

A Comprehensive Physically Based Approach to Modeling in Bioengineering and Life Sciences

Riccardo Sacco, Giovanna Guidoboni, Aurelio Giancarlo Mauri

A Comprehensive Physically Based Approach to Modeling in Bioengineering and Life Sciences provides a systematic methodology to the formulation of problems in biomedical engineering and the life sciences through the adoption of mathematical models based on physical principles, such as the conservation of mass, electric charge, momentum, and energy. It then teaches how to translate the mathematical formulation into a numerical algorithm that is implementable on a computer. The book employs computational models as synthesized tools for the investigation, quantification, verification, and comparison of different conjectures or scenarios of the behavior of a given compartment of the human body under physiological and pathological conditions.

Key Features

- Presents theoretical (modeling), biological (experimental), and computational (simulation) perspectives
- Features examples, exercises, and MATLAB codes for further reader involvement
- Covers basic and advanced functional and computational techniques throughout the book

About the Authors

Riccardo Sacco, PhD, is an applied mathematician whose research and teaching activities span a wide variety of topics, including computational biology, semiconductor device modeling and simulation, computational fluid mechanics, and finite element analysis. Dr. Sacco has been appointed as a member of the Editorial Board of the "Journal of Coupled Systems and Multiscale Dynamics" and of the "Journal of Modeling for Ophthalmology." In a joint partnership with Prof. Guidoboni and Prof. Harris, Dr. Sacco has promoted a series of international workshops, congresses, and doctoral courses with the twofold purpose of disseminating the use of mathematical and numerical methods in the study and clinical treatment of ophthalmological diseases and of fostering and favoring the interaction among students, scientists, and researchers in the fields of applied sciences and life sciences.

Giovanna Guidoboni, PhD, is an applied mathematician with expertise in mathematical and computational modeling of complex fluid flows arising in engineering and biomedical applications. Dr. Guidoboni has promoted the development of interdisciplinary approaches in physiology and ophthalmology at the international level. She co-founded a new peer-reviewed scientific journal titled "Journal for Modeling in Ophthalmology," for which she currently serves as co-Chief Editor and Managing Editor, and a new series of interdisciplinary congresses and doctoral courses creating a forum where ophthalmologists, physiologists, mathematicians, engineers, physicists, and biologists can discuss new ideas on how to address outstanding challenges in ophthalmology.

Aurelio Giancarlo Mauri, MSc, is a Senior Member of the Technical Staff of Micron Technology, where he currently works in the numerical simulation group appointed for the physical modeling of electronic devices. He is the main author of FEMOS-MP (Finite Element Method Oriented Simulator for Multiphysics Problems), a C++ platform for the simulation of complex multiphysics systems including thermomechanical effects, chemical reactions and kinetics, semiconductors, and nonconventional materials in the continuum framework and using atomistic kinetic Monte Carlo methods. Currently, he also holds a lecturer fellowship at Politecnico di Milano for the courses "Numerical Analysis" and "Computational Modeling for Electronics and Biomathematics."



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