

Oscillations and Traveling Waves in Chemical Systems

Richard J. Field Maria Burger

Oscillations And Traveling Waves In Chemical Systems

Stephen K. Scott



Oscillations And Traveling Waves In Chemical Systems:

Oscillations and Traveling Waves in Chemical Systems RJ Field (ed), 1985 *Oscillations and Traveling Waves in Chemical Systems* Maria Burger, 1985-04-02 Brings together in one comprehensive volume information on oscillating chemical systems and their experimental behavior As the first major work in this area it details their mechanistic interpretation and relationship to theories of oscillatory and related behavior Topics discussed include the mathematical aspects of temporal oscillations in reacting systems chemical oscillators based on iodate ion and hydrogen peroxide numerical techniques for modeling and analysis oscillating reactions halogen based oscillators in a flow reactor periodically perturbed chemical systems and the structure and variety of chemical waves **Chemical Waves and Patterns** Raymond Kapral, K. Showalter, 2012-12-06 The concept of macroscopic waves and patterns developing from chemical reaction coupling with diffusion was presented apparently for the first time at the Main Meeting of the Deutsche Bunsengesellschaft für Angewandte Physikalische Chemie held in Dresden Germany from May 21 to 24 1906 Robert Luther Director of the Physical Chemistry Laboratory in Leipzig read his paper on the discovery and analysis of propagating reaction diffusion fronts in autocatalytic chemical reactions 1 2 He presented an equation for the velocity of these new waves $V = \frac{1}{2} \sqrt{D \cdot k}$ and asserted that they might have features in common with propagating action potentials in nerve cell axons During the discussion period a skeptic in the audience voiced his objections to this notion It was none other than the great physical chemist Walther Nernst who believed that nerve impulse propagation was far too rapid to be akin to the propagating fronts He was also not willing to accept Luther's wave velocity equation without a derivation Luther stood his ground saying his equation was a simple consequence of the corresponding differential equation He described several different autocatalytic reactions that exhibit propagating fronts recommending gelling the solution to prevent convection and even presented a demonstration the autocatalytic permanganate oxidation of oxalate was carried out in a test tube with the image of the front projected onto a screen for the audience *Chaos in Chemistry and Biochemistry* Richard J. Field, László Györgyi, 1993 True deterministic chaos is characterized by unpredictable apparently random motion in a dynamical system completely described by a deterministic dynamic law usually a nonlinear differential equation with no stochastic component The inability to predict future behavior of a chaotic system occurs because trajectories evolving from arbitrarily close initial conditions diverge Chaos is universal as it may arise in any system governed by one of a class of quite common suitable nonlinear dynamic laws This book discusses both the experimental observation and theoretical interpretation of chaos in chemical and biochemical systems Examples are drawn from the Belousov Zhabotinsky reaction surface reactions electrochemical reactions enzyme reactions and periodically perturbed oscillating systems Nonlinear Oscillations in Biology and Chemistry Hans G. Othmer, 2013-03-08 This volume contains the proceedings of a meeting entitled Nonlinear Oscillations in Biology and Chemistry which was held at the University of Utah May 9 11 1985 The papers fall into four major categories i those that

deal with biological problems particularly problems arising in cell biology ii those that deal with chemical systems iii those that treat problems which arise in neurophysiology and iv those whose primary emphasis is on more general models and the mathematical techniques involved in their analysis Except for the paper by Auchmuty all are based on talks given at the meeting The diversity of papers gives some indication of the scope of the meeting but the printed word conveys neither the degree of interaction between the participants nor the intellectual sparks generated by that interaction The meeting was made possible by the financial support of the Department of Mathematics of the University of Utah I am indebted to Ms Toni Bunker of the Department of Mathematics for her very able assistance on all manner of details associated with the organization of the meeting Finally a word of thanks to all participants for their contributions to the success of the meeting and to the contributors to this volume for their efforts in preparing their manuscripts

Encyclopedia of Physical Organic Chemistry, 6 Volume Set Zerong Wang, Uta Wille, Eusebio Juaristi, 2017-04-17 Winner of 2018 PROSE Award for MULTIVOLUME REFERENCE SCIENCE This encyclopedia offers a comprehensive and easy reference to physical organic chemistry POC methodology and techniques It puts POC a classical and fundamental discipline of chemistry into the context of modern and dynamic fields like biochemical processes materials science and molecular electronics Covers basic terms and theories into organic reactions and mechanisms molecular designs and syntheses tools and experimental techniques and applications and future directions Includes coverage of green chemistry and polymerization reactions Reviews different strategies for molecular design and synthesis of functional molecules Discusses computational methods software packages and more than 34 kinds of spectroscopies and techniques for studying structures and mechanisms Explores applications in areas from biology to materials science The Encyclopedia of Physical Organic Chemistry has won the 2018 PROSE Award for MULTIVOLUME REFERENCE SCIENCE The PROSE Awards recognize the best books journals and digital content produced by professional and scholarly publishers Submissions are reviewed by a panel of 18 judges that includes editors academics publishers and research librarians who evaluate each work for its contribution to professional and scholarly publishing You can find out more at proseawards.com Also available as an online edition for your library for more details visit Wiley Online Library

Chemical Chaos Stephen K. Scott, 1993 This valuable account of chemical chaos now available in paperback reviews both theory and experiment emphasizing the simple features that combine to produce order within disorder The author begins by revealing the links between chemical kinetics and the interdisciplinary subject of dynamical systems Various bifurcation sequences are then introduced through representative model schemes with the emphasis on generality and simplicity Chaos arises in both conventional chemical reactions and forced or coupled systems and both are considered here Various experimental and diagnostic techniques to test for chaos are then described and the remaining chapters review experimental studies in a wide range of chemical and biochemical systems

Far-from-equilibrium Dynamics of Chemical Systems, 1994 Reaction-Transport Systems Vicenc Mendez, Sergei Fedotov, Werner Horsthemke, 2010-06-10 This book is

an introduction to the dynamics of reaction diffusion systems with a focus on fronts and stationary spatial patterns Emphasis is on systems that are non standard in the sense that either the transport is not simply classical diffusion Brownian motion or the system is not homogeneous A important feature is the derivation of the basic phenomenological equations from the mesoscopic system properties Topics addressed include transport with inertia described by persistent random walks and hyperbolic reaction transport equations and transport by anomalous diffusion in particular subdiffusion where the mean square displacement grows sublinearly with time In particular reaction diffusion systems are studied where the medium is in turn either spatially inhomogeneous compositionally heterogeneous or spatially discrete Applications span a vast range of interdisciplinary fields and the systems considered can be as different as human or animal groups migrating under external influences population ecology and evolution complex chemical reactions or networks of biological cells Several chapters treat these applications in detail

Chemical and Biological Processes in Fluid Flows Zolt n Neufeld,2010 Many chemical and biological processes take place in fluid environments in constant motion OCo chemical reactions in the atmosphere biological population dynamics in the ocean chemical reactors combustion and microfluidic devices Applications of concepts from the field of nonlinear dynamical systems have led to significant progress over the last decade in the theoretical understanding of complex phenomena observed in such systems This book introduces the theoretical approaches for describing mixing and transport in fluid flows It reviews the basic concepts of dynamical phenomena arising from the nonlinear interactions in chemical and biological systems The coverage includes a comprehensive overview of recent results on the effect of mixing on spatial structure and the dynamics of chemically and biologically active components in fluid flows in particular oceanic plankton dynamics Sample Chapter s Chapter 1 Fluid Flows 248 KB Contents Fluid Flows Mixing and Dispersion in Fluid Flows Chemical and Ecological Models Reaction Diffusion Dynamics Fast Binary Reactions and the Lamellar Approach Decay Type and Stable Reaction Dynamics in Flows Mixing in Autocatalytic Type Processes Mixing in Oscillatory Media Further Reading Readership Physicists applied mathematicians chemical engineers and marine ecologists

Reflexive Polymers and Hydrogels Nobuhiko Yui,Randall J. Mrsny,Kinam Park,2004-03-17 Despite their capacity to carry out functions that previously were unobtainable smart polymers and hydrogels tend to have painfully slow response times On the other hand biological systems go through phase changes at an extremely fast rate Reflexive Polymers and Hydrogels examines the natural systems that respond almost instantaneously to envi *Engineering of Chemical Complexity* Alexander S. Mikhailov,Gerhard Ertl,2013 This review volume co edited by Nobel laureate G Ertl provides a broad overview on current studies in the understanding of design and control of complex chemical systems of various origins on scales ranging from single molecules and nano phenomena to macroscopic chemical reactors Self organizational behavior and the emergence of coherent collective dynamics in reaction diffusion systems reactive soft matter and chemical networks are covered Special attention is paid to the applications in molecular cell biology and to the problems of biological evolution synthetic biology and

design of artificial living cells Starting with a detailed introduction on the history of research on complex chemical systems its current state of the art and perspectives the book comprises 19 chapters that survey the current progress in particular research fields The reviews prepared by leading international experts yield together a fascinating picture of a rapidly developing research discipline that brings chemical engineering to new frontiers **Autosolitons** B.S. Kerner,V.V. Osipov,2013-06-29 This monograph is devoted to an entirely new branch of nonlinear physics solitary intrinsic states or autosolitons which form in a broad class of physical chemical and biological dissipative systems Autosolitons are often observed as highly nonequilibrium regions in slightly nonequilibrium systems in many ways resembling ball lightning which occurs in the atmosphere We develop a new approach to problems of self organization and turbulence treating these phenomena as a result of spontaneous formation and subsequent evolution of autosolitons Scenarios of self organization involve sophisticated interactions between autosolitons whereas turbulence is regarded as a pattern of autosolitons which appear and disappear at random in different parts of the system This monograph is the first attempt to provide a comprehensive summary of the theory of autosolitons as developed by the authors over the years of research The monograph is comprised of three more or less autonomous parts Part I deals with the physical nature and experimental studies of autosolitons and self organization in various physical systems semiconductor and gas plasma heated gas mixture semiconductor structures composite superconductors optical and magnetic media systems with uniformly generated combustion matter distributed gas discharge and electronic systems We discuss feasibility of autosolitons in the form of highly nonequilibrium regions in slightly nonequilibrium gases and semiconductors hot and cold regions in semiconductor and gas plasmas static pulsating and traveling combustion fronts Nonlinear Wave Processes in Excitable Media Arunn V. Holden,Mario Markus,Hans G. Othmer,2013-12-21 Proceedings of a NATO ARW held in Leeds UK September 11 15 1989

Frontiers in Mathematical Biology Simon A. Levin,2013-03-13 From a mathematical point of view physiologically structured population models are an underdeveloped branch of the theory of infinite dimensional dynamical systems We have called attention to four aspects i A choice has to be made about the kind of equations one extracts from the predominantly verbal arguments about the basic assumptions and subsequently uses as a starting point for a rigorous mathematical analysis Though differential equations are easy to formulate different mechanisms don t interact in infinitesimal time intervals and so end up as separate terms in the equations they may be hard to interpret rigorously as infinitesimal generators Integral equations constitute an attractive alternative ii The ability of physiologically structured population models to increase our understanding of the relation between mechanisms at the i level and phenomena at the p level will depend strongly on the development of dynamical systems lab facilities which are applicable to this class of models iii Physiologically structured population models are ideally suited for the formulation of evolutionary questions Apart from the special case of age see Charlesworth 1980 Yodzis 1989 Caswell 1989 and the references given there hardly any theory exists at the moment This will

hopefully change rapidly in the coming years Again the development of appropriate software may turn out to be crucial

Chemical Complexity via Simple Models Valeriy I. Bykov, Svetlana B. Tsybenova, Gregory Yablonsky, 2018-01-22 This book is focused on mathematical modelling of chemical kinetics The authors present the classification of basic models of chemical kinetics thermokinetics and macrokinetics as well as their application for the most important chemical transformations such as combustion and catalysis Readers will find a detailed description and analysis of different mathematical instruments which can be applied for simulation of reaction dynamics

Advances in Artificial Life, Evolutionary Computation, and Systems Chemistry Federico Rossi, Stefano Piotto, Simona Concilio, 2017-04-20 This book constitutes the revised selected papers of the 11th Italian Workshop on Advances in Artificial Life Evolutionary Computation and Systems Chemistry WIVACE 2016 held at Fisciano Italy in October 2016 The 16 full papers together with 1 short papers presented have been thoroughly reviewed and selected from 54 submissions They cover the following topics evolutionary computation bioinspired algorithms genetic algorithms bioinformatics and computational biology modelling and simulation of artificial and biological systems complex systems synthetic and systems biology systems chemistry

Introduction to Systems Biology Sangdun Choi, 2008-05-17 Introduction to Systems Biology is an introductory text for undergraduate and graduate students who are interested in comprehensive biological systems The authors provide a broad overview of the field using key examples and typical approaches to experimental design The volume begins with an introduction to systems biology and then details experimental omics tools Other sections introduce the reader to challenging computational approaches to help understand biological dynamic systems The final sections of the volume provide ideas for theoretical and modeling optimization in systemic biological researches presenting most algorithms as implementations including an up to date full range of bioinformatic programs and available successful applications Informative and cutting edge this volume presents a clear and intuitive illustration of the biological systemic approaches and introduces ideal computational methods for research Introduction to Systems Biology is an indispensable resource providing a first glimpse into the state of the art in systems biology

Chronopharmaceutics Bi-Botti C. Youan, 2009-09-08 Chronopharmaceutics Science and Technology for Biological Rhythm Guided Therapy and Prevention of Diseases Edited by Bi Botti C Youan The first standard reference on chronopharmaceutics As we better understand how biological processes unfold in real time through advances in chronobiology and related fields we can create safer more effective drugs drug delivery systems and disease monitoring and prevention systems When administered in correct coordination with a patient's body rhythms such drugs can maximize therapeutic outcome while minimizing unwanted side effects Chronopharmaceutics presents the first standard reference text on this emerging cross disciplinary field and its potential for therapeutic and preventive medicine Bringing together the latest findings from experienced investigators this edited work presents a much needed single source on chronopharmaceutics After an introduction that includes a timeline of key discoveries an overview of regulatory formulation

manufacturing and key resource issues associated with chronopharmaceutics the detailed coverage examines Chronogenetics Chronopharmacokinetics Chronotherapy Controlled release systems triggered by physical and or chemical activation Chronopharmacodynamics chronomics and anesthesia Markers guided chronotheranostics Filling a gap in both the graduate classroom and the working industrial or research laboratory Chronopharmaceutics offers students instructors and professionals a unique and comprehensive reference for this cutting edge field

The History of Research on Chemical Periodic Processes Alexander Pechenkin, 2018-08-24 This book offers a survey of the historic development of selected areas of chemistry and chemical physics discussing in detail the European American and Russian approaches to the development of chemistry Other key topics include the kinetics and non linear thermodynamics of chemical reactions and mathematical modeling which have found new applications in the theory of dynamical systems The first observations of the periodicity of chemical reactions were lost in the mist of time In the second half of the 19th century the phenomenon of chemical periodicity was studied in relation to electrochemistry solutions and colloids Discovered in the late 19th century Liesegang rings are still enigmatic and remain attractive for researchers However the discovery of the Belousov Zhabotinsky reaction marked the successful culmination of the efforts to find a true chemical oscillatory reaction The book investigates chemical phenomena that were neglected in the past but have been rediscovered placing them into a new conceptual framework For example it notes that William Bray who discovered the first oscillatory homogeneous reaction in 1921 was influenced by the first bio mathematicians who predicted chemical oscillations in homogeneous systems

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