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Complex and Adaptive Dynamical Systems: A Primer (Springer Complexity)

Claudius Gros

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Complex system theory is rapidly developing and gaining importance, providing tools and concepts central to our modern understanding of emergent phenomena. This primer offers an introduction to this area together with detailed coverage of the mathematics involved.

All calculations are presented step by step and are straightforward to follow. This new third edition comes with new material, figures and exercises.

Network theory, dynamical systems and information theory, the core of modern complex system sciences, are developed in the first three chapters, covering basic concepts and phenomena like small-world networks, bifurcation theory and information entropy.

Further chapters use a modular approach to address the most important concepts in complex system sciences, with the emergence and self-organization playing a central role. Prominent examples are self-organized criticality in adaptive systems, life at the edge of chaos, hypercycles and coevolutionary avalanches, synchronization phenomena, absorbing phase transitions and the cognitive system approach to the brain.

Technical course prerequisites are the standard mathematical tools for an advanced undergraduate course in the natural sciences or engineering. Each chapter comes with exercises and suggestions for further reading - solutions to the exercises are provided in the last chapter.

From the reviews of previous editions:

This is a very interesting introductory book written for a broad audience of graduate students in natural sciences and engineering. It can be equally well used both for teaching and self-education. Very well structured and every topic is illustrated by simple and motivating examples. This is a true guidebook to the world of complex nonlinear phenomena. (Ilya Pavlyukevich, Zentralblatt MATH, Vol. 1146, 2008)

"Claudius Gros's Complex and Adaptive Dynamical Systems: A Primer is a welcome addition to the literature. . A particular strength of the book is its emphasis on analytical techniques for studying complex systems. (David P. Feldman, Physics Today, July, 2009)

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