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Numerical Methods for Bifurcation Problems and Large-Scale Dynamical Systems

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Numerical Methods For Bifurcation Problems And Large Scale Dynamical Systems

Carlos Castillo-Chavez,Sally Blower,Pauline van den Driessche,Denise Kirschner,Abdul-Aziz Yakubu

Numerical Methods For Bifurcation Problems And Large Scale Dynamical Systems:

Numerical Methods for Bifurcation Problems and Large-Scale Dynamical Systems Eusebius Doedel,Laurette S Tuckerman,2000-03-17 Numerical Methods for Bifurcation Problems and Large-scale Dynamical Systems Eusebius Doedel,Laurette S. Tuckerman,2000 The Institute for Mathematics and its Applications IMA devoted its 1997 1998 program to Emerging Applications of Dynamical Systems Dynamical systems theory and related numerical algorithms provide powerful tools for studying the solution behavior of differential equations and mappings In the past 25 years computational methods have been developed for calculating fixed points limit cycles and bifurcation points A remaining challenge is to develop robust methods for calculating more complicated objects such as higher codimension bifurcations of fixed points periodic orbits and connecting orbits as well as the calcuation of invariant manifolds Another challenge is to extend the applicability of algorithms to the very large systems that result from discretizing partial differential equations Even the calculation of steady states and their linear stability can be prohibitively expensive for large systems e g 10_3 10_6 equations if attempted by simple direct methods Several of the papers in this volume treat computational methods for low and high dimensional systems and in some cases their incorporation into software packages A few papers treat fundamental theoreti

Numerical Methods for Bifurcation Problems and Large-Scale Dynamical Systems Eusebius Doedel,Laurette S. Tuckerman,2012-12-06 The Institute for Mathematics and its Applications IMA devoted its 1997 1998 program to Emerging Applications of Dynamical Systems Dynamical systems theory and related numerical algorithms provide powerful tools for studying the solution behavior of differential equations and mappings In the past 25 years computational methods have been developed for calculating fixed points limit cycles and bifurcation points A remaining challenge is to develop robust methods for calculating more complicated objects such as higher codimension bifurcations of fixed points periodic orbits and connecting orbits as well as the calcuation of invariant manifolds Another challenge is to extend the applicability of algorithms to the very large systems that result from discretizing partial differential equations Even the calculation of steady states and their linear stability can be prohibitively expensive for large systems e g 10_3 10_6 equations if attempted by simple direct methods Several of the papers in this volume treat computational methods for low and high dimensional systems and in some cases their incorporation into software packages A few papers treat fundamental theoretical problems including smooth factorization of matrices self organized criticality and unfolding of singular heteroclinic cycles Other papers treat applications of dynamical systems computations in various scientific fields such as biology chemical engineering fluid mechanics and mechanical engineering 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 *Wireless Communications* Prathima Agrawal,Matthew D. Andrews,Philip J. Fleming,G. George Yin,Lisa Zhang,2010-05-05 This volume contains papers based on invited talks given at the 2005 IMA Summer Workshop on Wireless Communications held at the Institute for Mathematics and Its Applications University of Minnesota June 22 July 1 2005 It presents some of the highlights of the workshop and collects papers covering a broad spectrum of important and pressing issues in wireless communications **Compatible Spatial Discretizations** Douglas N. Arnold,Pavel B. Bochev,Richard B. Lehoucq,Roy A. Nicolaides,Mikhail Shashkov,2007-01-26 The IMA Hot Topics workshop on compatible spatialdiscretizations was held in 2004 This volume contains original contributions based on the material presented there A unique feature is the inclusion of work that is representative of the recent developments in compatible discretizations across a wide spectrum of disciplines in computational science Abstracts and presentation slides from the workshop can be accessed on the internet

Spectral/hp Element Methods for Computational Fluid Dynamics George Karniadakis,Spencer Sherwin,2013-01-10 Completely revised and expanded new edition covering the recent and significant progress in multi domain spectral methods at both the fundamental and application level Written by leading experts it is a must have for students academics and practitioners in computational fluid mechanics and related fields *Mathematical Approaches for Emerging and Reemerging Infectious Diseases: Models, Methods, and Theory* Carlos Castillo-Chavez,Sally Blower,Pauline van den Driessche,Denise Kirschner,Abdul-Aziz Yakubu,2012-12-06 This IMA Volume in Mathematics and its Applications MATHEMATICAL APPROACHES FOR EMERGING AND REEMERGING INFECTIOUS DISEASES MODELS AND THEORY METHODS is based on the proceedings of a successful one week workshop The pro ceedings of the two day tutorial which preceded the workshop Introduction to Epidemiology and Immunology appears as IMA Volume 125 Math ematical Approaches for Emerging and Reemerging Infectious Diseases An Introduction The tutorial and the workshop are integral parts of the September 1998 to June 1999 IMA program on MATHEMATICS IN BI OLOGY I would like to thank Carlos

Castillo Chavez Director of the Math ematical and Theoretical Biology Institute and a member of the Depart ments of Biometrics Statistics and Theoretical and Applied Mechanics Cornell University Sally M Blower Biomathematics UCLA School of Medicine Pauline van den Driessche Mathematics and Statistics Uni versity of Victoria and Denise Kirschner Microbiology and Immunology University of Michigan Medical School for their superb roles as organizers of the meetings and editors of the proceedings Carlos Castillo Chavez es pecially made a major contribution by spearheading the editing process I am also grateful to Kenneth L Cooke Mathematics Pomona College for being one of the workshop organizers and to Abdul Aziz Yakubu Mathe matics Howard University for serving as co editor of the proceedings I thank Simon A Levin Ecology and Evolutionary Biology Princeton Uni versity for providing an introduction **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 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 *Codes, Systems, and Graphical Models* Brian Marcus,Joachim Rosenthal,2012-12-06 Coding theory system theory and symbolic dynamics have much in common Among the central themes in each of these subjects are the construction of state space representations understanding of fundamental structural properties of sequence spaces construction of input output systems and understanding the special role played by algebraic structure A major new theme in this area of research is that of codes and systems based on graphical models This volume contains survey and research articles from leading researchers at the interface of these subjects **Resource Recovery, Confinement, and Remediation of Environmental Hazards** John Chadam,Al Cunningham,Richard E. Ewing,Peter Ortoleva,Mary F. Wheeler,2012-12-06 This IMA Volume in Mathematics and its Applications RESOURCE RECOVERY CONFINEMENT AND REMEDIATION OF ENVIRONMENTAL HAZARDS contains papers presented at two successful one week workshops Confine ment and Remediation of Environmental Hazards held on January 15 19 2000 and Resource Recovery February 9 13 2000 Both workshops were integral parts of the IMA annual program on Mathematics in Reactive Flow and Transport Phenomena

1999 2000 We would like to thank John Chadam University of Pittsburgh Al Cunningham Montana State Uni versity Richard E Ewing Texas A M University Peter Ortoleva In diana University and Mary Fanett Wheeler TICAM The University of Texas at Austin for their excellent work as organizers of the meetings and for editing the proceedings We take this opportunity to thank the National Science Foundation for their support of the IMA Series Editors Douglas N Arnold Director of the IMA Fadil Santosa Deputy Director of the IMA v PREFACE Advances in resource recovery and confinement remediation of envi ronmental hazards requires a coordinated interdisciplinary effort involving mathematicians scientists and engineers The intent of this collection of papers is to summarize recent theoretical computational and experimen tal advances in the theory of phenomena in porous media with the intent to identify similarities and differences concerning applications related to both resource recovery and confinement and remediation of environmental hazards Membrane Transport and Renal Physiology Harold E. Layton,Alan M. Weinstein,2002-08-06 The papers in this volume arose out of the workshop Membrane Transport and Renal Physiology which was conducted as part of the IMA 1998 1999 program year Mathematics in Biology The workshop brought together physiologists biophysicists and applied mathematicians who share a common interest in solute and water transport in biological systems especially in the integrated function of the kidney Solute and water transport through cells involves fluxes across two cell membranes usually via specialized proteins that are integral membrane components By means of mathematical representations transport fluxes can be related to transmembrane solute concentrations and electrochemical driving forces At the next level of functional integration these representations can serve as key components for models of renal transcellular transport Ultimately simulations can be developed for transport dependent aspects of overall renal function Workshop topics included solute fluxes through ion channels cotransporters and metabolically driven ion pumps transport across fiber matrix and capillary membranes coordinated transport by renal epithelia the urine concetrating mechanism and intra renal hemodynamic control This volume will be of interest to biological and mathematical scientists who would like a view of recent mathematical efforts to represent membrane transport and its role in renal function Decision Making Under Uncertainty Claude Greengard,Andrzej Ruszczynski,2012-12-06 In the ideal world major decisions would be made based on complete and reliable information available to the decision maker We live in a world of uncertainties and decisions must be made from information which may be incomplete and may contain uncertainty The key mathematical question addressed in this volume is how to make decision in the presence of quantifiable uncertainty The volume contains articles on model problems of decision making process in the energy and power industry when the available information is noisy and or incomplete The major tools used in studying these problems are mathematical modeling and optimization techniques especially stochastic optimization These articles are meant to provide an insight into this rapidly developing field which lies in the intersection of applied statistics probability operations research and economic theory It is hoped that the present volume will provide entry to newcomers into the field and stimulation for further research

Mathematical Approaches for Emerging and Reemerging Infectious Diseases: An Introduction Carlos Castillo-Chavez,2002-05-02 This book grew out of the discussions and presentations that began during the Workshop on Emerging and Reemerging Diseases May 17 21 1999 sponsored by the Institute for Mathematics and its Application IMA at the University of Minnesota with the support of NIH and NSF The workshop started with a two day tutorial session directed at ecologists epidemiologists immunologists mathematicians and scientists interested in the study of disease dynamics The core of this first volume Volume 125 covers tutorial and research contributions on the use of dynamical systems deterministic discrete delay PDEs and ODEs models and stochastic models in disease dynamics The volume includes the study of cancer HIV pertussis and tuberculosis Beginning graduate students in applied mathematics scientists in the natural social or health sciences or mathematicians who want to enter the fields of mathematical and theoretical epidemiology will find this book useful Atmospheric Modeling David P. Chock,Gregory R. Carmichael,2002-07-31 This volume contains refereed papers submitted by international experts who participated in the Atmospheric Modeling workshop March 15 19 2000 at the Institute for Mathematics and Its Applications IMA at the University of Minnesota The papers cover a wide range of topics presented in the workshop In particular mathematical topics include a performance comparison of operator splitting and non splitting methods time stepping methods to preserve positivity and consideration of multiple timescale issues in the modeling of atmospheric chemistry a fully 3D adaptive grid method impact of rid resolution on model predictions testing the robustness of different flow fields modeling and numerical methods in four dimensional variational data assimilation and parallel computing Modeling topics include the development of an efficient self contained global circulation chemistry transport model and its applications the development of a modal aerosol model and the modeling of the emissions and chemistry of monoterpenes that lead to the formation of secondary organic aerosols The volume provides an excellent cross section of current research activities in atmospheric modeling Mathematics of the Internet Brenda Dietrich,Rakesh V. Vohra,Patricia Brick,2001-12-14 The use of the internet for commerce has spawned a variety of auctions marketplaces and exchanges for trading everything from bandwidth to books Mechanisms for bidding agents dynamic pricing and combinatorial bids are being implemented in support of internet based auctions giving rise to new versions of optimization and resource allocation models This volume a collection of papers from an IMA Hot Topics workshop in internet auctions includes descriptions of real and proposed auctions complete with mathematical model formulations theoretical results solution approaches and computational studies This volume also provides a mathematical programming perspective on open questions in auction theory and provides a glimpse of the growing area of dynamic pricing *Fractals in Multimedia* Michael F. Barnsley,Dietmar Saupe,Edward R. Vrscay,2002-09-10 This IMA Volume in Mathematics and its Applications FRACTALS IN MULTIMEDIA is a result of a very successful three day minisymposium on the same title The event was an integral part of the IMA annual program on Mathemat ics in Multimedia 2000 2001 We would like to thank Michael F

Barnsley Department of Mathematics and Statistics University of Melbourne Di etmar Saupe Institut fUr Informatik UniversiUit Leipzig and Edward R Vrscay Department of Applied Mathematics University of Waterloo for their excellent work as organizers of the meeting and for editing the proceedings We take this opportunity to thank the National Science Foundation for their support of the IMA Series Editors Douglas N Arnold Director of the IMA Fadil Santosa Deputy Director of the IMA v PREFACE This volume grew out of a meeting on Fractals in Multimedia held at the IMA in January 2001 The meeting was an exciting and intense one focused on fractal image compression analysis and synthesis iterated function systems and fractals in education The central concerns of the meeting were to establish within these areas where we are now and to develop a vision for the future *Modern Methods in Scientific Computing and Applications* Anne Bourlioux,Martin Gander,2012-12-06 When we first heard in the spring of 2000 that the Seminaire de matMmatiques superieures SMS was interested in devoting its session of the summer of 200l its 40th to scientific computing the idea of taking on the organizational work seemed to us somewhat remote More immediate things were on our minds one of us was about to go on leave to the Courant Institute the other preparing for a research summer in Paris But the more we learned about the possibilities of such a seminar the support for the organization and also the great history of the SMS the more we grew attached to the project The topics we planned to cover were intended to span a wide range of theoretical and practical tools for solving problems in image processing thin films mathematical finance electrical engineering moving interfaces and combustion These applications alone show how wide the influence of scientific computing has become over the last two decades almost any area of science and engineering is greatly influenced by simulations and the SMS workshop in this field came very timely We decided to organize the workshop in pairs of speakers for each of the eight topics we had chosen and we invited the leading experts worldwide in these fields We were very fortunate that every speaker we invited accepted to come so the program could be realized as planned *Nonlinear Conservation Laws and Applications* Alberto Bressan,Gui-Qiang G. Chen,Marta Lewicka,Dehua Wang,2011-04-19 This volume contains the proceedings of the Summer Program on Nonlinear Conservation Laws and Applications held at the IMA on July 13 31 2009 Hyperbolic conservation laws is a classical subject which has experienced vigorous growth in recent years The present collection provides a timely survey of the state of the art in this exciting field and a comprehensive outlook on open problems Contributions of more theoretical nature cover the following topics global existence and uniqueness theory of one dimensional systems multidimensional conservation laws in several space variables and approximations of their solutions mathematical analysis of fluid motion stability and dynamics of viscous shock waves singular limits for viscous systems basic principles in the modeling of turbulent mixing transonic flows past an obstacle and a fluid dynamic approach for isometric embedding in geometry models of nonlinear elasticity the Monge problem and transport equations with rough coefficients In addition there are a number of papers devoted to applications These include models of blood flow self gravitating compressible fluids granular flow charge

transport in fluids and the modeling and control of traffic flow on networks

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