Pattern Formation And Dynamics In Nonequilibrium Systems

This Research Note aims to provide an insight into recent developments in the theory of pattern formation. In the last decade there has been considerable progress in this field, both from a theoretical and a practical point of view. Recent mathematical developments concern the study of the nonlinear stability of systems at near-critical conditions by an appropriate system of modulation equations. The complexity of the original problem can be reduced drastically by this approximation. Moreover, it provides unifying point of view for a wide range of problems. New applications of the theory arise in a multitude of scientific areas such as hydrodynamics, reaction-diffusion problems, oceanography, meteorology, combustion, geophysical and biological morphodynamics and semi-conductors.This book is intended to show the interactions between the mathematical theory of nonlinear dynamics and the study of pattern generating phenomena in the natural environment. There is an intimate relationship between new insights in the mathematical aspects of nonlinear pattern formation and the comprehension of such phenomena. Therefore there are two partly overlapping main themes: one in which the emphasis is on generally applicable mathematical theories and techniques and one in which the phenomenology of pattern evolution in various areas is discussed.The book comprises 19 contributions by experts in the field. Although the emphasis changes considerably from paper to paper, in each contribution the same two themes are present; all the authors have aimed to achieve a suitable balance between the mathematical theory and the physical phenomena.

This book is a systematic introduction to a new and exciting field of patterns in granular matter. Granular materials are collections of discrete macroscopic solid grains with a typical size large enough that thermal fluctuations are negligible. Despite this seeming simplicity, properties of granular materials are different from conventional solids, liquids and gases due to the dissipative and highly nonlinear nature of forces among grains. The last decade has seen an explosion of interest to nonequilibrium phenomena in granular matter among physicists, both on the experimental and theoretical side. Among these phenomena, one of the most interesting is the ability of granular matter upon mechanical excitation to form highly ordered patterns such as ripples, avalanches, or bands of segregated materials. This book presents a comprehensive review of experiments and novel theoretical concepts needed to understand the mechanisms of pattern formation in granular materials. This book is written for experienced physicists interested in this new rapidly developing field, as well as young researchers and graduate students entering this field. We hope that both experimentalists and theorists already working in the field will find it useful.

This text explores the use of cellular automata in modeling pattern formation in biological systems. It describes several mathematical modeling approaches utilizing cellular automata that can be used to study the dynamics of interacting cell systems both in simulation and in practice. New in this edition are chapters covering cell migration, tissue development, and cancer dynamics, as well as updated references and new research topic suggestions that reflect the rapid development of the field. The book begins with an introduction to pattern-forming principles in biology and the various mathematical modeling techniques that can be used to analyze them. Cellular automaton models are then discussed in detail for different types of cellular processes and interactions, including random movement, cell migration, adhesive cell interaction, alignment and cellular swarming, growth processes, pigment cell pattern formation, tissue development, tumor growth and invasion, and Turing-type patterns and excitable media. In the final chapter, the authors critically discuss possibilities and limitations of the cellular automaton approach in modeling various biological applications, along with future research directions. Suggestions for research projects are provided throughout the book to encourage additional engagement with the material, and an accompanying simulator is available for readers to perform their own simulations on several of the models covered in the text. QR codes are included within the text for easy access to the simulator. With its accessible presentation and interdisciplinary approach, Cellular Automaton Modeling of Biological Pattern Formation is suitable for graduate and advanced undergraduate students in mathematical biology, biological modeling, and biological computing. It will also be a valuable resource for researchers and practitioners in applied mathematics, mathematical biology, computational physics, bioengineering, and computer science. PRAISE FOR THE FIRST EDITION "An ideal guide for someone with a mathematical or physical background to start exploring biological modelling. Importantly, it will also serve as an excellent guide for experienced modellers to innovate and improve their methodologies for analysing simulation results." —Mathematical Reviews

Proceedings of a Symposium Organized Along with the International Conference on Nonlinear Dynamics and Pattern Formation in the Natural Environment Noordwijkerhout, The Netherlands, July 4–7, 1994

Nonlinear Phenomena and Pattern Formation

Modelling the Dynamics of Biological Systems

Nonliner Dynamics of Pattern Formation Via Electrohydrodynamic Instabilities

Pattern Formation and Dynamics in Nonequilibrium Systems

In Nonlinear Dynamics and Pattern Formation in Semiconductors and Devices the contributions of the International Conference on Nonlinear Dynamics and Pattern Formation in the Natural Environment (ICPF '94) in Noordwijkerhout, held by many internationally reknown experts, are compiled. To connect the field of semiconductor physics with the theory of nonequilibrium dissipative systems, the emphasis lies on the study of localized structures, their stability and bifurcation behaviour. A point of special interest is the evolution of dynamic structures and the investigation of more complex structures arising from interactions between these structures. Possible applications of nonlinear effects and self-organization phenomena with respect to signal processing are discussed.

Nonlinear Physics of Ecosystems introduces the concepts and tools of pattern formation theory and demonstrates their utility in ecological research using problems from spatial ecology. Written in language understandable to both physicists and ecologists in most parts, the book reveals the mechanisms of pattern formation and pattern dynamics. It also explores the implications of these mechanisms in important ecological problems. The first part of the book gives an overview of pattern formation and spatial ecology, showing how these disparate research fields are strongly related to one another. The next part presents an advanced account of pattern formation theory. The final part describes applications of pattern formation theory to ecological problems, including self-organized vegetation patchiness, desertification, and biodiversity in changing environments. Focusing on the emerging interface between spatial ecology and pattern formation, this book shows how pattern formation methods address a variety of ecological problems using water-limited ecosystems as a case study. Readers with basic knowledge of linear algebra and ordinary differential equations will develop a general understanding of pattern formation theory while more advanced readers who are familiar with partial differential equations will appreciate the descriptions of analytical tools used to study pattern formation and dynamics.

Spatio-temporal patterns appear almost everywhere in nature, and their description and understanding still raise important and basic questions. However, if one looks back 20 or 30 years, definite progress has been made in the modeling of insta bilities, analysis of the dynamics in their vicinity, pattern formation and stability, quantitative experimental and numerical analysis of patterns, and so on. Universal behaviors of complex systems close to instabilities have been determined, leading to the wide interdisciplinarity of a field that is now referred to as nonlinear science or science of complexity, and in which initial concepts of dissipative structures or synergetics are deeply rooted. In pioneering domains related to hydrodynamics or chemical instabilities, the interactions between experimentalists and theoreticians, sometimes on a daily basis, have been a key to progress. Everyone in the field praises the role played by the interactions and permanent feedbacks between ex perimental, numerical, and analytical studies in the achievements obtained during these years. Many aspects of convective patterns in normal fluids, binary mixtures or liquid crystals are now understood and described in this framework. The generic pres ence of defects in extended systems is now well established and has induced new developments in the physics of laser with large Fresnel numbers. Last but not least, almost 40 years after his celebrated paper, Turing structures have finally been ob tained in real-life chemical reactors, triggering anew intense activity in the field of reaction-diffusion systems.

Pattern Formation In Complex Dissipative Systems: Fluid Patterns, Liquid Crystals, Chemical Reactions

Spatial Dynamics and Pattern Formation in Biological Populations

Characterization, Examples, and Analysis

An Introduction to Methods

Genesis, Dynamics, and Control

This Research Note aims to provide an insight into recent developments in the theory of pattern formation. In the last decade there has been considerable progress in this field, both from a theoretical and a practical point of view. Recent mathematical developments concern the study of the nonlinear stability of systems at near-critical conditions by an appropriate system of modulation equations. The complexity of the original problem can be reduced drastically by this approximation. Moreover, it provides unifying point of view for a wide range of problems. New applications of the theory arise in a multitude of scientific areas such as hydrodynamics, reaction-diffusion problems, oceanography, meteorology, combustion, geophysical and biological morphodynamics and semi-conductors. This book is intended to show the interactions between the mathematical theory of nonlinear dynamics and the study of pattern generating phenomena in the natural environment. There is an intimate relationship between new insights in the mathematical aspects of nonlinear pattern formation and the comprehension of such phenomena. Therefore there are two partly overlapping main themes: one in which the emphasis is on generally applicable mathematical theories and techniques and one in which the phenomenology of pattern evolution in various areas is discussed. The book comprises 19 contributions by experts in the field. Although the emphasis changes considerably from paper to paper, in each contribution the same two themes are present; all the authors have aimed to achieve a suitable balance between the mathematical theory and the physical phenomena. Contents:

This book is devoted to the study of evolution of nonequilibrium systems. Such a system usually consists of regions with different dominant scales, which coexist in the space-time where the system lives. In the case of high nonuniformity in special direction, one can see patterns separated by clearly distinguishable boundaries or interfaces. The author considers several examples of nonequilibrium systems. One of the examples describes the invasion of the solid phase into the liquidphase during the crystallization process. Another example is the transition from oxidized to reduced states in certain chemical reactions. An easily understandable example of the transition in the temporal direction is a sound beat, and the author describes typical patterns associated with thisphenomenon. The main goal of the book is to present a mathematical approach to the study of highly nonuniform systems and to illustrate it with examples from physics and chemistry. The two main theories discussed are the theory of singular perturbations and the theory of dissipative systems. A set of carefully selected examples of physical and chemical systems nicely illustrates the general methods described in the book.

Half a billion years of evolution have turned the eye into an unbelievable pattern detector. Everything we perceive comes in delightful multicolored forms. Now, in the age of science, we want to comprehend what and why we see. Two dozen outstanding biologists, chemists, physicists, psychologists, computer scientists and mathematicians met at the Institut d'Hautes Etudes Scientifiques in Bures-sur-Yvette, France. They expounded their views on the physical, biological and physiological mechanisms creating the tapestry of patterns we see in molecules, plants, insects, seashells, and even the human brain. This volume comprises surveys of different aspects of pattern formation and recognition, and is aimed at the scientifically minded reader. p>Sample Chapter(s) Chapter 1.1: Introduction (242 KB) Chapter 1.2: Single blind agent with finite memory (170 KB) Chapter 1.3: Single blind agent with inflnite memory (190 KB) Chapter 1.4: Single sighted agent receiving cues from the environment (one-way exogenous control) (315 KB) Chapter 1.5: Single sighted agent receiving cues from the structure (two-way exogenous control) (165 KB) Chapter 1.6: Single self-controlled agent (endogenous control) (176 KB) Chapter 1.7: Multiple blind agents with finite memory (189 KB) Chapter 1.8: Multiple blind agents with infinite memory (124 KB) Chapter 1.9: Multiple sighted agents (264 KB) Contents:Growth and Form:Paradigms of Pattern Formation — Towards a Computational Theory of Morphogenesis (P Prusinkiewicz)Growth and Form of Sponges and Corals in a Moving Fluid (J A Kaandorp & P M A Sloot)From Pseudo-Random Numbers to Stochastic Growth Models and Texture Images (L P Yaroslavsky)Crystal Growth, Biological Cell Growth, and Geometry (J W Cannon et al.)Recent Results on Aperiodic Wang Tilings (J Kari)Reaction-Diffusion and Beyond:Biological Pattern Formation as a Complex Dynamic Phenomenon (H Meinhardt)Andronov Bifurcations and Sea Shell Patterns (M Argentina & P Coullet)Rational and Irrational Angles in Phyllotaxis (Y Couder & S Douady)Cellular Patterns:Organogenetic Cellular Patterning in Plants (P W Barlow et al.)A Classification of Plant Meristems Based on Cellworks (3D L-Systems). The Maintainance and Complexity of Their Cellular Patterns (J Lück & H B Lück)Plant Meristems and Their Patterns (B Zagórska-Marek)Mechanical Stress Patterns in Plant Cell Walls and Their Morphogenetical Importance (Z Hejnowicz)Tensorial Model for Growth and Cell Division in the Shoot Apex (J Nakielski)DNA and Genetic Control:DNA Nanotechnology — From Topological Control to Structural Control (N C Seeman)3D DNA Patterns and Computation (N Jonoska)Circular Suggestions for DNA Computing (T Head)DNA Computing by Matching — Sticker Systems and Watson-Crick Automata (G Paun)Images and Perception:Aspects of Human Shape Perception (J Ninio)Pattern Recognition in the Visual System and the Nature of Neural Coding (S Thorpe)How Can Singularity Theory Help in Image Processing? (M Briskin et al.) Readership: Biologists, mathematicians and computer scientists. Keywords:Growth Models;L-Systems;Cell Growth;Phyllotaxis;Cellular Patterns;DNA Nanotechnology;DNA Computation;Tiling;Vision;Pattern Recognition;Shape PerceptionReviews: "This gorgeously produced book gives an important entrée into the emerging world of biological mathematics … One of the most revolutionary and exciting areas discussed in this book is that of DNA computing and DNA nanotechnology … Mathematicians should find this book a fascinating introduction as well as a useful source book." Journal la Gazette des Mathematiciens

Pattern Formation and Dynamics in Inclined Layer Convection

Dynamics of Pattern Formation and Emergence of Swarming in C. Elegans

Pattern Formation and Dynamics in Lasers

Pattern Formation In The Physical And Biological Sciences

Pattern Formation

Fully illustrated mathematical guide to pattern formation. Includes instructive exercises and examples.

Spirals, vortices, crystalline lattices, and other attractive patterns are prevalent in Nature. How do such beautiful patterns appear from the initial chaos? What universal dynamical rules are responsible for their formation? What is the dynamical origin of spatial disorder in nonequilibrium media? Based on the many visual experiments in physics, hydrodynamics, chemistry, and biology, this invaluable book answers those and related intriguing questions. The mathematical models presented for the dynamical theory of pattern formation are nonlinear partial differential equations. The corresponding theory is not so accessible to a wide audience. Consequently, the authors have made every attempt to synthesize long and complex mathematical calculations to exhibit the underlying physics. The book will be useful for final year undergraduates, but is primarily aimed at graduate students, postdoctoral fellows, and others interested in the puzzling phenomena of pattern formation. Contents:Patterns: Prelude to a Dynamical DescriptionLinear Stage of Pattern FormationModel EquationsThe Ginzburg–Landau Equation'Crystal' FormationQuasicrystalsBreaking of OrderLocalized PatternsSpiralsPatterns in Oscillating Soap FilmsPatterns in Colonies of MicroorganismsSpatial DisorderPatterns in Chaotic MediaEpilogue: Living Matter and Dynamic FormsA Short Guide to Nonlinear DynamicsKey Experiments in Pattern Formation Readership: Graduate students of mathematical physics and nonlinear science. Keywords:Quasicrystals;Disordered Patterns;Defects;Spirals;Turbulence;Synchronization;Convection;Capillary Waves;Chaotic Dynamics;Biological PatternsReviews: "This beautifully illustrated book brings together a remarkable array of pattern-forming phenomena … The authors have assembled an impressive collection of striking photographs and computer-generated images, and the book would be worth buying for this alone … the Appendix describing key experiments is a highlight. Here the authors outline the historical development of experiments in parametrically-excited patterns, thermal convection and diffusive chemical reactions." UK Nonlinear News "This book contains a very impressive account of key ideas and results in nonlinear dynamics and an equally excellent description of important experiments in pattern formation … readers can gain quite comprehensive knowledge about all possible patterns and their mathematical theories by reading a single chapter, coupled with Appendix I." Mathematical Reviews

Half a billion years of evolution have turned the eye into an unbelievable pattern detector. Everything we perceive comes in delightful multicolored forms. Now, in the age of science, we want to comprehend what and why we see. Two dozen outstanding biologists, chemists, physicists, psychologists, computer scientists and mathematicians met at the Institut d'Hautes Etudes Scientifiques in Bures-sur-Yvette, France. They expounded their views on the physical, biological and physiological mechanisms creating the tapestry of patterns we see in molecules, plants, insects, seashells, and even the human brain. This volume comprises surveys of different aspects of pattern formation and recognition, and is aimed at the scientifically minded reader.

Nonlinear Dynamics of Laser Light Pattern Formation in Sodium Vapor

The Dynamics of Patterns

New Trends, Dynamics and Scales in Pattern Formation

Dynamics and Pattern Formation in an Oscillatory Reaction-diffusion System

Spatio-Temporal Pattern Formation

Mathematics of Computing -- Miscellaneous.

Pattern Formation in Morphogenesis is a rich source of interesting and challenging mathematical problems. The volume aims at showing how a combination of new discoveries in developmental biology and associated modelling and computational techniques has stimulated or may stimulate relevant advances in the field. Finally it aims at facilitating the process of unfolding a mutual recognition between Biologists and Mathematicians of their complementary skills, to the point where the resulting synergy generates new and novel discoveries. It offers an interdisciplinary interaction space between biologists from embryology, genetics and molecular biology who present their own work in the perspective of the advancement of their specific fields, and mathematicians who propose solutions based on the knowledge grasped from biologists.

Excitable media comprise a class of models for a wide range of physical, chemical, and biological systems that exhibit spontaneous formation of spatial patterns. Patterns in Excitable Media: Genesis, Dynamics, and Control explores several aspects of the dynamics of such patterns-in particular their evolution upon interaction with structural and fun

With Examples from Physics, Chemistry, and Materials Science

Pattern Formation in Granular Materials

Chaos and Nonlinear Dynamics

Pattern Formation in Morphogenesis

Cases of Spikes and Droplets

Where possible we have compared our experimental results with published theory either analytic or numeric. In the cases where no theory exists we have done our best to present a numerical simulation, give an analytic explanation for our observations, or present an ansatz solution to a theoretical model.

The development of a proper description of the living world today stands as one of the most significant challenges to physics. A variety of new experimental techniques in molecular biology, microbiol ogy, physiology and other fields of biological research constantly expand our knowledge and enable us to make increasingly more detailed functional and structural descriptions. Over the past decades, the amount and complexity of available information have multiplied dramatically, while at the same time our basic understanding of the nature of regulation, behavior, morphogenesis and evolution in the living world has made only modest progress. A key obstacle is clearly the proper handling of the available data. This requires a stronger emphasis on mathematical modeling through which the consistency of the adopted explanations can be checked, and general princi ples may be extracted. As an even more serious problem, however, it appears that the proper physical concepts for the development of a theoretically oriented biology have not hitherto been available. Classical mechanics and equilibrium thermody namics, for instance, are inappropriate and useless in some of the most essen tial biological contexts. Fortunately, there is now convincing evidence that the concepts and methods of the newly developed fields of nonlinear dynam ics and complex systems theory, combined with irreversible thermodynamics and far-from-equilibrium statistical mechanics will enable us to move ahead with many of these problems.

In this volume, the problems of pattern formation in physics, chemistry and other related fields in complex and nonlinear dissipative systems are studied. Main subjects discussed are formation mechanisms, properties, statistics, characterization and dynamics of periodic and nonperiodic patterns in the electrohydrodynamics in liquid crystals, Rayleigh-Benard convection, crystallization, viscous fingering and Belouzov-Zhabotinsky chemical reaction. Recent developments in topological and defect-mediated chaos, chaos in systems with large degrees of freedom and turbulence-turbulence transitions are also discussed.

An Introduction for Scientists and Engineers

Pattern Formation and Non-linear Dynamics of Non-equilibrium Systems

Nonlinear Dynamics of Laser Leght Pattern Formation in Sodium Vapor

Dynamics of Spatial Pattern Formation

Far-from-equilibrium Dynamics

This volume contains a number of mini-review articles authored by speakers and attendees at the IMA workshop on Pattern Formation in Continuous and Coupled Systems. Pattern formation has been studied intensively for most of this century by both experimentalists and theoreticians. This workshop focused on new directions in the patterns literature. The goals were to continue communication between these groups, and to familiarize a larger audience with some of the newer directions in the field. 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. The mini-reviews in this volume are intended to be pointers to the current literature for researchers at all levels and therefore include extensive bibliographies. They are also intended to discuss why certain subjects are currently exciting and worthy of additional research.

Spontaneous pattern formation in nonlinear dissipative systems far from equilibrium occurs in a variety of settings in nature and technology, and has applications ranging from nonlinear optics through solid and fluid mechanics, physical chemistry and chemical engineering to biology. This book explores the forefront of current research, describing in-depth the analytical methods that elucidate the complex evolution of nonlinear dissipative systems.

Granular materials are an integral part of our everyday life. They are also the base material for most industrial processing techniques. The highly dissipative nature of the particle collisions means energy input is needed in order to mobilize the grains. This interplay of dissipation and excitation leads to a wide variety of pattern formation processes, which are addressed in this book. The reader is introduced to this wide field by, first, a description of the material properties of granular materials under different experimental conditions that are important in connection with the pattern formation dynamics and, second, by further details given later on in the description of the specific system.

Patterns and Interfaces in Dissipative Dynamics

Pattern Formation in Biology, Vision and Dynamics

Characterization of the Dynamics of Pattern Formation and Analysis of Self-assembly of Nanostructures

Nonlinear Physics of Ecosystems

Cellular Automaton Modeling of Biological Pattern Formation

Describes pattern formation processes and how they can be modeled for graduate-level courses.

The basic aim of the NATO Advanced Research Workshop on "New Trends in Nonlinear Dynamics and Pattern-Forming Phenomena: The Geometry of Nonequilibrium" was to bring together researchers from various areas of physics to review and explore new ideas regarding the organisation of systems driven far from equilibrium. Such systems are characterized by a close relationship between broken spatial and tempo ral symmetries. The main topics of interest included pattern formation in chemical systems, materials and convection, traveling waves in binary fluids and liquid crystals, defects and their role in the disorganisa tion of structures, spatio-temporal intermittency, instabilities and large-scale vortices in open flows, the mathematics of non-equilibrium systems, turbulence, and last but not least growth phenomena. Written contributions from participants have been grouped into chapters addressing these different areas. For additional clarity, the first chapter on pattern formation has been subdivided into sections. One of the main concerns was to focus on the unifying features between these diverse topics. The various scientific communities repre sented were encouraged to discuss and compare their approach so as to mutually benefit their respective fields. We hope that, to a large degree, these goals have been met and we thank all the participants for their efforts. The workshop was held in Cargese (Corsica, France) at the Institut d'Etudes Scientifiques from August 2nd to August 12th, 1988. We greatly thank Yves Pomeau and Daniel Walgraef who, as members of the organising committee, gave us valuable advice and encouragements.

An account of how complex patterns form in sustained nonequilibrium systems; for graduate students in biology, chemistry, engineering, mathematics, and physics.

Pattern Formation by Dynamics Systems and Pattern Recognition

The Geometry of Nonequilibrium

Granular Patterns

A Survey Volume

New Trends in Nonlinear Dynamics and Pattern-Forming Phenomena

The book provides an introduction to deterministic (and some stochastic) modeling of spatiotemporal phenomena in ecology, epidemiology, and neural systems. A survey of the classical models in the fields with up to date applications is given. The book begins with detailed description of how spatial dynamics/diffusive processes influence the dynamics of biological populations. These processes play a key role in understanding the outbreak and spread of pandemics which help us in designing the control strategies from the public health perspective. A brief discussion on the functional mechanism of the brain (single neuron models and network level) with classical models of neuronal dynamics in space and time is given. Relevant phenomena and existing modeling approaches in ecology, epidemiology and neuroscience are introduced, which provide examples of pattern formation in these models. The analysis of patterns enables us to study the dynamics of macroscopic and microscopic behaviour of underlying systems and travelling wave type patterns observed in dispersive systems. Moving on to virus dynamics, authors present a detailed analysis of different types models of infectious diseases including two models for influenza, five models for Ebola virus and seven models for Zika virus with diffusion and time delay. A Chapter is devoted for the study of Brain Dynamics (Neural systems in space and time). Significant advances made in modeling the reaction-diffusion systems are presented and spatiotemporal patterning in the systems is reviewed. Development of appropriate mathematical models and detailed analysis (such as linear stability, weakly nonlinear analysis, bifurcation analysis, control theory, numerical simulation) are presented. Key Features Covers the fundamental concepts and mathematical skills required to analyse reaction-diffusion models for biological populations. Concepts are introduced in such a way that readers with a basic knowledge of differential equations and numerical methods can understand the analysis. The results are also illustrated with figures. Focuses on mathematical modeling and numerical simulations using basic conceptual and classic models of population dynamics, Virus and Brain dynamics. Covers wide range of models using spatial and non-spatial approaches. Covers single, two and multispecies reaction-diffusion models from ecology and models from bio-chemistry. Models are analysed for stability of equilibrium points, Turing instability, Hopf bifurcation and pattern formations. Uses Mathematica for problem solving and MATLAB for pattern formations. Contains solved Examples and Problems in Exercises. The Book is suitable for advanced undergraduate, graduate and research students. For those who are working in the above areas, it provides information from most of the recent works. The text presents all the fundamental concepts and mathematical skills needed to build models and perform analyses.

This Lecture Notes Volume represents the first time any of the summer school lectures have been collected and published on a discrete subject rather than grouping all of a season's lectures together. This volume provides a broad survey of current thought on the problem of pattern formation. Spanning six years of summer school lectures, it includes articles which examine the origin and evolution of spatial patterns in physio-chemical and biological systems from a great diversity of theoretical and mechanistic perspectives. In addition, most of these pieces have been updated by their authors and three articles never previously published have been added.

Problems and Mathematical Issues

Patterns in Excitable Media

Dynamics of Self-Organized and Self-Assembled Structures

On the Dynamics of Pattern Formation in Biomimetic Systems

Nonlinear Dynamics and Pattern Formation in Semiconductors and Devices