

Springer Complexity

Springer Complexity is an interdisciplinary program publishing the best research and academic-level teaching on both fundamental and applied aspects of complex systems—cutting across all traditional disciplines of the natural and life sciences, engineering, economics, medicine, neuroscience, social and computer science.

Complex Systems are systems that comprise many interacting parts with the ability to generate a new quality of macroscopic collective behavior the manifestations of which are the spontaneous formation of distinctive temporal, spatial or functional structures. Models of such systems can be successfully mapped onto quite diverse “real-life” situations like the climate, the coherent emission of light from lasers, chemical reaction-diffusion systems, biological cellular networks, the dynamics of stock markets and of the internet, earthquake statistics and prediction, freeway traffic, the human brain, or the formation of opinions in social systems, to name just some of the popular applications.

Although their scope and methodologies overlap somewhat, one can distinguish the following main concepts and tools: self-organization, nonlinear dynamics, synergetics, turbulence, dynamical systems, catastrophes, instabilities, stochastic processes, chaos, graphs and networks, cellular automata, adaptive systems, genetic algorithms and computational intelligence.

The three major book publication platforms of the Springer Complexity program are the monograph series “Understanding Complex Systems” focusing on the various applications of complexity, the “Springer Series in Synergetics”, which is devoted to the quantitative theoretical and methodological foundations, and the “Springer Briefs in Complexity” which are concise and topical working reports, case studies, surveys, essays and lecture notes of relevance to the field. In addition to the books in these two core series, the program also incorporates individual titles ranging from textbooks to major reference works.

Indexed by SCOPUS, INSPEC, zbMATH, SCImago.

Series Editors

Henry D. I. Abarbanel, Institute for Nonlinear Science, University of California, San Diego, La Jolla, CA, USA

Dan Braha, New England Complex Systems Institute, University of Massachusetts, Dartmouth, USA

Péter Érdi, Center for Complex Systems Studies, Kalamazoo College, Kalamazoo, USA;

Hungarian Academy of Sciences, Budapest, Hungary

Karl J. Friston, Institute of Cognitive Neuroscience, University College London, London, UK

Sten Grillner, Department of Neuroscience, Karolinska Institutet, Stockholm, Sweden

Hermann Haken, Center of Synergetics, University of Stuttgart, Stuttgart, Germany

Viktor Jirsa, Centre National de la Recherche Scientifique (CNRS), Université de la Méditerranée, Marseille, France

Janusz Kacprzyk, Systems Research Institute, Polish Academy of Sciences, Warsaw, Poland

Kunihiko Kaneko, Research Center for Complex Systems Biology, The University of Tokyo, Tokyo, Japan

Markus Kirkilionis, Mathematics Institute and Centre for Complex Systems, University of Warwick, Coventry, UK

Ronaldo Menezes, Department of Computer Science, University of Exeter, UK

Jürgen Kurths, Nonlinear Dynamics Group, University of Potsdam, Potsdam, Germany

Andrzej Nowak, Department of Psychology, Warsaw University, Warszawa, Poland

Hassan Qudrat-Ullah, School of Administrative Studies, York University, Toronto, Canada

Linda Reichl, Center for Complex Quantum Systems, University of Texas, Austin, USA

Peter Schuster, Theoretical Chemistry and Structural Biology, University of Vienna, Vienna, Austria

Frank Schweitzer, System Design, ETH Zürich, Zürich, Switzerland

Didier Sornette, Entrepreneurial Risk, ETH Zürich, Zürich, Switzerland

Stefan Thurner, Section for Science of Complex Systems, Medical University of Vienna, Vienna, Austria

Understanding Complex Systems

Founding Editor: Scott Kelso

Ragupathy Venkatachalam
Editor

Artificial Intelligence, Learning and Computation in Economics and Finance

 Springer

Editor

Ragupathy Venkatachalam
Institute of Management Studies
Goldsmiths, University of London
London, UK

ISSN 1860-0832

ISSN 1860-0840 (electronic)

Understanding Complex Systems

ISBN 978-3-031-15293-1

ISBN 978-3-031-15294-8 (eBook)

<https://doi.org/10.1007/978-3-031-15294-8>

© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Switzerland AG 2023

This work is subject to copyright. All rights are solely and exclusively licensed by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors, and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

*Dedicated to
Prof. Shu-Heng Chen*

Acknowledgements

There are quite a few people who I would like to acknowledge for their help and support, without which this volume could not have been possible. From the time I first mooted the idea of having a festschrift for Shu-Heng Chen, all the way to the very end, I enjoyed the constant support of Vela Velupillai. I am grateful for his guidance, support, and, more importantly, for introducing Shu-Heng Chen to me. A special thanks to Connie Wang, who was instrumental for the successful completion of this project. Her unwavering support and kindness throughout deserve a special mention. I sincerely thank all the authors for their hard work and interesting contributions. Their enthusiasm and commitment to celebrate Shu-Heng's work has been a formidable source of inspiration for me, especially in light of what seemed like never-ending challenges and delays posed by the pandemic. Constantinos Repapis was extremely generous with his time and helped me during the initial stages of this project. I am grateful to Astrid Van den Bossche, Diviya Pant, Edgar Gutierrez, Sarath Jakka, Selda Kao, Sunil Kumar, Ye-Rong Du, and all the referees for their help and assistance in various ways. Finally, I would like to thank Hisako Niko, along with other members of the Springer team for their excellent support (and patience) through the making of this volume.

Contents

1	Computational Thinking in Economics and Finance: Introductory Remarks	1
	Ragupathy Venkatachalam and Shu G. Wang	
2	<i>Uncomputabilities, Games, Axioms, Proofs and Artificial Intelligence</i>	13
	K. Vela Velupillai	
3	Logic and Epistemology in Behavioral Economics	27
	J. Barkley Rosser Jr.	
4	Agent-Based Computational Economics: Overview and Brief History	41
	Leigh Tesfatsion	
5	Sequential Monte Carlo Squared for Agent-Based Models	59
	Thomas Lux	
6	Toward a General Model of Financial Markets	71
	Nihad Aliyev and Xue-Zhong He	
7	Sand Castles and Financial Systems: A Sandpile Metaphor	101
	Francesco Luna	
8	A Systematic Review of Investor Attention: Measurements, Implications, and Future Directions	121
	Dehua Shen and Chen Wang	
9	What is the Market? The Essential Teachings from an AI Market Experiment	141
	Yuji Aruka	
10	Market Power and the Hayek Hypothesis: An Experimental Investigation	161
	Chung-Ching Tai and Bin-Tzong Chie	

- 11 Counterfactual Thinking and Causal Mediation:
An Application to Female Labour Force Participation in India 187**
Sunil Mitra Kumar and Ying-Fang Kao
- 12 When Supply and Demand do NOT Meet: Sraffa’s Critique
of Economic Theory Restated 207**
Stefano Zambelli
- 13 Visualizing the Roles of Frequent Terms in LTEs Following
Two Economic Crisis Trigger Articles 247**
Brian J. Kokensparger
- 14 Design and Performance Metrics for Autonomous
Human-Machine Teams and Systems (A-HMT-S) 277**
W. F. Lawless
- 15 Thirty-Five Years of Computational Economics 291**
Robert Marks
- 16 Extending Herbert Simon’s “Science of Design”: the Role
of Collaboration and Users in Development of Technically
Advanced Systems 307**
Ben Vermeulen and Andreas Pyka

Contributors

Aliyev Nihad University of Technology Sydney, Finance Department, UTS, Ultimo, Australia

Aruka Yuji Chuo University, Hachioji, Tokyo, Japan

Chie Bin-Tzong Department of Industrial Economics, Tamkang University, New Taipei City, Taiwan

He Xue-Zhong International Business School Suzhou (IBSS) Business Building (BS), South Campus, Xi'an Jiaotong-Liverpool University, Suzhou, People's Republic of China

Kao Ying-Fang Experimentation Team, Machine Learning and AI Division, Just Eat, London, UK

Kokensparger Brian J. Computer Science, Design and Journalism Department, Creighton University, Omaha, NE, USA

Kumar Sunil Mitra India Institute and Department of International Development, King's College London, London, UK

Lawless W. F. Professor of Math and Psychology, Paine College, Augusta, GA, USA

Luna Francesco Office of Innovation and Change, International Monetary Fund, Washington DC, NW, USA

Lux Thomas Department of Economics, University of Kiel, Kiel, Germany

Marks Robert Economics, University of New South Wales, Sydney, Australia

Pyka Andreas Institute of Economics, University of Hohenheim, Stuttgart, Germany

Rosser J. Barkley Jr. JMU College of Business, James Madison University, Harrisonburg, VA 22807, USA

Shen Dehua School of Finance, Nankai University, Tianjin, P.R. China

Tai Chung-Ching Southampton Business School, University of Southampton, Southampton, UK

Tesfatsion Leigh Research Professor and Professor Emerita of Economics, Courtesy Research Professor of Electrical and Computer Engineering, Iowa State University, Ames, IA, USA

Velupillai K. Vela Solna, Sweden

Venkatachalam Ragupathy Institute of Management Studies, Goldsmiths, University of London, London, UK

Vermeulen Ben IQIB, Bad Neuenahr-Ahrweiler, Germany

Wang Chen College of Management and Economics, Tianjin University, Nankai District, Tianjin, P.R. China

Wang Shu G. Department of Economics (retired), National Chengchi University, Taipei, Taiwan

Zambelli Stefano Department of Economics and Management, University of Trento, Trento, Italy