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Synergetic Phenomena in Active Lattices

Patterns, Waves, Solitons,
Chaos



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Synergetic Phenomena In Active Lattices Patterns Waves Solitons Chaos

Alexander S. Mikhailov, Vera Calenbuhr



Synergetic Phenomena In Active Lattices Patterns Waves Solitons Chaos:

Synergetic Phenomena in Active Lattices Vladimir Nekorkin, M. G. Velarde, 2012-08-17 In this book the authors deal with basic concepts and models with methodologies for studying the existence and stability of motions understanding the mechanisms of formation of patterns and waves their propagation and interactions in active lattice systems and about how much cooperation or competition between order and chaos is crucial for synergetic behavior and evolution

Synergetic Phenomena in Active Lattices Vladimir I. Nekorkin, M. G. Velarde, 2012-12-06 In recent years there has been growing interest in the study of the nonlinear spatio-temporal dynamics of problems appearing in various fields of science and engineering In a wide class of such systems an important place is occupied by active lattice dynamical systems Active lattice systems are e.g. networks of identical or almost identical interacting units ordered in space The activity of lattices is provided by the activity of units in them that possess energy or matter sources In real 1D 2D or 3D space processes develop by means of various types of connections the simplest being diffusion The uniqueness of lattice systems is that they represent spatially extended systems while having a finite dimensional phase space Therefore active lattice systems are of interest for the study of multidimensional dynamical systems and the theory of nonlinear waves and dissipative structures of extended systems as well The theory of nonlinear waves and dissipative structures of spatially distributed systems demands using theoretical methods and approaches of the qualitative theory of dynamical systems bifurcation theory and numerical methods or computer experiments In other words the investigation of spatio-temporal dynamics in active lattice systems demands a multitool synergetic approach which we shall use in this book

Nonlinear Waves and Solitons on Contours and Closed Surfaces Andrei Ludu, 2007-09-09 Everything the Power of the World does is done in a circle The sky is round and I have heard that the earth is round like a ball and so are all the stars The wind in its greatest power whirls Birds make their nests in circles for theirs is the same religion as ours The sun comes forth and goes down again in a circle The moon does the same and both are round Even the seasons form a great circle in their changing and always come back again to where they were The life of a man is a circle from childhood to childhood And so it is everything where power moves Black Elk 1863 1950 Nonlinearity is a captivating manifestation of the observable Universe whose importance has increased over the decades and has found more and more fields of application ranging from elementary particles nuclear physics biology wave dynamics at any scale fluids plasmas to astrophysics The central character of this 172 year old story is the soliton Namely a localized pulse traveling without spreading and having particle like properties plus an infinite number of conservation laws associated to its dynamics In general solitons arise as exact solutions of approximative models There are different explanations at different levels for the existence of solitons From the experimentalist point of view solitons can be created if the propagation configuration is long enough narrow enough like long and shallow channels fiber optics electric lines etc

Synergetics Hermann Haken, 2004-01-12 This book is an often requested reprint of two classic texts by H. Haken *Synergetics: An Introduction* and

Advanced Synergetics Synergetics an interdisciplinary research program initiated by H Haken in 1969 deals with the systematic and methodological approach to the rapidly growing field of complexity Going well beyond qualitative analogies between complex systems in fields as diverse as physics chemistry biology sociology and economics Synergetics uses tools from theoretical physics and mathematics to construct an unifying framework within which quantitative descriptions of complex self organizing systems can be made This may well explain the timelessness of H Haken s original texts on this topic which are now recognized as landmarks in the field of complex systems They provide both the beginning graduate student and the seasoned researcher with solid knowledge of the basic concepts and mathematical tools Moreover they admirably convey the spirit of the pioneering work by the founder of Synergetics through the essential applications contained herein that have lost nothing of their paradigmatic character since they were conceived **Brain Dynamics** Hermann

Haken, 2006-11-22 Twenty Five Years of Springer Series in Synergetics The year 2002 marks the 25th anniversary of the Springer Series in Synergetics It started in 1977 with my book Synergetics An Introduction Nonequilibrium Phase Transitions and Self Organization in Physics Chemistry and Biology In the near future the 100th volume of this series will be published Its success has been made possible by the contributions of outstanding authors who presented their quite often pioneering results to the science community well beyond the borders of a special discipline Indeed interdisciplinarity is one of the main features of this series But interdisciplinarity is not enough The main goal is the search for common features of self organizing systems in a great variety of seemingly quite different systems or still more precisely speaking the search for general principles underlying the spontaneous formation of spatial temporal or functional structures The objects studied may be as diverse as lasers and fluids in physics pattern formation in chemistry morphogenesis in biology brain functions in neurology or self organization in a city As is witnessed by several volumes great attention is being paid to the pivotal interplay between deterministic and stochastic processes as well as to the dialogue between theoreticians and experimentalists All this has contributed to a remarkable cross fertilization between disciplines and to a deeper understanding of complex systems The timeliness and potential of such an approach are also mirrored among other indicators by numerous interdisciplinary workshops and conferences all over the world **Quantum Signatures of Chaos** Fritz Haake, 2010-04-21 Nine years have

passed since I dispatched the second edition and the book still appears to be in demand The time may be ripe for an update As the perhaps most conspicuous extension I describe the understanding of universal spectral fluctuations recently reached on the basis of periodic orbit theory To make the presentation of those semiclassical developments self-contained I decided to underpin them by a new short chapter on classical Hamiltonian mechanics Inasmuch as the semiclassical theory not only draws inspiration from the nonlinear sigma model but actually aims at constructing that model in terms of periodic orbits it appeared indicated to make small additions to the previous treatment within the chapter on superanalysis Less voluminous but as close to my heart are additions to the chapter on level dynamics which close previous gaps in that approach to spectral

universality It was a pleasant duty to pay my respect to colleagues in our Transregio Sonderforschungsbereich Martin Zirnbauer Alex Altland Alan Huckleberry and Peter Heinzner by including a short account of their beautiful work on nonstandard symmetry classes The chapter on random matrices has not been expanded in proportion to the development of the field but now includes an up to date treatment of an old topic in algebra Newton's relations to provide a background to the Riemann Siegel theorem like of semiclassical periodic orbit theory *Collective Beings* Gianfranco Minati, Eliano Pessa, 2006-12-26 Microscopic models 226 The intrinsic limitations of the theory of phase transitions 229 5 3 Quantum Field Theory 230 5 4 Spontaneous Symmetry Breaking 239 5 5 Non ideal models of emergence 249 5 5 1 Neural networks 250 5 5 2 Cellular Automata 261 5 5 3 Artificial Life 265 5 6 The role of noise 273 5 7 The relationships between traditional and non traditional models 279 Chapter 6 The Role of Ergodicity 291 6 1 Some definitions related to ergodicity 293 6 1 1 Ergodic 293 6 1 2 Disciplinary definitions 293 6 2 Ergodicity and stationarity 300 6 3 Ergodicity in Collective Beings 302 6 4 Emergence Collective Beings and Ergodicity 306 6 5 Further considerations 309 6 6 Some remarks and possible lines of research 313 Chapter 7 Applications to Social Systems 1 growth development sustainable development and ethics 321 7 1 Growth Development and Sustainable Development 323 7 1 1 Representing Growth 324 7 1 2 Development 326 7 1 3 Managing for development 334 7 2 Ethics 336 7 2 1 Ethics and Quality 340 7 2 2 Effectiveness and advantages of Ethics 342 7 2 3 Ethics for quality and effectiveness 343 7 2 4 Ethics and Globalization 346 viii Contents Chapter 8 Applications to Social Systems 2 systems archetypes virtual systems knowledge management organizational learning industrial districts 353 8 1 Systems archetypes and collective beings 353 8 2 Virtual systems 359 8 2 *Patterns and Interfaces in Dissipative Dynamics* L.M. Pismen, 2006-07-07 Spontaneous pattern formation in nonlinear dissipative systems far from equilibrium is a paradigmatic case of emergent behaviour associated with complex systems It is encountered in a great variety of settings both in nature and technology and has numerous applications ranging from nonlinear optics through solid and fluid mechanics physical chemistry and chemical engineering to biology Nature creates its variety of forms through spontaneous pattern formation and self assembly and this strategy is likely to be imitated by future biomorphic technologies This book is a first hand account by one of the leading players in this field which gives in depth descriptions of analytical methods elucidating the complex evolution of nonlinear dissipative systems and brings the reader to the forefront of current research The introductory chapter on the theory of dynamical systems is written with a view to applications of its powerful methods to spatial and spatio temporal patterns It is followed by two chapters treating moving interfaces based largely on reaction diffusion and phase separating systems The following two chapters on amplitude equations for patterns and waves describe universal phenomena generated by representative equations which can be derived for a variety of non equilibrium systems originating in fluid mechanics physical chemistry or nonlinear optics This book addresses graduate students and non specialists from the many related areas of applied mathematics physical chemistry chemical engineering and biology as well as the seasoned scientist

in search of a modern source of reference

Dissipative Solitons: From Optics to Biology and Medicine Nail

Akhmediev, Adrian Ankiewicz, 2008-08-26 The dissipative soliton concept is a fundamental extension of the concept of solitons in conservative and integrable systems It includes ideas from three major sources namely standard soliton theory developed since the 1960s nonlinear dynamics theory and Prigogine's ideas of systems far from equilibrium These three sources also correspond to the three component parts of this novel paradigm This book explains the above principles in detail and gives the reader various examples

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

Brain Dynamics H. Haken, 2002 This book addresses a large variety of models in mathematical and computational neuroscience It is written for the experts as well as for graduate students wishing to enter this fascinating field of research The author studies the behaviour of large neural networks composed of many neurons coupled by spike trains He devotes the main part to the synchronization problem He presents neural net models more realistic than the conventional ones by taking into account the detailed dynamics of axons synapses and dendrites allowing rather arbitrary couplings between neurons He gives a complete stable analysis that goes significantly beyond what has been known so far He also derives pulse averaged equations including those of the Wilson Cowan and the Jirsa Haken Nunez types and discusses the formation of spatio temporal neuronal activity patterns An analysis of phase locking via sinusoidal couplings leading to various kinds of movement coordination is included

Nonlinear Dynamics of Chaotic and Stochastic Systems Vadim S. Anishchenko, Vladimir Astakhov, Alexander Neiman, Tatjana Vadivasova, Lutz Schimansky-Geier, 2007-07-20 We present an improved and enlarged version of our book Nonlinear dynamics of Chaotic and Stochastic Systems published by Springer in 2002 Basically the new edition of the book corresponds to its first version While preparing this edition we made some clarifications in several sections and also corrected the misprints noticed in some formulas Besides three new sections have been added to Chapter 2 They are Statistical Properties of Dynamical Chaos Effects of Synchronization in Extended Self Sustained Oscillatory Systems and Synchronization in Living Systems The sections

indicated reflect the most interesting results obtained by the authors after publication of the first edition We hope that the new edition of the book will be of great interest for a wide section of readers who are already specialists or those who are beginning research in the fields of nonlinear oscillation and wave theory dynamical chaos synchronization and stochastic process theory Saratov Berlin and St Louis V S Anishchenko November 2006 A B Neiman T E Vadiavasova V V Astakhov L Schimansky Geier Preface to the First Edition This book is devoted to the classical background and to contemporary results on nonlinear dynamics of deterministic and stochastic systems Considerable attention is given to the effects of noise on various regimes of dynamic systems with noise induced order On the one hand there exists a rich literature of excellent books on nonlinear dynamics and chaos on the other hand there are many marvelous monographs and textbooks on the statistical physics of far from equilibrium and stochastic processes This book is an attempt to combine the approach of nonlinear dynamics based on the deterministic evolution equations with the approach of statistical physics based on stochastic or kinetic equations One of our main aims is to show the important role of noise in the organization and properties of dynamic regimes of nonlinear dissipative systems

Synchronization in Oscillatory Networks Grigory V. Osipov, Jürgen Kurths, Changsong Zhou, 2007-08-10 This work systematically investigates a large number of oscillatory network configurations that are able to describe many real systems such as electric power grids lasers or even the heart muscle to name but a few The book is conceived as an introduction to the field for graduate students in physics and applied mathematics as well as being a compendium for researchers from any field of application interested in quantitative models *From Cells to Societies* Alexander S. Mikhailov, Vera Calenbuhr, 2013-06-29 This book written by two well known scientists represents an excellent addition to the Springer Series in Synergetics in several ways It shows how by rather simple models we can gain remarkable insights into the behavior of complex systems At the same time it demonstrates the progress made in this interdisciplinary field While in the early days of Synergetics the self organized coherent action of atoms in the laser a physical device was in the foreground of interest of my book Synergetics An Introduction Springer Berlin Heidelberg New York 1977 the coherent action of nerve cells got into the focus of research as is witnessed by the book by P Tass in this series P Tass Phase Resetting in Medicine and Biology Springer Berlin Heidelberg New York 1999 In these books the elements were disturbed by noise Now in the present book by Mikhailov and Calenbuhr the self organized coherent action of otherwise chaotic elements is studied and important as well as surprising results by Kaneko Mikhailov and others are presented Let me mention just another highly interesting problem treated in this book the coherent interaction of tens of thousands of reactions going on in biological cells But other phenomena such as the formation of swarms of fish or the collective behavior of ants are also modelled These are just a few examples of the many fascinating subjects dealt with in this book that relate to many disciplines under unifying aspects

Frontiers of Fundamental Physics B. G. Sidharth, Furio Honsell, Alessandro De Angelis, 2007-09-18 The Sixth International Symposium Frontiers of Fundamental and Computational Physics Udine Italy 26-29 September 2004 aimed at providing a

platform for a wide range of physicists to meet and share thoughts on the latest trends in various mainly cross disciplinary research areas This includes the exploration of frontier lines in High Energy Physics Theoretical Physics Gravitation and Cosmology Astrophysics Condensed Matter Physics Fluid Mechanics Such frontier lines were unified by the use of computers as an often primary research instruments or dealing with issues related to information theory The book contains contributions by Nobel Laureates Leon N Cooper 1972 and Gerard t Hooft 1999 and concludes with two interesting chapters on new approaches to Physics Teaching Audience Graduate students lecturers and researches in Physics

Nonlinear Fokker-Planck Equations T.D. Frank, 2005-01-07 Centered around the natural phenomena of relaxations and fluctuations this monograph provides readers with a solid foundation in the linear and nonlinear Fokker Planck equations that describe the evolution of distribution functions It emphasizes principles and notions of the theory e g self organization stochastic feedback free energy and Markov processes while also illustrating the wide applicability e g collective behavior multistability front dynamics and quantum particle distribution The focus is on relaxation processes in homogeneous many body systems describable by nonlinear Fokker Planck equations Also treated are Langevin equations and correlation functions Since these phenomena are exhibited by a diverse spectrum of systems examples and applications span the fields of physics biology and neurophysics mathematics psychology and biomechanics

Solitary Waves in Fluids R. Grimshaw, 2007 Edited by R H J Grimshaw this book covers the topic of solitary waves in fluids

Nonlinear Waves in Fluids: Recent Advances and Modern Applications Roger Grimshaw, 2007-03-23 Although nonlinear waves occur in nearly all branches of physics and engineering there is an amazing degree of agreement about the fundamental concepts and the basic paradigms The underlying unity of the theory for linearized waves is already well established with the importance of such universal concepts as group velocity and wave superposition For nonlinear waves the last few decades have seen the emergence of analogous unifying concepts The pervasiveness of the soliton concept is amply demonstrated by the ubiquity of such models as the Korteweg de Vries equation and the nonlinear Schrodinger equation Similarly there is a universality in the study of wave wave interactions whether deterministic or statistical and in the recent developments in the theory of wave mean flow interactions The aim of this text is to present the basic paradigms of weakly nonlinear waves in fluids This book is the outcome of a CISM Summer School held at Udine from September 20-24 2004 Like the lectures given there the text covers asymptotic methods for the derivation of canonical evolution equations such as the Korteweg de Vries and nonlinear Schrodinger equations descriptions of the basic solution sets of these evolution equations and the most relevant and compelling applications These themes are interlocked and this will be demonstrated throughout the text The topics address any fluid flow application but there is a bias towards geophysical fluid dynamics reflecting for the most part the areas where many applications have been found

Self-Organization of Molecular Systems Nino Russo, Victor Ya Antonchenko, Eugene Kryachko, 2009-05-21
 Proceedings of the NATO Advanced Research Workshop on Molecular Self Organization From Molecules to Water to

Nanoparticles to DNA and Proteins Kyiv Ukraine 8 12 June 2008

Without Bounds: A Scientific Canvas of

Nonlinearity and Complex Dynamics Ramon G. Rubio, Yuri S. Ryazantsev, Victor M Starov, Guo-Xiang Huang, Alexander P Chetverikov, Paolo Arena, Alex A. Nepomnyashchy, Alberto Ferrus, Eugene G. Morozov, 2013-05-30 Bringing together over fifty contributions on all aspects of nonlinear and complex dynamics this impressive topical collection is both a scientific and personal tribute on the occasion of his 70th birthday by many outstanding colleagues in the broad fields of research pursued by Prof Manuel G Velarde The topics selected reflect the research areas covered by the famous Instituto Pluridisciplinar at the Universidad Complutense of Madrid which he co founded over two decades ago and include fluid physics and related nonlinear phenomena at interfaces and in other geometries wetting and spreading dynamics geophysical and astrophysical flows and novel aspects of electronic transport in anharmonic lattices as well as topics in neurodynamics and robotics

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