

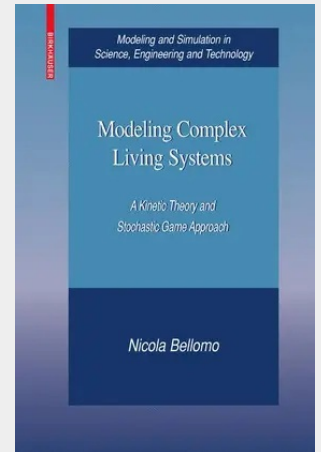
Modeling Complex Living Systems

A Kinetic Theory and Stochastic Game Approach

This book develops new mathematical methods and tools to model living systems. The material it presents can be used in such real-world applications as immunology, transportation engineering, and economics. The first part of the book deals with deriving general evolution equations that can be customized to particular systems of interest in the applied sciences. The second part of the book deals with various models and applications.

Specific topics covered include: modeling of the competition between cells of an aggressive invasive agent and cells of the immune system; modeling of vehicular traffic flow; modeling of swarms and crowd dynamics in complex geometric environments; and methodological aspects related to multiscale modeling of large systems viewed as interconnected subsystems. The book will be of interest applied mathematicians, engineers, physicists, biologists, economists, and graduate students involved in modeling complex social systems and living matter in general.

The subject of this book is the modeling of complex systems in the life sciences constituted by a large number of interacting entities called active particles. Their physical state includes, in addition to geometrical and mechanical variables, a variable called the activity, which characterizes the specific living system to be modeled. Interactions among particles not only modify the microscopic state, but may generate proliferative and/or destructive phenomena. The aim of the book is to develop mathematical methods and tools, even a new mathematics, for the modeling of living systems. The background idea is that the modeling of living systems requires technically complex mathematical methods, which may be substantially different from those used to deal with inert matter. The first part of the book discusses methodological issues, namely the derivation of various general mathematical frameworks suitable to model particular systems of interest in the applied sciences. The second part presents the various models and applications. The mathematical approach used in the book is based on mathematical kinetic theory for active particles, which leads to the derivation of evolution equations for a one-particle distribution function over the microscopic state. Two types of equations, to be regarded as a general mathematical framework for deriving the models, are derived corresponding to short and long range interactions.



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