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Systems and Models - Hartmut Bossel 2007
A multitude of complex systems and actors pursuing their own agenda shape the dynamics of our world. Better understanding of their actions and interactions is crucial, and can be achieved by a profound knowledge of systems and their properties, and their representation in models allowing simulation of probable behavior. Drawing

on his extensive research and teaching experience in modeling and simulation of a wide range of systems - from engineering to social systems and ecosystems - the author presents the fundamental concepts and approaches for understanding and modeling the complex systems shaping the dynamics of our world. The book applies state space analysis and system dynamics to deal with the dynamic processes of "causal systems," discusses information processing approaches for modeling decision processes of "actors" and "agents," and uses aspects of the coevolutionary development of systems in their environment to deal with normative orientation, ethics, and evaluation of policies and long-term development. The concepts are applied in particular to the issue of sustainable development of human society in an evolving world. The book is complemented by a survey of system topics and of models from many fields, and by an extensive bibliography on the many systems-related subjects covered. Hartmut Bossel is Professor Emeritus of environmental systems analysis. He taught for many years at the University of California in Santa Barbara and the University of Kassel, Germany, where he was director of the Center for Environmental Systems Research until his retirement. He holds an engineering degree from the Technical University of Darmstadt, and a Ph.D. degree from the University of California at Berkeley. With a background in engineering, systems science, and mathematical modeling, he has led many research projects and future studies in different countries, developing computer simulation models and decision support systems in the areas of

energy supply policy, global dynamics, orientation of behavior, agricultural policy, and forest dynamics and management. He has written numerous books on modeling and simulation of dynamic systems, social change and future paths, and has published widely in the scientific literature in several fields. Bossel is author of a System Zoo containing over one hundred simulation models of diverse systems.

The Functional Role of Critical Dynamics in Neural Systems - Nergis Tomen 2019-07-23

This book offers a timely overview of theories and methods developed by an authoritative group of researchers to understand the link between criticality and brain functioning. Cortical information processing in particular and brain function in general rely heavily on the collective dynamics of neurons and networks distributed over many brain areas. A key concept for characterizing and understanding brain dynamics is the idea that networks operate near a critical state, which offers several potential benefits for computation and information processing. However, there is still a large gap between research on criticality and understanding brain function. For example, cortical networks are not homogeneous but highly structured, they are not in a state of spontaneous activation but strongly driven by changing external stimuli, and they process information with respect to behavioral goals. So far the questions relating to how critical dynamics may support computation in this complex setting, and whether they can outperform other information processing schemes remain open. Based on the workshop “Dynamical Network States, Criticality and Cortical Function", held in March

2017 at the Hanse Institute for Advanced Studies (HWK) in Delmenhorst, Germany, the book provides readers with extensive information on these topics, as well as tools and ideas to answer the above-mentioned questions. It is meant for physicists, computational and systems neuroscientists, and biologists.

Managing Complexity: Insights, Concepts, Applications - Dirk Helbing 2007-10-13

The essays and lectures collected in this book center around knowledge transfer from the complex-system sciences to applications in business, industry and society, as viewed from a broad perspective. The contributions aim to raise awareness across the spectrum to meet the increasing need to integrate lessons from complexity research into everyday planning, decision making, logistics or optimization procedures and forecasting. The writing has been largely kept non-technical.

The Combinatory Systems Theory - Piero Mella 2017-05-11

This study adopts the logic of Systems Thinking and Control Systems, presenting a simple but complete theory called the Theory of Combinatory Systems. This new theory is able to describe, interpret, explain, simulate and control collective phenomena and their observable effects. Despite specific differences among these phenomena – many of which are “one way", non-repeatable or reproducible – they can all be described or explained, and thus understood, using the model, as simple as it is general, of combinatory systems; that is, systems formed by collectivities, or populations of non-connected and unorganized individuals of some species, which appear to be directed by an invisible hand that guides the analogous actions of similar

individuals in order to produce an emerging collective phenomenon. Combinatory Systems function due to the presence of micro control systems which, operating at the individual level, lead to uniform micro behavior by individuals in order to eliminate the (gap) with respect to the objective that is represented – or revealed – by the global information (macro behavior or effect). The book also examines Combinatory Automata, which represent a powerful tool for simulating the most relevant combinatory systems. In stochastic combinatory automata, when both probabilities and periods of transition of state are agent/time/state sensitive, the probabilistic micro behaviors are conditioned by the macro behavior of the entire system, which makes the micro-macro feedback more evident. The Combinatory Systems Theory: Understanding, Modeling and Simulating Collective Phenomena is composed of four main chapters. Chapter 1 presents the basic ideas behind the theory, which are analysed in some detail. Chapter 2 describes the heuristic models of several relevant combinatory systems observable in different environments. Chapter 3, while not making particular use of sophisticated mathematical and statistical tools, presents the Theory of Combinatory Automata and builds models for simulating the operative logic of combinatory systems. Chapter 4 tries to answer three questions: are combinatory systems "systems" in the true sense of the term? Why is this theory able to explain so many and so varied a number of phenomena, even though it is based on a very simple modus operandi? Are combinatory systems different than complex systems? The book has been written with no prerequisite

required to read and understand it, in particular math, statistics and computer knowledge.

Self-Organized Criticality in Earth Systems - Stefan Hergarten 2013-03-14

Self-organized criticality (SOC) has become a magic word in various scientific disciplines; it provides a framework for understanding complexity and scale invariance in systems showing irregular fluctuations. In the first 10 years after Per Bak and his co-workers presented their seminal idea, more than 2000 papers on this topic appeared. Seismology has been a field in earth sciences where the SOC concept has already deepened the understanding, but there seem to be much more examples in earth sciences where applying the SOC concept may be fruitful. After introducing the reader into the basics of fractals, chaos and SOC, the book presents established and new applications of SOC in earth sciences, namely earthquakes, forest fires, landslides and drainage networks.

Complexity Science: An Introduction - Peletier Mark A 2019-03-20

This book on complexity science comprises a collection of chapters on methods and principles from a wide variety of disciplinary fields — from physics and chemistry to biology and the social sciences.In this two-part volume, the first part is a collection of chapters introducing different aspects in a coherent fashion, and providing a common basis and the founding principles of the different complexity science approaches; the next provides deeper discussions of the different methods of use in complexity science, with interesting illustrative applications.The fundamental topics deal with self-organization, pattern formation,

forecasting uncertainties, synchronization and revolutionary change, self-adapting and self-correcting systems, and complex networks. Examples are taken from biology, chemistry, engineering, epidemiology, robotics, economics, sociology, and neurology.

Critical Transitions in Nature and Society - Marten Scheffer 2020-11-10

How do we explain the remarkably abrupt changes that sometimes occur in nature and society--and can we predict why and when they happen? This book offers a comprehensive introduction to critical transitions in complex systems--the radical changes that happen at tipping points when thresholds are passed. Marten Scheffer accessibly describes the dynamical systems theory behind critical transitions, covering catastrophe theory, bifurcations, chaos, and more. He gives examples of critical transitions in lakes, oceans, terrestrial ecosystems, climate, evolution, and human societies. And he demonstrates how to deal with these transitions, offering practical guidance on how to predict tipping points, how to prevent "bad" transitions, and how to promote critical transitions that work for us and not against us. Scheffer shows the time is ripe for understanding and managing critical transitions in the vast and complex systems in which we live. This book can also serve as a textbook and includes a detailed appendix with equations. Provides an accessible introduction to dynamical systems theory Covers critical transitions in lakes, oceans, terrestrial ecosystems, the climate, evolution, and human societies Explains how to predict tipping points Offers strategies for preventing "bad" transitions and triggering "good" ones

Features an appendix with equations

The Art of Artificial Evolution - Juan Romero 2008

Art is the Queen of all sciences communicating knowledge to all the generations of the world. Leonardo da Vinci Artistic behavior is one of the most valued qualities of the human mind. Although artistic manifestations vary from culture to culture, dedication to artistic tasks is common to all. In other words, artistic behavior is a universal trait of the human species. The current, Western de?nition of art is relatively new. However, a d- ication to artistic endeavors — such as the embellishment of tools, body - namentation, or gathering of unusual, arguably aesthetic, objects — can be traced back to the origins of humanity. That is, art is ever-present in human history and prehistory. Artandsciencesharealongan denduringrelationship.Theb est-known- ample of the explorationof this relationship is probably the work of Leonardo da Vinci. Somewhere in the 19th century art and science grew apart, but the cross-transfer of concepts between the two domains continued to exist. Currently, albeit the need for specialization, there is a growing interest in the exploration of the connections between art and science. Focusingoncomputerscience ,itisinterestingtonoticethate arlypioneers of this discipline such as Ada Byron and Alan Turing showed an interest in using computational devices for art-making purposes. Oddly, in spite of this early interest and the ubiquity of art, it has received relatively little attention fromthe computersciencecommunity ingeneral,and,moresurprisin gly,from the arti?cial intelligence community.

Guerrilla Science - Ernesto Altshuler 2017-03-16

Full of drama, dedication, and humor, this book narrates the author's often frustrating experiences working as an experimental physicist in Cuba after the disintegration of the so-called socialist block. Lacking finance and infrastructure, faced with makeshift equipment, unpredictable supplies, and unreliable IT, Altshuler tells how he and his students overcame numerous challenges to make novel and interesting contributions to several fields of science. Along the way, he explains the science - from studies of ant colonies to superconductivity - either qualitatively or quantitatively, but always at a level fully understandable to an undergraduate student of natural sciences or engineering. An even wider audience, however, may skip the technical sections without missing the essence. With numerous anecdotes, photographs and the author's own delightful cartoons, the book tells a remarkable, and often amusing story of how successful science can be performed against all odds.

Complexity from Microscopic to Macroscopic Scales: Coherence and Large Deviations - A.T. Skjeltorp 2012-12-06

Many mesoscopic systems display `adaptive' behaviour - changes in some physical property that results from a small change in an internal or external driving force. There is a kind of progression in adaptive phenomena, from quantum mesoscopics to complex, evolved cooperative systems and large scale events like turbulence. The field of mesoscopic magnetism, especially quantum coherence and quantum tunnelling in spin systems, and the coupling between mesoscopic magnetism and mesoscopic transport is currently a very active area of solid state physics. `Dephasing' is an important

concept in mesoscopic systems like these. A basic question is the limit at which quantum mechanics breaks down and what it can be replaced with. Another interesting crossover is that between complexity and large excursions or events, with turbulence as a prototype example. The book also contains a discussion of finance. Qualitatively speaking, turbulence and financial markets are apparently similar, so our understanding of turbulence may be relevant to understanding price fluctuations.

The Palgrave Handbook of Learning for Transformation - Aliki Nicolaides 2022-01-24

This handbook offers an expanded discourse on transformative learning by making the turn into new passageways to explore the phenomenon of transformation. It curates diverse discourses, knowledges and practices of transformation, in ways that both includes and departs from the adult learning mainstay of transformative learning and adult education. The purpose of this handbook is not to resolve or unify a theory of transformation and all the disciplinary contributions that clearly promote a living concept of transformation. Instead, the intent is to catalyze a more complex and deeper inquiry into the "Why of transformation." Each discipline, culture, ethics and practice has its own specialized care and reasons for paying attention to transformation. How can scholars, practitioners, and active members of discourses on transformative learning make a difference? How can they foster and create conditions that allow us to move on to other, unaddressed or understudied questions? To answer these questions, the editors and their authors employ the metaphor of the

many turns into passageways to convey the potential of transformation that may emerge from the many connecting passageways between, for instance, people and society, theory and practice, knowledge created by diverse disciplines and fields/professions, individual and collective transformations, and individual and social action.

Self-Organized Criticality, Three Decades Later - Subhrangshu Sekhar Manna 2022-01-28

Islands of Order - J. Stephen Lansing 2019-10-08

Over the past two decades, anthropologist J. Stephen Lansing and geneticist Murray Cox have explored dozens of villages on the islands of the Malay Archipelago, combining ethnographic research with research into genetic and linguistic markers to shed light on how these societies change over time. Islands of Order draws on their pioneering fieldwork to show how the science of complexity can be used to better understand unstable dynamics in culture, language, cooperation, and the emergence of hierarchies. Complexity science has opened exciting new vistas in physics and biology, but poses challenges for social scientists. What triggers fundamental, discontinuous social change? And what brings stable patterns—islands of order—into existence? Lansing and Cox begin with an incisive and accessible introduction to models of change, from simple random drift to coupled interactions, phase transitions, co-phylogenies, and adaptive landscapes. Then they take readers on a series of journeys to the islands of the Indo-Pacific to demonstrate how social scientists can harness these powerful tools to discover

out-of-equilibrium social dynamics. Lansing and Cox address empirical questions surrounding the colonization of the Pacific, the relationship of language to culture, the emergence and disappearance of male and female hierarchies, and more. Unlocking new possibilities for the social sciences, Islands of Order is accompanied by an interactive companion website that enables readers to explore the models described in the book.

Mechanics of Materials and Interfaces - Chandrakant S. Desai 2000-12-20

The disturbed state concept (DSC) is a unified, constitutive modelling approach for engineering materials that allows for elastic, plastic, and creep strains, microcracking and fracturing, stiffening or healing, all within a single, hierarchical framework. Its capabilities go well beyond other available material models yet lead to significant simplifications for practical applications. Until now, however, there has been no resource that fully describes the theory, techniques, and potential of this powerful method. Mechanics of Materials and Interfaces: Disturbed State Concept presents a detailed theoretical treatment of the DSC and shows that it can provide a unified and simplified approach for mathematical characterization of the mechanical response of materials and interfaces. Within this comprehensive treatment, the author: Compares the DSC with other available models Identifies the physical meaning of the relevant parameters and presents procedures to determine them from laboratory test data Validates the DSC models with respect to laboratory tests used to find the parameters and independent tests not used in the calibration Implements the models in

computer procedures Validates those procedures by comparing predictions with observations from simulated and field boundary value problems Solves problems from a variety of disciplines, including civil, mechanical, and electrical engineering If you are involved in the mechanics of materials, you owe it to yourself to explore the disturbed state concept. Mechanics of Materials and Interfaces provides the first- and to date, the only- comprehensive means of doing so.

How Nature Works - Per Bak 1996-08-29

Self-organized criticality, the spontaneous development of systems to a critical state, is the first general theory of complex systems with a firm mathematical basis. This theory describes how many seemingly desperate aspects of the world, from stock market crashes to mass extinctions, avalanches to solar flares, all share a set of simple, easily described properties. "...a'must read'...Bak writes with such ease and lucidity, and his ideas are so intriguing...essential reading for those interested in complex systems...it will reward a sufficiently skeptical reader." -NATURE "...presents the theory (self-organized criticality) in a form easily absorbed by the non-mathematically inclined reader." -BOSTON BOOK REVIEW "I picture Bak as a kind of scientific musketeer; flamboyant, touchy, full of swagger and ready to join every fray... His book is written with panache. The style is brisk, the content stimulating. I recommend it as a bracing experience." - NEW SCIENTIST

Science Matters - Maria Burguete 2008

All earnest and honest human quests for knowledge are efforts to understand Nature, which includes both human and nonhuman systems, the objects of study in science.

Thus, broadly speaking, all these quests are in the science domain. The methods and tools used may be different; for example, the literary people use mainly their bodily sensors and their brain as the information processor, while natural scientists may use, in addition, measuring instruments and computers. Yet, all these activities could be viewed in a unified perspective ? they are scientific developments at varying stages of maturity and have a lot to learn from each other.That ?everything in Nature is part of science? was well recognized by Aristotle, da Vinci and many others. Yet, it is only recently, with the advent of modern science and experiences gathered in the study of statistical physics, complex systems and other disciplines, that we know how the human-related disciplines can be studied scientifically.Science Matters is about all human-dependent knowledge, wherein humans (the material system of Homo sapiens) are studied scientifically from the perspective of complex systems. It includes all the topics covered in the humanities and social sciences. Containing contributions from knowledgeable humanists, social scientists and physicists, the book is intended for those ? from artists to scientists ? who are curious about the world and are interested in understanding it with a unified perspective.

Design and Control of Swarm Dynamics - Roland Bouffanais 2015-10-16

The book is about the key elements required for designing, building and controlling effective artificial swarms comprised of multiple moving physical agents. Therefore this book presents the fundamentals of each of those key elements in the particular frame of dynamic swarming, specifically exposing the

profound connections between these elements and establish some general design principles for swarming behaviors. This scientific endeavor requires an inter-disciplinary approach: biomimetic inspiration from ethology and ecology, study of social information flow, analysis of temporal and adaptive signaling network of interaction, considerations of control of networked real-time systems, and lastly, elements of complex adaptive dynamical systems. This book offers a completely new perspective on the scientific understanding of dynamic collective behaviors thanks to its multi-disciplinary approach and its focus on artificial swarm of physical agents. Two of the key problems in understanding the emergence of swarm intelligent behaviors are identifying the social interaction rules a.k.a. the behavioral algorithm and uncovering how information flows between swarming agents. While most books about swarm dynamics have been focusing on the former, this book emphasizes the much-less discussed topic of distributed information flow, always with the aim of establishing general design principles.

Dynamics of Multiscale Earth Systems - Horst J. Neugebauer 2008-01-26

In many aspects science becomes conducted nowadays through technology and preferential criteria of economy. Thus investigation and knowledge is evidently linked to a speci?c purpose. Especially Earth science is confronted with two major human perspectives concerning our natural environment:sustainability of resources and assessment of risks. Both aspects are expressing urgent needs of the living society, but in the same way those needs are addressing a long lasting fundamental

challenge which has so far not been met. Following on the patterns of economy and technology, the key is presumed to be found through a devel- mentoffeasibleconceptsfora management ofbothournaturalenvironme ntand in one or the other way the realm of life. Although new techniques for obser- tion and analysis led to an increase of rather speci?c knowledge about particular phenomena, yet we fail now even more frequently to avoid unforeseen impli- tions and sudden changes of a situation. Obviously the improved technological tools and the assigned expectations on a management of nature still exceed our traditional scienti?c experience and accumulated competence. Earth- and Life- Sciences are nowadays exceedingly faced with the puzzling nature of an almost boundless network of relations, i. e. , the complexity of phenomena with respect to their variability. The disciplinary notations and their particular approaches arethusnolongeraccountings u?cientlyfortherecordedcont extofphenomena, for their permanent variability and their unpredictable implications. The large environmental changes of glacial climatic cycles, for instance, demonstrate this complexity of such a typical phenomenology.

Self-Organizing Systems - Hermann De Meer 2006-09-21

This book constitutes the refereed proceedings of the First International Workshop on Self-Organizing Systems, IWSOS 2006. The book offers 16 revised full papers and 6 revised short papers together with 2 invited talks and 3 poster papers. The papers are organized in topical sections on dynamics of structured and unstructured overlays, self-organization in peer-to-peer

networks, self-organization in wireless environments, self-organization in distributed and grid computing, self-managing and autonomic computing, and more.

Reforming the Doctrine of God - F. LeRon Shults 2005-11

Linking traditional attributes of God with contemporary philosophy, F. LeRon Shults culminates with a reformed doctrine of God that revolves around themes of God's omniscient faithfulness, omnipotent love, and omnipresent hope.

Self-organized Complexity in the Physical, Biological, and Social Sciences - Donald Lawson Turcotte 2002

Self-Organization in Continuous Adaptive Networks - Anne-Ly Do 2012-10-31

This volume presents new analytical approaches, which combine tools from dynamical systems theory and statistical physics with tools from graph theory to address the principles behind adaptive self-organization. It is the first class of approaches that is applicable to continuous networks.

New Frontiers in Artificial Intelligence - Takashi Washio 2006-06-29

This book presents the joint post-proceedings of five international workshops organized by the Japanese Society for Artificial Intelligence, during the 19th Annual Conference JSAI 2005. The volume includes 5 award winning papers of the main conference, along with 40 revised full workshop papers, covering such topics as logic and engineering of natural language semantics, learning with logics, agent network dynamics and intelligence, conversational informatics and risk management systems with intelligent data analysis.

Power Grid Complexity - Shengwei Mei 2011-09-15

“Power Grid Complexity”

introduces the complex system theory known as self-organized criticality (SOC) theory and complex network theory, and their applications to power systems. It studies the network characteristics of power systems, such as their small-world properties, structural vulnerability, decomposition and coordination strategies, and simplification and equivalence methods. The book also establishes four blackout models based on SOC theory through which the SOC of power systems is studied at both the macroscopic and microscopic levels. Additionally, applications of complex system theory in power system planning and emergency management platforms are also discussed in depth. This book can serve as a useful reference for engineers and researchers working with power systems. Shengwei Mei is a Professor at the Department of Electrical Engineering at Tsinghua University, China. Xuemin Zhang is a Lecturer at the Department of Electrical Engineering at Tsinghua University, China. Ming Cao is an Assistant Professor at the Faculty of Mathematics and Natural Sciences at the University of Groningen, the Netherlands.

Entrepreneurship and Regional Economic Development - Henri L. F. de Groot 2004-01-01

'Entrepreneurship had been high on the jobs growth and economic development agendas for many years and this edited book makes an important and timely contribution to the debate. . . . the book is nicely poised to bring together space, innovation and economic growth linked together with entrepreneurship. . . This book provides an excellent and worthwhile insight into many of the issues with many contributions that significantly add to our understanding of entrepreneurship and

regional development.' - Ronald W. McQuaid, Growth & Change

How Nature Works - Ivan Zelinka 2013-07-18

This book is based on the outcome of the “2012 Interdisciplinary Symposium on Complex Systems” held at the island of Kos. The book consists of 12 selected papers of the symposium starting with a comprehensive overview and classification of complexity problems, continuing by chapters about complexity, its observation, modeling and its applications to solving various problems including real-life applications. More exactly, readers will have an encounter with the structural complexity of vortex flows, the use of chaotic dynamics within evolutionary algorithms, complexity in synthetic biology, types of complexity hidden inside evolutionary dynamics and possible controlling methods, complexity of rugged landscapes, and more. All selected papers represent innovative ideas, philosophical overviews and state-of-the-art discussions on aspects of complexity. The book will be useful as instructional material for senior undergraduate and entry-level graduate students in computer science, physics, applied mathematics and engineering-type work in the area of complexity. The book will also be valuable as a resource of knowledge for practitioners who want to apply complexity to solve real-life problems in their own challenging applications. The authors and editors hope that readers will be inspired to do their own experiments and simulations, based on information reported in this book, thereby moving beyond the scope of the book.

Self-organized Criticality and Predictability in Atmospheric Flows - Amujuri Mary Selvam

2017-05-05

This book presents a new concept of General Systems Theory and its application to atmospheric physics. It reveals that energy input into the atmospheric eddy continuum, whether natural or manmade, results in enhancement of fluctuations of all scales, manifested immediately in the intensification of high-frequency fluctuations such as the Quasi-Biennial Oscillation and the El-Nino–Southern Oscillation cycles. Atmospheric flows exhibit self-organised criticality, i.e. long-range correlations in space and time manifested as fractal geometry to the spatial pattern concomitant with an inverse power law form for fluctuations of meteorological parameters such as temperature, pressure etc. Traditional meteorological theory cannot satisfactorily explain the observed self-similar space time structure of atmospheric flows. A recently developed general systems theory for fractal space-time fluctuations shows that the larger-scale fluctuation can be visualised to emerge from the space-time averaging of enclosed small-scale fluctuations, thereby generating a hierarchy of self-similar fluctuations manifested as the observed eddy continuum in power spectral analyses of fractal fluctuations. The interconnected network of eddy circulations responds as a unified whole to local perturbations such as global-scale response to El-Nino events. The general systems theory model predicts an inverse power law form incorporating the golden mean τ for the distribution of space-time fluctuation patterns and for the power (variance) spectra of the fluctuations. Since the probability distributions of amplitude and variance are the same, atmospheric flows exhibit quantumlike chaos. Long-

range correlations inherent to power law distributions of fluctuations are identified as nonlocal connection or entanglement exhibited by quantum systems such as electrons or photons. The predicted distribution is close to the Gaussian distribution for small-scale fluctuations, but exhibits a fat long tail for large-scale fluctuations. Universal inverse power law for fractal fluctuations rules out unambiguously linear secular trends in climate parameters.

Adaptive Networks - Thilo Gross 2009-08-11

Adding one and one makes two, usually. But sometimes things add up to more than the sum of their parts. This observation, now frequently expressed in the maxim “more is different”, is one of the characteristic features of complex systems and, in particular, complex networks. Along with their ubiquity in real world systems, the ability of networks to exhibit emergent dynamics, once they reach a certain size, has rendered them highly attractive targets for research. The resulting network hype has made the word “network” one of the most in uential buzzwords seen in almost every corner of science, from physics and biology to economy and social sciences. The theme of “more is different” appears in a different way in the present v- ume, from the viewpoint of what we call “adaptive networks.” Adaptive networks uniquely combine dynamics on a network with dynamical adaptive changes of the underlying network topology, and thus they link classes of mechanisms that were previously studied in isolation. Here adding one and one certainly does not make two, but gives rise to a number of new phenomena, including highly robust se- organization of topology and dynamics and other remarkably rich dynamical

beh- iors.

Hurricanes and Climate Change - James B. Elsner 2010-09-02

Hurricanes are nature's most destructive agents. Widespread interest surrounds the possibility that they might get even more destructive in the future. Policy makers consider it a call for action. Answers about when and by how much hurricanes will change are sought by financial institutions especially industry. And scientists are challenged by the range and interactions of the processes involved. This book, arising from the 2nd International Summit on Hurricanes and Climate Change, contains new research on topics related to hurricanes and climate change since the 1st Summit. Chapters are grouped into research studies using global climate models and those taking empirical and statistical approaches. The latter include investigations of basin-wide and regional hurricane activity.

Understanding Complex Ecosystem Dynamics - William S. Yackinous 2015-06-03

Understanding Complex Ecosystem Dynamics: A Systems and Engineering Perspective takes a fresh, interdisciplinary perspective on complex system dynamics, beginning with a discussion of relevant systems and engineering skills and practices, including an explanation of the systems approach and its major elements. From this perspective, the author formulates an ecosystem dynamics functionality-based framework to guide ecological investigations. Next, because complex system theory (across many subject matter areas) is crucial to the work of this book, relevant network theory, nonlinear dynamics theory, cellular automata theory, and roughness (fractal) theory is covered in some detail. This material

serves as an important resource as the book proceeds. In the context of all of the foregoing discussion and investigation, a view of the characteristics of ecological network dynamics is constructed. This view, in turn, is the basis for the central hypothesis of the book, i.e., ecological networks are ever-changing networks with propagation dynamics that are punctuated, local-to-global, and perhaps most importantly fractal. To analyze and fully test this hypothesis, an innovative ecological network dynamics model is defined, designed, and developed. The modeling approach, which seeks to emulate features of real-world ecological networks, does not make a priori assumptions about ecological network dynamics, but rather lets the dynamics develop as the model simulation runs. Model analysis results corroborate the central hypothesis. Additional important insights and principles are suggested by the model analysis results and by the other supporting investigations of this book – and can serve as a basis for going-forward complex system dynamics research, not only for ecological systems but for complex systems in general. Provides a fresh interdisciplinary perspective, offers a broad integrated development, and contains many new ideas Clearly explains the elements of the systems approach and applies them throughout the book Takes on the challenging and open issues of complex system network dynamics Develops and utilizes a new, innovative ecosystem dynamics modeling approach Contains over 135 graphic illustrations to help the reader visualize and understand important concepts

Complexity and Criticality - Kim

Christensen 2005
This book provides a challenging and stimulating introduction to the contemporary topics of complexity and criticality, and explores their common basis of scale invariance, a central unifying theme of the book.Criticality refers to the behaviour of extended systems at a phase transition where scale invariance prevails. The many constituent microscopic parts bring about macroscopic phenomena that cannot be understood by considering a single part alone. The phenomenology of phase transitions is introduced by considering percolation, a simple model with a purely geometrical phase transition, thus enabling the reader to become intuitively familiar with concepts such as scale invariance and renormalisation. The Ising model is then introduced, which captures a thermodynamic phase transition from a disordered to an ordered system as the temperature is lowered in zero external field. By emphasising analogies between percolation and the Ising model, the reader's intuition of phase transitions is developed so that the underlying theoretical formalism may be appreciated fully. These equilibrium systems undergo a phase transition only if an external agent finely tunes certain external parameters to particular values.Besides fractals and phase transitions, there are many examples in Nature of the emergence of such complex behaviour in slowly driven non-equilibrium systems: earthquakes in seismic systems, avalanches in granular media and rainfall in the atmosphere. A class of non-equilibrium systems, not constrained by having to tune external parameters to obtain critical behaviour, is addressed in the framework of simple models, revealing that the repeated application of

simple rules may spontaneously give rise to emergent complex behaviour not encoded in the rules themselves. The common basis of complexity and criticality is identified and applied to a range of non-equilibrium systems. Finally, the reader is invited to speculate whether self-organisation in non-equilibrium systems might be a unifying concept for disparate fields such as statistical mechanics, geophysics and atmospheric physics.Visit http://www.complexityandcriticality.com for animations for the models in the book (available for Windows and Linux), solutions to exercises, as well as a list with corrections.

Critical Phenomena in Natural Sciences - Didier Sornette 2013-04-17

A modern up-to-date introduction for readers outside statistical physics. It puts emphasis on a clear understanding of concepts and methods and provides the tools that can be of immediate use in applications.

Complex Sciences - Jie Zhou 2009-06-29

I was invited to join the Organizing Committee of the First International Conference on Complex Sciences: Theory and Applications (Complex 2009) as its ninth member. At that moment, eight distinguished colleagues, General Co-chairs Eugene Stanley and Gaoxi Xiao, Technical Co-chairs J·nos Kertész and Bing-Hong Wang, Local Co-chairs Hengshan Wang and Hong-An Che, Publicity Team Shi Xiao and Yubo Wang, had spent hundreds of hours pushing the conference half way to its birth. Ever since then, I have been amazed to see hundreds of papers flooding in, reviewed and commented on by the TPC members. Finally, more than 200 contributions were - lected for the proceedings currently in your hands. They include about 200

papers from the main conference (selected from more than 320 submissions) and about 33 papers from the five collated workshops: Complexity Theory of Art and Music (COART) Causality in Complex Systems (ComplexCCS) Complex Engineering Networks (ComplexEN) Modeling and Analysis of Human Dynamics (MANDYN) Social Physics and its Applications (SPA) Complex sciences are expanding their colonies at such a dazzling speed that it - comes literally impossible for any conference to cover all the frontiers.

Experimental and Computational Techniques in Soft Condensed Matter Physics - Jeffrey Olafsen 2010-09-02

Soft condensed matter physics relies on a fundamental understanding at the interface between physics, chemistry, biology, and engineering for a host of materials and circumstances that are related to, but outside, the traditional definition of condensed matter physics. Featuring contributions from leading researchers in the field, this book uniquely discusses both the contemporary experimental and computational manifestations of soft condensed matter systems. From particle tracking and image analysis, novel materials and computational methods, to confocal microscopy and bacterial assays, this book will equip the reader for collaborative and interdisciplinary research efforts relating to a range of modern problems in nonlinear and non-equilibrium systems. It will enable both graduate students and experienced researchers to supplement a more traditional understanding of thermodynamics and statistical systems with knowledge of the techniques used in contemporary

investigations. Color versions of a selection of the figures are available at www.cambridge.org/9780521115902.

Social Self-Organization - Dirk Helbing 2012-05-05

What are the principles that keep our society together? This question is even more difficult to answer than the long-standing question, what are the forces that keep our world together. However, the social challenges of humanity in the 21st century ranging from the financial crises to the impacts of globalization, require us to make fast progress in our understanding of how society works, and how our future can be managed in a resilient and sustainable way. This book can present only a few very first steps towards this ambitious goal. However, based on simple models of social interactions, one can already gain some surprising insights into the social, ``macro-level'' outcomes and dynamics that is implied by individual, ``micro-level'' interactions. Depending on the nature of these interactions, they may imply the spontaneous formation of social conventions or the birth of social cooperation, but also their sudden breakdown. This can end in deadly crowd disasters or tragedies of the commons (such as financial crises or environmental destruction). Furthermore, we demonstrate that classical modeling approaches (such as representative agent models) do not provide a sufficient understanding of the self-organization in social systems resulting from individual interactions. The consideration of randomness, spatial or network interdependencies, and nonlinear feedback effects turns out to be crucial to get fundamental insights into how social patterns and dynamics emerge. Given the explanation of sometimes

counter-intuitive phenomena resulting from these features and their combination, our evolutionary modeling approach appears to be powerful and insightful. The chapters of this book range from a discussion of the modeling strategy for socio-economic systems over experimental issues up the right way of doing agent-based modeling. We furthermore discuss applications ranging from pedestrian and crowd dynamics over opinion formation, coordination, and cooperation up to conflict, and also address the response to information, issues of systemic risks in society and economics, and new approaches to manage complexity in socio-economic systems. Selected parts of this book had been previously published in peer reviewed journals.

Complexity, Cognition and the City - Juval Portugali 2011-07-06

Complexity, Cognition and the City aims at a deeper understanding of urbanism, while invoking, on an equal footing, the contributions both the hard and soft sciences have made, and are still making, when grappling with the many issues and facets of regional planning and dynamics. In this work, the author goes beyond merely seeing the city as a self-organized, emerging pattern of some collective interaction between many stylized urban "agents" – he makes the crucial step of attributing cognition to his agents and thus raises, for the first time, the question on how to deal with a complex system composed of many interacting complex agents in clearly defined settings. Accordingly, the author eventually addresses issues of practical relevance for urban planners and decision makers. The book unfolds its message in a largely nontechnical manner, so as to provide a broad interdisciplinary

readership with insights, ideas, and other stimuli to encourage further research – with the twofold aim of further pushing back the boundaries of complexity science and emphasizing the all-important interrelation of hard and soft sciences in recognizing the cognitive sciences as another necessary ingredient for meaningful urban studies.

Advances in Artificial Life - Mathieu Capcarrere 2005-08-29

TheArti?cialLifetermappearedmorethan20yearsagoinasmallcornerofNew Mexico, USA. Since then the area has developed dramatically, many researchers joining enthusiastically and research groups sprouting everywhere. This frenetic activity led to the emergence of several strands that are now established ?elds in themselves. We are now reaching a stage that one may describe as maturer: with more rigour, more benchmarks, more results, more stringent acceptance criteria, more applications, in brief, more sound science. This, which is the n- ural path of all new areas, comes at a price, however. A certain enthusiasm, a certain adventurousness from the early years is fading and may have been lost on the way. The ?eld has become more reasonable. To counterbalance this and to encourage lively discussions, a conceptual track, where papers were judged on criteria like importance and/or novelty of the concepts proposed rather than the experimental/theoretical results, has been introduced this year. A conference on a theme as broad as Arti?cial Life is bound to be very - verse,but a few tendencies emerged. First, ?elds like 'Robotics and Autonomous Agents' or 'Evolutionary Computation' are still extremely active and keep on bringing a wealth of

results to the A-Life community. Even there, however, new tendencies appear, like collective robotics, and more speci?cally self-assembling robotics, which represent now a large subsection. Second, new areas appear.

Parallel Computing Technologies - Victor Malyshkin 2007-08-29

This book constitutes the refereed proceedings of the 9th International Conference on Parallel Computing Technologies, PaCT 2007, held in conjunction with the Russian-Taiwan symposium on Methods and Tools of Parallel Programming of Multicomputers. It covers models and languages, applications, techniques for parallel programming supporting, cellular automata, as well as methods and tools of parallel programming of multicomputers.

Complex Systems and Self-organization Modelling - Cyrille Bertelle 2008-12-03

This book, the outcome of a workshop meeting within ESM 2006, explores the use of emergent computing and self-organization modeling within various applications of complex systems.

Sync - Steven Strogatz 2004-04-29

'SYNC' IS A STORY OF A DAZZLING KIND OF ORDER IN THE UNIVERSE, THE HARMONY THAT COMES FROM CYCLES IN SYNC. THE TENDENCY TO SYCHRONIZE IS ONE OF THE MOST FAR-REACHING DRIVES IN ALL OF NATURE. IT EXTENDS FROM PEOPLE TO PLANETS, FROM ANIMALS TO ATOMS. IN 'SYNC' PROFESSOR STEVEN STROGATZ CONSIDERS A RANGE OF APPLICATIONS - HUMAN SLEEP AND CIRCADIAN RHYTHMS, MENSTRUAL SYNCHRONY, INSECT OUTBREAKS, SUPERCONDUCTORS, LASERS, SECRET CODES, HEART ARRHYTHMIAS

AND FADS - CONNECTING ALL TRHOUGH AN EXPLORATION OF THE SAME MATHEMATICAL THEME: SELF-ORGANISATION, OR THE SPONTANEOUS EMERGENCE OF ORDER OUT OF CHAOS. FOCUSED ENOUGH TO PRESENT A COHERENT WORLD UNTO THEMSELVES, STROGATZ'S CHOSEN TOPICS TOUCH ON SEVERAL OF THE HOTTEST DIRECTIONS IN CONTEMPORARY SCIENCE.