exhaustive and progressive way this book presents the tools for studying local bifurcations of limit cycles in families of planar vector fields A systematic introduction is given to such methods as division of an analytic family of functions in its ideal of coefficients and asymptotic expansion of non differentiable return maps and desingularisation The exposition moves from classical analytic geometric methods applied to regular limit periodic sets to more recent tools for singular limit sets The methods can be applied to theoretical problems such as Hilbert s 16th problem but also for the purpose of establishing bifurcation diagrams of specific families as well as explicit computations The book as a whole is a well balanced exposition that can be recommended to all those who want to gain a thorough understanding and proficiency in the recently developed methods The book reflecting the current state of the art can also be used for teaching special courses Mathematical Reviews

Bifurcations of Planar Vector Fields ,1990 [Bifurcations of Planar Vector Fields](#) Freddy Dumortier,Robert Roussarie,Jorge Sotomayor,Henryk Zoladek,2006-12-08 The book reports on recent work by the authors on the bifurcation structure of singular points of planar vector fields whose linear parts are nilpotent The bifurcation diagrams of the most important codimension three cases are studied in detail The results presented reach the limits of what is currently known on the bifurcation theory of planar vector fields While the treatment is geometric special analytical tools using abelian integrals are needed and are explicitly developed The rescaling and normalization methods are improved for application here The reader is assumed to be familiar with the elements of Bifurcation and Dynamical Systems Theory The book is addressed to researchers and graduate students working in Ordinary Differential Equations and Dynamical Systems as well as anyone modelling complex multiparametric phenomena *Bifurcations of Planar Vector Fields* Jean-Pierre Franoise,Robert H. Roussarie,1990 **Bifurcations of planar vector fields and Hilbert's 16th problem** Robert H. Roussarie,1995

Normal Forms and Bifurcation of Planar Vector Fields Shui-Nee Chow,Chengzhi Li,Duo Wang,1994-07-29 This book is concerned with the bifurcation theory the study of the changes in the structures of the solution of ordinary differential equations as parameters of the model vary *Bifurcations of Planar Vector Fields* Freddy Dumortier,1991 The book reports on recent work by the authors on the bifurcation structure of singular points of planar vector fields whose linear parts are nilpotent The bifurcation diagrams of the most important codimension three cases are studied in detail The results presented reach the limits of what is currently known on the bifurcation theory of planar vector fields While the treatment is geometric special analytical tools using abelian integrals are needed and are explicitly developed The rescaling and normalization methods are improved for application here The reader is assumed to be familiar with the elements of Bifurcation and Dynamical Systems Theory The book is addressed to researchers and graduate students working in Ordinary Differential Equations and Dynamical Systems as well as anyone modelling complex multiparametric phenomena **Bifurcation of**

Planar Vector Fields and Hilbert's Sixteenth Problem Robert H. Roussarie, 1998 In a coherent exhaustive and progressive way this book presents the tools for studying local bifurcations of limit cycles in families of planar vector fields A systematic introduction is given to such methods as division of an analytic family of functions in its ideal of coefficients and asymptotic expansion of non differentiable return maps and desingularisation The exposition moves from classical analytic geometric methods applied to regular limit periodic sets to more recent tools for singular limit sets The methods can be applied to theoretical problems such as Hilbert's 16th problem but also for the purpose of establishing bifurcation diagrams of specific families as well as explicit computations

Bifurcations of Planar Vector Fields and Hilbert's 16th Problem
Robert H. Roussarie, Instituto de Matemática Pura e Aplicada (Brazil), 1995* **Bifurcations** Takashi Matsumoto, Motomasa Komuro, Hiroshi Kokubu, Ryuji Tokunaga, 2012-12-06 Bifurcation originally meant splitting into two parts Namely a system under goes a bifurcation when there is a qualitative change in the behavior of the system Bifurcation in the context of dynamical systems where the time evolution of systems are involved has been the subject of research for many scientists and engineers for the past hundred years simply because bifurcations are interesting A very good way of understanding bifurcations would be to see them first and study theories second Another way would be to first comprehend the basic concepts and theories and then see what they look like In any event it is best to both observe experiments and understand the theories of bifurcations This book attempts to provide a general audience with both avenues toward understanding bifurcations Specifically 1 A variety of concrete experimental results obtained from electronic circuits are given in Chapter 1 All the circuits are very simple which is crucial in any experiment The circuits however should not be too simple otherwise nothing interesting can happen Albert Einstein once said as simple as possible but no more One of the major reasons for the circuits discussed being simple is due to their piecewise linear characteristics Namely the voltage current relationships are composed of several line segments which are easy to build Piecewise linearity also simplifies rigorous analysis in a drastic manner 2 The piecewise linearity of the circuits has far reaching consequences

Bifurcations and Periodic Orbits of Vector Fields Dana Schlomiuk, 1993-07-31 The last thirty years were a period of continuous and intense growth in the subject of dynamical systems New concepts and techniques and at the same time new areas of applications of the theory were found The 31st session of the Seminaire de Mathematiques Superieures SMS held at the Universite de Montreal in July 1992 was on dynamical systems having as its center theme Bifurcations and periodic orbits of vector fields This session of the SMS was a NATO Advanced Study Institute ASI This ASI had the purpose of acquainting the participants with some of the most recent developments and of stimulating new research around the chosen center theme These developments include the major tools of the new resummation techniques with applications in particular to the proof of the non accumulation of limit cycles for real analytic plane vector fields One of the aims of the ASI was to bring together methods from real and complex dynamical systems There is a growing awareness that an interplay between real and complex methods is both useful and necessary for

the solution of some of the problems Complex techniques become powerful tools which yield valuable information when applied to the study of the dynamics of real vector fields The recent developments show that no rigid frontiers between disciplines exist and that interesting new developments occur when ideas and techniques from diverse disciplines are married One of the aims of the ASI was to show these multiple interactions at work

Nonlinear Systems, Vol. 1 Victoriano Carmona, Jesús Cuevas-Maraver, Fernando Fernández-Sánchez, Elisabeth García-Medina, 2018-09-15 This book is part of a two volume set which presents the analysis of nonlinear phenomena as a long standing challenge for research in basic and applied science as well as engineering It discusses nonlinear differential and differential equations bifurcation theory for periodic orbits and global connections The integrability and reversibility of planar vector fields and theoretical analysis of classic physical models are sketched This first volume concentrates on the mathematical theory and computational techniques that are essential for the study of nonlinear science a second volume deals with real world nonlinear phenomena in condensed matter biology and optics

Planar Dynamical Systems Yirong Liu, Jibin Li, Wentao Huang, 2014-10-29 In 2008 November 23-28 the workshop of Classical Problems on Planar Polynomial Vector Fields was held in the Banff International Research Station Canada Called classical problems it was concerned with the following 1 Problems on integrability of planar polynomial vector fields 2 The problem of the center stated by Poincaré for real polynomial differential systems which asks us to recognize when a planar vector field defined by polynomials of degree at most n possesses a singularity which is a center 3 Global geometry of specific classes of planar polynomial vector fields 4 Hilbert's 16th problem These problems had been posed more than 110 years ago Therefore they are called classical problems in the studies of the theory of dynamical systems The qualitative theory and stability theory of differential equations created by Poincaré and Lyapunov at the end of the 19th century had major developments as two branches of the theory of dynamical systems during the 20th century As a part of the basic theory of nonlinear science it is one of the very active areas in the new millennium This book presents in an elementary way the recent significant developments in the qualitative theory of planar dynamical systems The subjects are covered as follows the studies of center and isochronous center problems multiple Hopf bifurcations and local and global bifurcations of the equivariant planar vector fields which concern with Hilbert's 16th problem The book is intended for graduate students post doctors and researchers in dynamical systems For all engineers who are interested in the theory of dynamical systems it is also a reasonable reference It requires a minimum background of a one year course on nonlinear differential equations

Normal Forms, Melnikov Functions and Bifurcations of Limit Cycles Maoan Han, Pei Yu, 2012-04-23 Dynamical system theory has developed rapidly over the past fifty years It is a subject upon which the theory of limit cycles has a significant impact for both theoretical advances and practical solutions to problems Hopf bifurcation from a center or a focus is integral to the theory of bifurcation of limit cycles for which normal form theory is a central tool Although Hopf bifurcation has been studied for more than half a century and normal form theory

for over 100 years efficient computation in this area is still a challenge with implications for Hilbert's 16th problem. This book introduces the most recent developments in this field and provides major advances in fundamental theory of limit cycles. Split into two parts, the first focuses on the study of limit cycles bifurcating from Hopf singularity using normal form theory with later application to Hilbert's 16th problem while the second considers near-Hamiltonian systems using Melnikov function as the main mathematical tool. Classic topics with new results are presented in a clear and concise manner and are accompanied by the liberal use of illustrations throughout. Containing a wealth of examples and structured algorithms that are treated in detail, a good balance between theoretical and applied topics is demonstrated. By including complete Maple programs within the text, this book also enables the reader to reconstruct the majority of formulas provided, facilitating the use of concrete models for study. Through the adoption of an elementary and practical approach, this book will be of use to graduate mathematics students wishing to study the theory of limit cycles as well as scientists across a number of disciplines with an interest in the applications of periodic behavior.

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 application 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 of legged locomotion, Condensed Matter, among others, while all other contributions have been revised and updated. Coverage includes the theory of Poincaré, 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.

Bifurcation of Symmetric Planar Vector Fields Hyeon-Kwan Ju, 1988

Bifurcation and Chaos in Complex Systems, 2006-06-30. The book presents the recent achievements on bifurcation studies of nonlinear dynamical systems. The contributing authors of the book are all distinguished researchers in this interesting subject area. The first two chapters deal with the fundamental theoretical issues of bifurcation analysis in smooth and non-smooth dynamical systems. The cell mapping methods are presented for global bifurcations in stochastic and deterministic nonlinear dynamical

systems in the third chapter The fourth chapter studies bifurcations and chaos in time varying parametrically excited nonlinear dynamical systems The fifth chapter presents bifurcation analyses of modal interactions in distributed nonlinear dynamical systems of circular thin von Karman plates The theories methods and results presented in this book are of great interest to scientists and engineers in a wide range of disciplines This book can be adopted as references for mathematicians scientists engineers and graduate students conducting research in nonlinear dynamical systems

New Views for Difficult Problems Novel Ideas and Concepts Hilbert's 16th Problem Normal Forms in Polynomial Hamiltonian Systems Grazing Flow in Non smooth Dynamical Systems Stochastic and Fuzzy Nonlinear Dynamical Systems Fuzzy Bifurcation Parametrical Nonlinear Systems Mode Interactions in nonlinear dynamical systems

Normal Forms, Bifurcations and Finiteness Problems in Differential Equations Christiane Rousseau, Gert Sabidussi, 2004-02-29 Proceedings of the Nato Advanced Study Institute held in Montreal Canada from 8 to 19 July 2002

Elements of Applied Bifurcation Theory И. У. А. Александрович Кuznetsov, 1995-06-13 A solid basis for anyone studying the dynamical systems theory providing the necessary understanding of the approaches methods results and terminology used in the modern applied mathematics literature Covering the basic topics in the field the text can be used in a course on nonlinear dynamical systems or system theory Special attention is given to efficient numerical implementations of the developed techniques illustrated by several examples from recent research papers A moderate mathematical background is assumed and whenever possible only elementary mathematical tools are used making this book suitable for advanced undergraduate or graduate students in applied mathematics as well as for researchers in other disciplines who use dynamical systems as model tools in their studies

Investigation of Global Bifurcations in Planar Vector Fields John Guckenheimer, CORNELL UNIV ITHACA NY., 1988 The general area of the research has been the investigation of nonlinear dynamical systems and their bifurcations A number of different investigations of bifurcation in multiparameter systems of differential equations have been undertaken

- 1 The investigation of global bifurcations in planar vector fields In studying higher codimension bifurcations in models of chemical reactors it was necessary to study codimension two bifurcations involving the presence of homoclinic orbits for these systems A classification of codimension two bifurcations involving a single saddle point was constructed and applied to chemical reactor problems
- 2 The investigation of dynamical systems with symmetry groups A significant discovery is the occurrence of heteroclinic cycles that are structurally stable within the class of symmetric systems
- 3 The investigation of one dimensional mappings Attracting Cantor sets that occur at the limit of period doubling sequences of bifurcations have Lebesgue measure zero

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