Introduction to the Modeling and Analysis of Complex Systems
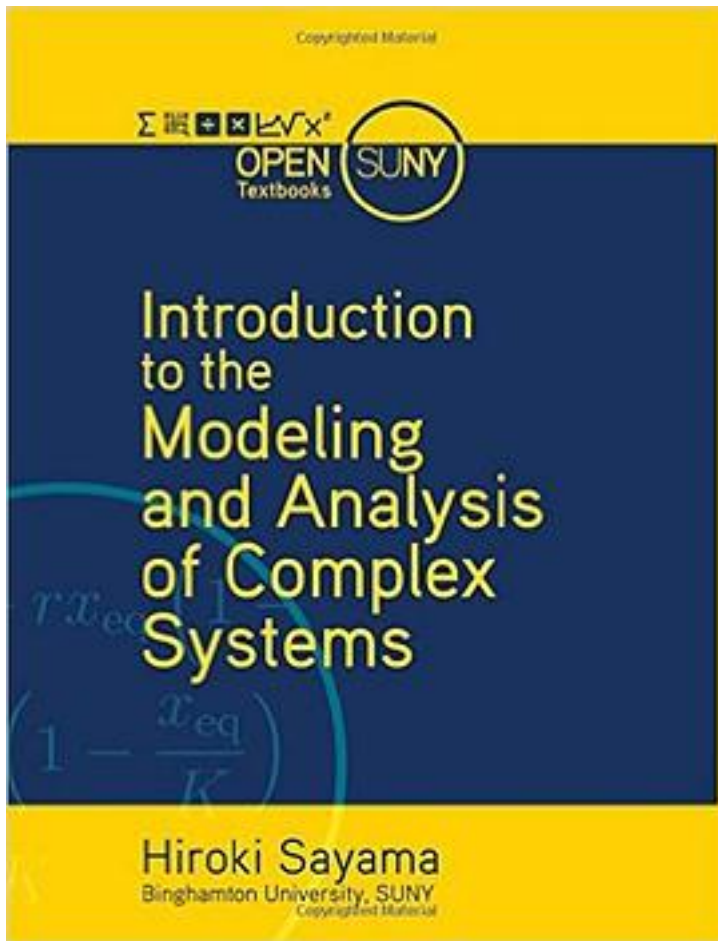

[Introduction to the Modeling and Analysis of Complex Systems_下载链接1_](#)

著者:Hiroki Sayama

出版者:Open SUNY Textbooks

出版时间:2015

装帧:Paperback

isbn:9781942341086

Introduction to the Modeling and Analysis of Complex Systems introduces students to

mathematical/computational modeling and analysis developed in the emerging interdisciplinary field of Complex Systems Science. Complex systems are systems made of a large number of microscopic components interacting with each other in nontrivial ways. Many real-world systems can be understood as complex systems, where critically important information resides in the relationships between the parts and not necessarily within the parts themselves. This textbook offers an accessible yet technically-oriented introduction to the modeling and analysis of complex systems. The topics covered include: fundamentals of modeling, basics of dynamical systems, discrete-time models, continuous-time models, bifurcations, chaos, cellular automata, continuous field models, static networks, dynamic networks, and agent-based models. Most of these topics are discussed in two chapters, one focusing on computational modeling and the other on mathematical analysis. This unique approach provides a comprehensive view of related concepts and techniques, and allows readers and instructors to flexibly choose relevant materials based on their objectives and needs. Python sample codes are provided for each modeling example.

This textbook is also available free online from the Open SUNY Textbooks website (http://textbooks.opensuny.org).

作者介绍:

Review

"Hiroki Sayama's book "Introduction to the Modeling and Simulation of Complex Systems" is therefore a unique and welcome addition to any instructor's collection. What makes it valuable is that it not only presents a state-of-the-art review of the domain but also serves as a gentle guide to learning the sophisticated art of modeling complex systems."

–Muaz A. Niazi, Complex Adaptive Systems Modeling 2016 4:3"

About the Author

Hiroki Sayama, D.Sc., is an Associate Professor in the Department of Systems Science and Industrial Engineering, and the Director of the Center for Collective Dynamics of Complex Systems (CoCo), at Binghamton University, State University of New York. He received his BSc, MSc and DSc in Information Science, all from the University of Tokyo, Japan. He did his postdoctoral work at the New England Complex Systems Institute in Cambridge, Massachusetts, from 1999 to 2002. His research interests include complex dynamical networks, human and social dynamics, collective behaviors, artificial life/chemistry, and interactive systems, among others. He is an expert of mathematical/computational modeling and analysis of various complex systems. He has published more than 100 peer-reviewed journal articles and conference proceedings papers and has edited eight books and conference proceedings about complex systems related topics. His publications have acquired more than 2000 citations as of July 2015. He currently serves as an elected Board Member of the International Society for Artificial Life (ISAL) and as an editorial board member for Complex Adaptive Systems Modeling (SpringerOpen), International Journal of Parallel, Emergent and Distributed Systems (Taylor & Francis), and Applied Network Science (SpringerOpen).

目录: Book Review

Introduction to the modeling and analysis of complex systems: a review
Muaz A. Niazi
Copyright information

Abstract

Sayama, H Introduction to the Modeling and Analysis of Complex Systems Open SUNY textbooks, Milne Library, State University of New York at Geneseo (2015). 485 pages, Print ISBN: 1942341083.

Overview

While there is considerable diversity in the domain of complex adaptive systems modeling research Niazi (2013), there are only a handful of books in the market suitable for use in complexity-related courses. Existing books include Boccara's "Modeling Complex Systems" Boccara (2010) and books with a focus on agent-based modeling including Macal and North's textbook Macal and North (2007) and Railsback and Grimm's book with a focus on the ecological perspective Railsback and Grimm (2011). Mathematically-oriented textbooks include a book by Edward and Hamson, Edwards and Hamson (2007) as well as one by Dym (2004). Hiroki Sayama's book "Introduction to the Modeling and Simulation of Complex Systems" is therefore a unique and welcome addition to any instructor's collection. What makes it valuable is that it not only presents a state-of-the-art review of the domain but also serves as a gentle guide to learning the sophisticated art of modeling complex systems.

The book is primarily composed of three types of chapters: preliminary chapters followed by logically interspersed modeling and analysis chapters. It has been designed for use both in basic as well as advanced courses spanning 1–2 semesters. Additionally, the book demonstrates the use of PyCX, a freely available Python-based complex systems simulation framework Sayama (2013).

Review

In terms of organization, the book is intuitively sectioned in three parts. The first part starts with an overview of complex systems basics. The second part covers introductory material for formal/mathematical modeling of complex systems. The third part deals with modeling complex systems with a large number of variables.

Part I

The first chapter gives a bird's eye view of the author's perspective of the complex systems universe. In the second chapter, basic concepts and a general overview of modeling and analysis of complex systems are described.

Part II

Chapter 3 describes fundamental concepts of dynamical systems and phase spaces. Chapter 4 describes discrete time modeling using difference equations with a hands-on approach. Chapter 5 focuses on the analysis of discrete-time models including the discovery of equilibrium points, phase space visualization, and cobweb plots among other topics. Chapter 6 describes continuous-time modeling using differential equations with an exercise involving developing a model's equation. Chapter 7 logically follows Chapter 6 with a focus on analyses similar to Chapter 5. Chapter 8 focuses on bifurcations in both continuous and discrete-time models. Chapter 9 introduces Chaos basics including Lyapunov exponent among other topics.

Part III

Chapter 10 introduces interactive simulation of complex systems using PyCX. Chapter 11 and 12 focus on the modeling and analysis of cellular automata models.

Continuous field models are described next in Chapter 13 and 14. Chapter 15 introduces network models and is followed by three chapters on the modeling and analysis of dynamic networks both in terms of topology as well as dynamics. The final Chapter 19 introduces agent-based models.

Price

The eVersion of the book is available for free. Additionally, there are two different prices for the color and black and white editions of the printed book—making it an economical buy in either case.

Conclusions

Overall, the book covers a lot of material and is an excellent compendium for modeling and simulation researchers as well as grad students and instructors. After reading it, the only hope is that Dr. Sayama would perhaps also consider adding a second volume or a few chapters in the next edition to discuss more topics specific to agents and agent-based modeling.

Competing interests

The author declare that they have no competing interests.

References

Boccara N (2010) Modeling complex systems. Springer, Heidelberg

Dym C (2004) Principles of mathematical modeling. Academic press, New York

Edwards D, Hamson M (2007) Guide to mathematical modelling. Industrial Press, South Norwalk

Macal CM, North M (2007) Managing business complexity: discovering strategic solutions with agent-based modeling and simulation. Oxford Scholarship Online

Niazi MA (2013) Complex adaptive systems modeling: a multidisciplinary roadmap. Complex Adaptive Syst Model 1(1):1–14

CrossRef

Railsback SF, Grimm V (2011) Agent-based and individual-based modeling: a practical introduction. Princeton University Press, Princeton

Sayama H (2013) Pycx: a python-based simulation code repository for complex systems education. Complex Adaptive Syst Model 1(1):1–10

CrossRef

· · · · · · ([收起](#))

[Introduction to the Modeling and Analysis of Complex Systems_下载链接1_](#)

标签

chaos

计算机

编程

Python

Programming

NECSI

评论

NECSI合作者写的，日本写的书就是简单，不过最后对复杂科学有基础，否则有代码也白干

非常非常清楚易懂，书略厚……

[Introduction to the Modeling and Analysis of Complex Systems_下载链接1_](#)

书评

[Introduction to the Modeling and Analysis of Complex Systems_下载链接1_](#)