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Numerical Bifurcation Analysis for Reaction-Diffusion Equations

Zhen Mei



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Numerical Bifurcation Analysis For Reactiondiffusion Equations

Rüdiger Seydel



Numerical Bifurcation Analysis For Reaction-Diffusion Equations:

Numerical Bifurcation Analysis for Reaction-Diffusion Equations Zhen Mei, 2000-06-21 This monograph is the first to provide readers with numerical tools for a systematic analysis of bifurcation problems in reaction diffusion equations Many examples and figures illustrate analysis of bifurcation scenario and implementation of numerical schemes Readers will gain a thorough understanding of numerical bifurcation analysis and the necessary tools for investigating nonlinear phenomena in reaction diffusion equations

Numerical Bifurcation Analysis for Reaction-Diffusion Equations Zhen Mei, 2013-03-09 Reaction diffusion equations are typical mathematical models in biology chemistry and physics These equations often depend on various parameters e.g temperature catalyst and diffusion rate etc Moreover they form normally a nonlinear dissipative system coupled by reaction among different substances The number and stability of solutions of a reaction diffusion system may change abruptly with variation of the control parameters Correspondingly we see formation of patterns in the system for example an onset of convection and waves in the chemical reactions This kind of phenomena is called bifurcation Nonlinearity in the system makes bifurcation take place constantly in reaction diffusion processes Bifurcation in turn induces uncertainty in outcome of reactions Thus analyzing bifurcations is essential for understanding mechanism of pattern formation and nonlinear dynamics of a reaction diffusion process However an analytical bifurcation analysis is possible only for exceptional cases This book is devoted to numerical analysis of bifurcation problems in reaction diffusion equations The aim is to pursue a systematic investigation of generic bifurcations and mode interactions of a class of reaction diffusion equations This is realized with a combination of three mathematical approaches numerical methods for continuation of solution curves and for detection and computation of bifurcation points effective low dimensional modeling of bifurcation scenario and long time dynamics of reaction diffusion equations analysis of bifurcation scenario mode interactions and impact of boundary conditions

Computational Science — ICCS 2004 Marian Bubak, Geert D. van Albada, Peter M.A. Sloot, Jack Dongarra, 2004-05-25 The International Conference on Computational Science ICCS 2004 held in Krakow Poland June 6-9 2004 was a follow up to the highly successful ICCS 2003 held at two locations in Melbourne Australia and St Petersburg Russia ICCS 2002 in Amsterdam The Netherlands and ICCS 2001 in San Francisco USA As computational science is still evolving in its quest for subjects of investigation and efficient methods ICCS 2004 was devised as a forum for scientists from mathematics and computer science as the basic computing disciplines and application areas interested in advanced computational methods for physics chemistry life sciences engineering arts and humanities as well as computer system vendors and software developers The main objective of this conference was to discuss problems and solutions in all areas to identify new issues to shape future directions of research and to help users apply various advanced computational techniques The event harvested recent developments in computational grids and next generation computing systems tools advanced numerical methods data driven systems and novel

application elds such as complex stems nance econo physics and population evolution Bifurcation Analysis of Fluid Flows
Henk A. Dijkstra,Fred W. Wubs,2023-08-24 A better understanding of the mechanisms leading a fluid system to exhibit turbulent behavior is one of the grand challenges of the physical and mathematical sciences Over the last few decades numerical bifurcation methods have been extended and applied to a number of flow problems to identify critical conditions for fluid instabilities to occur This book provides a state of the art account of these numerical methods with much attention to modern linear systems solvers and generalized eigenvalue solvers These methods also have a broad applicability in industrial environmental and astrophysical flows The book is a must have reference for anyone working in scientific fields where fluid flow instabilities play a role Exercises at the end of each chapter and Python code for the bifurcation analysis of canonical fluid flow problems provide practice material to get to grips with the methods and concepts presented in the book

Practical Bifurcation and Stability Analysis Rüdiger Seydel,2009-12-14 Probably the first book to describe computational methods for numerically computing steady state and Hopf bifurcations Requiring only a basic knowledge of calculus and using detailed examples problems and figures this is an ideal textbook for graduate students **Patterns of Dynamics** Pavel Gurevich,Juliette Hell,Björn Sandstede,Arnd Scheel,2018-02-07 Theoretical advances in dynamical systems theory and their applications to pattern forming processes in the sciences and engineering are discussed in this volume that resulted from the conference Patterns in Dynamics held in honor of Bernd Fiedler in Berlin July 25 29 2016 The contributions build and develop mathematical techniques and use mathematical approaches for prediction and control of complex systems The underlying mathematical theories help extract structures from experimental observations and conversely shed light on the formation dynamics and control of spatio temporal patterns in applications Theoretical areas covered include geometric analysis spatial dynamics spectral theory traveling wave theory and topological data analysis also discussed are their applications to chemotaxis self organization at interfaces neuroscience and transport processes

Combustion Thermodynamics and Dynamics Joseph M. Powers,2016-04-18 Combustion Thermodynamics and Dynamics builds on a foundation of thermal science chemistry and applied mathematics that will be familiar to most undergraduate aerospace mechanical and chemical engineers to give a first year graduate level exposition of the thermodynamics physical chemistry and dynamics of advection reaction diffusion Special effort is made to link notions of time independent classical thermodynamics with time dependent reactive fluid dynamics In particular concepts of classical thermochemical equilibrium and stability are discussed in the context of modern nonlinear dynamical systems theory The first half focuses on time dependent spatially homogeneous reaction while the second half considers effects of spatially inhomogeneous advection and diffusion on the reaction dynamics Attention is focused on systems with realistic detailed chemical kinetics as well as simplified kinetics Many mathematical details are presented and several quantitative examples are given Topics include foundations of thermochemistry reduced kinetics reactive Navier Stokes equations reaction diffusion systems laminar flame

oscillatory combustion and detonation *Computational Modelling of Bifurcations and Instabilities in Fluid Dynamics*
 Alexander Gelfgat, 2018-07-06 Instabilities of fluid flows and the associated transitions between different possible flow states provide a fascinating set of problems that have attracted researchers for over a hundred years This book addresses state of the art developments in numerical techniques for computational modelling of fluid instabilities and related bifurcation structures as well as providing comprehensive reviews of recently solved challenging problems in the field **Elliptic Partial Differential Equations** Vitaly Volpert, 2014-05-10 If we had to formulate in one sentence what this book is about it might be How partial differential equations can help to understand heat explosion tumor growth or evolution of biological species These and many other applications are described by reaction diffusion equations The theory of reaction diffusion equations appeared in the first half of the last century In the present time it is widely used in population dynamics chemical physics biomedical modelling The purpose of this book is to present the mathematical theory of reaction diffusion equations in the context of their numerous applications We will go from the general mathematical theory to specific equations and then to their applications Existence stability and bifurcations of solutions will be studied for bounded domains and in the case of travelling waves The classical theory of reaction diffusion equations and new topics such as nonlocal equations and multi scale models in biology will be considered 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

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