

A. S. Mikhailov  
V. Calenbuhr

# From Cells to Societies

Models of  
Complex Coherent Action



Springer

# From Swarms To Societies Models Of Complex Coherent Action

**Dirk Helbing**



## **From Swarms To Societies Models Of Complex Coherent Action:**

*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.

**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 to 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

**Models, Simulations, and the Reduction of Complexity** Ulrich Gähde,Stephan Hartmann,Jörn Henning Wolf,2013-11-27 Modern science is to a large extent a model building activity But how are models constructed How are they related to theories and data How do they explain complex scientific phenomena and which role do computer simulations play here These questions have kept philosophers of science busy for many years and much work has been done to identify modeling as the central activity of theoretical science At the same time these questions have been addressed by methodologically minded scientists albeit from a different point of view While philosophers typically have an eye on general aspects of scientific modeling scientists typically take their own science as the starting point and are often more concerned with specific methodological problems There is however also much common ground in middle where philosophers and scientists can engage in a productive dialogue as the present volume demonstrates To do so the editors of this volume have invited eight leading scientists from cosmology climate science social science chemical engineering and neuroscience to reflect upon their modeling work and eight philosophers of science to provide a commentary

Self-formation Theory and Applications [sic] ,2004 This volume comprises the proceedings of the 6th international conference on Self Formation Theory and Applications

*Managing Complexity: Insights, Concepts, Applications* Dirk Helbing,2007-10-13 Each chapter in Managing Complexity focuses on analyzing real world complex systems and transferring knowledge from the complex systems sciences to applications in business industry and society The interdisciplinary contributions range from markets and production through logistics traffic control and critical infrastructures up to network design information systems social conflicts and building consensus They serve to raise readers awareness concerning the often counter intuitive behavior of complex systems and to help them integrate insights gained in complexity research into everyday planning decision making strategic optimization and policy Intended for a broad readership the contributions have been kept largely non technical and address a general scientifically literate audience involved in corporate academic and public institutions

**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

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**Principles of Evolution** Hildegard Meyer-Ortmanns, Stefan Thurner, 2011-04-11 With contributions from a team of leading experts this volume provides a comprehensive survey of recent achievements in our scientific understanding of evolution The questions it asks concern the beginnings of the universe the origin of life and the chances of its arising at all the role of contingency and the search for universal features in the plethora of evolutionary phenomena Rather than oversimplified or premature answers the chapters provide a clear picture of how these essential problems are being tackled enabling the reader to understand current thinking and open questions The tools employed stem from a range of disciplines including mathematics physics biochemistry and cell biology Self organization as an overarching concept is demonstrated in the most diverse areas from galaxy formation in the universe to spindle and aster formation in the cell Chemical master equations population dynamics and evolutionary game theory are presented as suitable frameworks for understanding the universal mechanisms and organizational principles observed in a wide range of living units ranging from cells to societies This book will provide engaging reading and food for thought for all those seeking a deeper understanding of the science of evolution

**Diffusion and Defect Data**, 2004 Methods, Models, Simulations And Approaches Towards A General Theory Of Change - Proceedings Of The Fifth National Conference Of The Italian Systems Society Gianfranco Minati, Mario Abram, Eliano Pessa, 2012-03-27 The book contains the Proceedings of the 2010 Conference of the Italian Systems Society Papers deal with the interdisciplinary study of processes of changing related to a wide variety of specific disciplinary aspects Classical attempts to deal with them based on generalising approaches used to study the movement of bodies and environmental influence have included ineffective reductionistic simplifications Indeed changing also relates for instance to processes of acquisition and varying properties such as for software growing and aging biological systems learning cognitive systems and socio economic systems growing and developing through innovations Some approaches to modelling such processes are based on considering changes in structure e g phase transitions Other approaches are based on considering 1 periodic changes in structure as for processes of self organisation 2 non periodic but coherent changes in structure as for processes of emergence 3 the quantum level of description Papers in the book study the problem considering its transdisciplinary nature i e systemic properties studied per se and not within specific disciplinary contexts The aim of these studies is to outline a transdisciplinary theory of change in systemic properties Such a theory should have simultaneous corresponding and eventually hierarchical disciplinary aspects as expected for a general theory of emergence Within this transdisciplinary context specific disciplinary research activities and results are assumed to be

mutually represented as within a philosophical and conceptual framework based on the theoretical centrality of the observer and conceptual non separability of context and observer related to logically open systems and Quantum Entanglement Contributions deal with such issues in interdisciplinary ways considering theoretical aspects and applications from Physics Cognitive Science Biology Artificial Intelligence Economics Architecture Philosophy Music and Social Systems

*International Encyclopedia of Systems and Cybernetics* Charles François,2011-12-07 No detailed description available for International Encyclopedia of Systems and Cybernetics *Books In Print 2004-2005* Ed Bowker Staff,Staff Bowker, Ed,2004

*Mutual Aid* Pablo Servigne,Gauthier Chapelle,2021-11-11 In the merciless arena of life we are all subject to the law of the jungle to ruthless competition and the survival of the fittest such is the myth that has given rise to a society that has become toxic for our planet and for our and future generations But today the lines are shifting A growing number of new movements and thinkers are challenging this skewed view of the world and reviving words such as altruism cooperation kindness and solidarity A close look at the wide spectrum of living beings reveals that at all times and in all places animals plants microorganisms and human beings have practised different forms of mutual aid And those which survive difficult conditions best are not necessarily the strongest but those which help each other the most Pablo Servigne and Gauthier Chapelle explore a vast forgotten continent of mutual aid in order to discover the mechanisms of this other law of the jungle In so doing they provide a more rounded view of the world of living things and give us some of the conceptual tools we need to move beyond the vicious circle of competition and self destruction that is leading our civilization to the verge of collapse

**Subject Guide to Books in Print** ,1991 **New Achievements in Evolutionary Computation** Peter Korosec,2010-02-01 Evolutionary computation has been widely used in computer science for decades Even though it started as far back as the 1960s with simulated evolution the subject is still evolving During this time new metaheuristic optimization approaches like evolutionary algorithms genetic algorithms swarm intelligence etc were being developed and new fields of usage in artificial intelligence machine learning combinatorial and numerical optimization etc were being explored However even with so much work done novel research into new techniques and new areas of usage is far from over This book presents some new theoretical as well as practical aspects of evolutionary computation This book will be of great value to undergraduates graduate students researchers in computer science and anyone else with an interest in learning about the latest developments in evolutionary computation Swarm Intelligence Eric Bonabeau,Marco Dorigo,Guy Theraulaz,1999 This book provides a rigorous look at the mechanisms underlying collective behavior in social insects The field is developing rapidly and the book includes up to date research from biology neuroscience artificial intelligence robotics operations research and computer graphics **Proceedings of the 44th Annual American Astronautical Society Guidance, Navigation, and Control Conference, 2022** Matt Sandnas,David B. Spencer,2024-03-30 This conference attracts GN C specialists from across the globe The 2022 Conference was the 44th Annual GN C conference with more than 230 attendees

from six different countries with 44 companies and 28 universities represented The conference presented more than 100 presentations and 16 posters across 18 topics This year the planning committee wanted to continue a focus on networking and collaboration hoping to inspire innovation through the intersection of diverse ideas These proceedings present the relevant topics of the day while keeping our more popular and well attended sessions as cornerstones from year to year Several new topics including Autonomous Control of Multiple Vehicles and Results and Experiences from OSIRIS REx were directly influenced by advancements in our industry In the end the 44th Annual GN C conference became a timely reflection of the current state of the GN C ins the space industry The annual American Astronautical Society Rocky Mountain Guidance Navigation and Control GN C Conference began 1977 as an informal exchange of ideas and reports of achievements among guidance and control specialists local to the Colorado area Bud Gates Don Parsons and Bob Culp organized the first conference and began the annual series of meetings the following winter In March 1978 the First Annual Rocky Mountain Guidance and Control Conference met at Keystone Colorado It met there for eighteen years moving to Breckenridge in 1996 where it has been for over 25 years

**The Worth of the Social Economy** Marie J. Bouchard,2009 This book fills a gap in the literature about the social economy of today must cater and for which questions of evaluation appear to be the most telling

Interdisciplinary Approaches to the Structure and Performance of Interdependent Autonomous Human Machine Teams and Systems (A-HMT-S) William Frere Lawless,Donald Sofge,Daniel M. Lofaro,2023-03-30

**Katachi ? Symmetry** Tohru Ogawa,Koryo Miura,Takashi Masunari,Denes Nagy,2012-12-06 In Japanese culture the concept of katachi has special significance connoting relationships and connectedness Although katachi cannot be translated precisely it corresponds most closely to form shape pattern or Gestalt The contemporary study of katachi is interdisciplinary and encompasses virtually all scientific and aesthetic endeavors Katachi research seeks to bridge the gap between cultures whether the two cultures of C P Snow or the contrasting cultures of East and West To help achieve this aim and to foster international cooperation the interdisciplinary symposium titled Katachi U Symmetry was convened in Tsukuba Japan November 21 25 1994 With many participants from differing backgrounds and cultural perspectives the symposium was the culmination of 15 years of work in the field Like minded researchers and philosophers came together from two movements in interdisciplinary studies of katachi and symmetry that arose in the 1980s one in Japan the other in Hungary The proceedings of the symposium will stimulate and provoke the interest of scientists and mathematicians engineers and architects philosophers and semioticians indeed all those with a lively sense of curiosity and a wide ranging intellect

Digital Biology P. J. Bentley,2001 A leading scientist s visionary work explains the next revolution in computers following the principles of the biological universe they will yield profound insights into the world of nature Digital Biology takes readers on a groundbreaking and entertaining journey into a universe where nature is transforming technology just on the other side of our computer screens

## Adopting the Track of Phrase: An Mental Symphony within **From Swarms To Societies Models Of Complex Coherent Action**

In a world consumed by monitors and the ceaseless chatter of instant interaction, the melodic beauty and emotional symphony created by the published term frequently diminish into the background, eclipsed by the constant sound and interruptions that permeate our lives. Nevertheless, set within the pages of **From Swarms To Societies Models Of Complex Coherent Action** a charming literary prize overflowing with organic feelings, lies an immersive symphony waiting to be embraced. Constructed by a masterful composer of language, that charming masterpiece conducts visitors on a mental journey, skillfully unraveling the hidden melodies and profound influence resonating within each carefully crafted phrase. Within the depths of the moving examination, we will investigate the book is central harmonies, analyze its enthralling publishing design, and submit ourselves to the profound resonance that echoes in the depths of readers souls.

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