THE IMA VOLUMES IN MATHEMATICS AND ITS APPLICATIONS VOLUME 115

Martin Golubitsky Dan Luss
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Editors

Pattern Formation in Continuous and Coupled Systems

A Survey Volume

Springer

Pattern Formation In Continuous And Coupled Systems A Survey Volume

Christopher K.R.T. Jones,Alexander I. Khibnik

Pattern Formation In Continuous And Coupled Systems A Survey Volume:

Pattern Formation in Continuous and Coupled Systems Martin Golubitsky,Dan Luss,Steven H. Strogatz,1999-06-22 Systems that generate new types of pattern such as discrete coupled systems systems with global coupling and combustion experiments were stressed as were new types of pattern BOOK JACKET **Pattern Formation in Continuous and Coupled Systems** Martin Golubitsky,Dan Luss,Steven H Strogatz,1999-06-01 **Pattern Formation in Continuous and Coupled Systems** Martin Golubitsky,Dan Luss,Steven H. Strogatz,2012-12-06 This IMA Volume in Mathematics and its Applications PATTERN FORMATION IN CONTINUOUS AND COUPLED SYSTEMS is based on the proceedings of a workshop with the same title but goes be yond the proceedings by presenting a series of mini review articles that sur vey and provide an introduction to interesting problems in the field The workshop was an integral part of the 1997 98 IMA program on EMERG ING APPLICATIONS OF DYNAMICAL SYSTEMS I would like to thank Martin Golubitsky University of Houston Math ematics Dan Luss University of Houston Chemical Engineering and Steven H Strogatz Cornell University Theoretical and Applied Mechan ics for their excellent work as organizers of the meeting and for editing the proceedings I also take this opportunity to thank the National Science Foundation NSF and the Army Research Office ARO whose financial support made the workshop possible Willard Miller Jr Professor and Director v PREFACE Pattern formation has been studied intensively for most of this cen tury by both experimentalists and theoreticians and there have been many workshops and conferences devoted to the subject In the IMA workshop on Pattern Formation in Continuous and Coupled Systems held May 11 15 1998 we attempted to focus on new directions in the patterns literature *Mathematical Models for Biological Pattern Formation* Philip K. Maini,Hans G. Othmer,2012-12-06 This 121st IMA volume entitled MATHEMATICAL MODELS FOR BIOLOGICAL PATTERN FORMATION is the first of a new series called FRONTIERS IN APPLICATION OF MATHEMATICS The FRONTIERS volumes are motivated by IMA pro grams and workshops but are specially planned and written to provide an entree to and assessment of exciting new areas for the application of mathematical tools and analysis The emphasis in FRONTIERS volumes is on surveys exposition and outlook to attract more mathematicians and other scientists to the study of these areas and to focus efforts on the most important issues rather than papers on the most recent research results aimed at an audience of specialists The present volume of peer reviewed papers grew out of the 1998 99 IMA program on Mathematics in Biology in particular the Fall 1998 em phasis on Theoretical Problems in Developmental Biology and Immunol ogy During that period there were two workshops on Pattern Formation and Morphogenesis organized by Professors Murray Maini and Othmer James Murray was one of the principal organizers for the entire year pro gram I am very grateful to James Murray for providing an introduction and to Philip Maini and Hans Othmer for their excellent work in planning and preparing this first FRONTIERS volume I also take this opportunity to thank the National Science Foundation whose financial support of the IMA made the Mathematics in Biology pro gram possible *Symmetries and Overdetermined Systems of Partial*

Differential Equations Michael Eastwood,Willard Miller,2009-04-23 This three week summer program considered the symmetries preserving various natural geometric structures There are two parts to the proceedings The articles in the first part are expository but all contain significant new material The articles in the second part are concerned with original research All articles were thoroughly refereed and the range of interrelated work ensures that this will be an extremely useful collection **Deterministic Learning Theory for Identification, Recognition, and Control** Cong Wang,David J. Hill,2018-10-03 Deterministic Learning Theory for Identification Recognition and Control presents a unified conceptual framework for knowledge acquisition representation and knowledge utilization in uncertain dynamic environments It provides systematic design approaches for identification recognition and control of linear uncertain systems Unlike many books currently available that focus on statistical principles this book stresses learning through closed loop neural control effective representation and recognition of temporal patterns in a deterministic way A Deterministic View of Learning in Dynamic Environments The authors begin with an introduction to the concepts of deterministic learning theory followed by a discussion of the persistent excitation property of RBF networks They describe the elements of deterministic learning and address dynamical pattern recognition and pattern based control processes The results are applicable to areas such as detection and isolation of oscillation faults ECG EEG pattern recognition robot learning and control and security analysis and control of power systems A New Model of Information Processing This book elucidates a learning theory which is developed using concepts and tools from the discipline of systems and control Fundamental knowledge about system dynamics is obtained from dynamical processes and is then utilized to achieve rapid recognition of dynamical patterns and pattern based closed loop control via the so called internal and dynamical matching of system dynamics This actually represents a new model of information processing i e a model of dynamical parallel distributed processing DPDP **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 *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 *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 **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 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 Dynamical Systems* Christopher K.R.T. Jones,Alexander I. Khibnik,2012-12-06 Systems with sub processes evolving on many different time scales are ubiquitous in applications chemical reactions electro optical and neuro biological systems to name just a few This volume contains papers that expose the state of the art in mathematical techniques for analyzing such systems Recently developed geometric ideas are highlighted in this work that includes a theory of relaxation oscillation phenomena in higher dimensional phase spaces Subtle exponentially small effects result from singular perturbations implicit in certain multiple time scale systems Their role in the slow motion of fronts bifurcations and jumping between invariant tori are all explored here Neurobiology has played a particularly stimulating role in the development of these techniques and one paper is directed specifically at applying geometric singular perturbation theory to reveal the synchrony in networks of neural oscillators

Parallel Solution of Partial Differential Equations Petter Bjorstad,Mitchell Luskin,2012-12-06 This IMA Volume in Mathematics and its Applications PARALLEL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS is based on the proceedings of a workshop with the same title The work shop was an integral part of the 1996 97IMA program on MATHEMAT ICS IN HIGH PERFORMANCE COMPUTING I would like to thank Petter Bj0rstad of the Institutt for Informatikk University of Bergen and Mitchell Luskin of the School of Mathematics University of Minnesota for their excellent work as organizers of the meeting and for editing the proceedings I also take this opportunity to thank the National Science Founda tion NSF Department of Energy DOE and the Army Research Office ARO whose financial support made the workshop

possible Willard Miller Jr Professor and Director v PREFACE The numerical solution of partial differential equations has been of major importance to the development of many technologies and has been the target of much of the development of parallel computer hardware and software Parallel computers offer the promise of greatly increased perfor mance and the routine calculation of previously intractable problems The papers in this volume were presented at the IMA workshop on the Paral lel Solution of PDE held during June 9 13 1997 The workshop brought together leading numerical analysts computer scientists and engineers to assess the state of the art and to consider future directions **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 *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

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 **Towards Higher Categories** John C. Baez,J. Peter May,2009-09-23 This IMA Volume in Mathematics and its Applications TOWARDS HIGHER CATEGORIES contains expository and research papers based on a highly successful IMA Summer Program on n Categories Foundations and Applications We are grateful to all the participants for making this occasion a very productive and stimulating one We would like to thank John C Baez Department of Mathematics University of California Riverside and J Peter May Department of Ma ematics University of Chicago for their superb role as summer program organizers and editors of this volume We take this opportunity to thank the National Science Foundation for its support of the IMA Series Editors Fadil Santosa Director of the IMA Markus Keel Deputy Director of the IMA v PREFACE DEDICATED TO MAX KELLY JUNE 5 1930 TO JANUARY 26 2007 This is not a proceedings of the 2004 conference n Categories Fo dations and Applications that we organized and ran at the IMA during the two weeks June 7 18 2004 We thank all the participants for helping make that a vibrant and inspiring occasion We also thank the IMA sta for a magni cent job There has been a great deal of work in higher c egory theory since then but we still feel that it is not yet time to o er a volume devoted to the main topic of the conference **Colloidal Magnetic Fluids** Stefan Odenbach,2009-04-07 Research into the fascinating properties and applications of magnetic fluids also called ferrofluids is rapidly growing making it necessary to provide at regular intervals a coherent and tutorial account of the combined theoretical and experimental advances in the field This volume is an outgrow of seven years of research by some 30 interdisciplinary groups of scientists theoretical physicists describing the behaviour of such complex fluids chemical engineers synthesizing nanosize magnetic particles experimentalist measuring the fluid properties and mechanical engineers exploring the many applications such fluids offer in turn providing application guided feedback to the modellers and requests for the preparation of new fluid types to chemists in particular those providing optimum response to given magnetic field configurations Moreover recent developments towards biomedical applications widens this spectrum to include medicine and pharmacology Consisting of six large chapters on synthesis and characterization thermo and electrodynamics surface instabilities structure and rheology biomedical applications as well as engineering and technical applications this work is both a unique source of reference for anyone working in the field and a suitable introduction for newcomers to the field *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

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