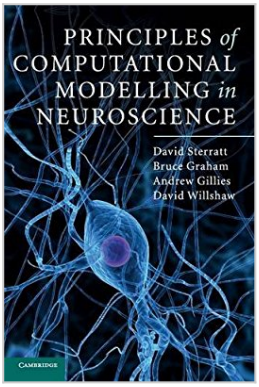

Principles of Computational Modelling in Neuroscience

By David Sterratt, Bruce Graham, Dr Andrew Gillies, David Willshaw

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The nervous system is made up of a large number of interacting elements. To understand how such a complex system functions requires the construction and analysis of computational models at many different levels. This book provides a step-by-step account of how to model the neuron and neural circuitry to understand the nervous system at all levels, from ion channels to networks. Starting with a simple model of the neuron as an electrical circuit, gradually more details are added to include the effects of neuronal morphology, synapses, ion channels and intracellular signaling. The principle of abstraction is explained through chapters on simplifying models, and how simplified models can be used in networks. This theme is continued in a final chapter on modeling the development of the nervous system. Requiring an elementary background in neuroscience and some high school mathematics, this textbook is an ideal basis for a course on computational neuroscience.

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Editorial Review

Review
"Here at last is a book that is aware of my problem, as an experimental neuroscientist, in understanding the maths, the book helps me deal with it with the patience that the team always showed to students and professors alike. I expect it to be as mind expanding as my involvement with its authors was over the years. I only wish I had had the whole book sooner - then my students and post-docs would have been able to understand what I was trying to say and been able to derive the critical tests of the ideas that only the rigor of the mathematical formulation of them could have generated."
Gordon W. Arbuthnott, Okinawa Institute of Science and Technology

"This is a wonderful, clear and compelling text on mathematically-minded computational modelling in neuroscience. It is beautifully aimed at those engaged in capturing quantitatively, and thus simulating, complex neural phenomena at multiple spatial and temporal scales, from intracellular calcium dynamics and stochastic ion channels, through compartmental modelling, all the way to aspects of development. It takes particular care to define the processes, potential outputs and even some pitfalls of modelling; and can be recommended for containing the key lessons and pointers for people seeking to build their own computational models. By eschewing issues of coding and information processing, it largely hews to concrete biological data, and it nicely avoids sacrificing depth for breadth. It is very suitably pitched as a Master's level text, and its two appendices, on mathematical methods and software resources, will rapidly become dog-eared."
Peter Dayan, University College London

"This book has done a nice job of laying out their strategy or covering major topics in the field of computational neuroscience while maintaining a well-organized structure. It is prepared for both expert and non-expert readers with an elementary background in neuroscience and some high school mathematics. This is a timely, well-written book that provides a comprehensive, in-depth and state-of-the-art coverage of computational modeling in neuroscience. It can serve as an excellent text for a graduate level course in computational neuroscience, as well as a valuable reference for experimental neuroscientists, computational neuroscientists and people working in relevant areas such as neuroinformatics and systems biology."
Li Shen, Briefings in Bioinformatics

About the Author
David Sterratt is a Research Fellow in the School of Informatics at the University of Edinburgh. His computational neuroscience research interests include models of learning and forgetting, and the formation of connections within the developing nervous system.

Bruce Graham is a Reader in Computing Science in the Department of Computing Science and Mathematics at the University of Stirling. Focusing on computational neuroscience, his research covers nervous system modelling at many levels.

Andrew Gillies works at Psymetrix Limited, Edinburgh. He has been actively involved in computational neuroscience research.

David Willshaw is Professor of Computational Neurobiology in the School of Informatics at the University of Edinburgh. His research focuses on the application of methods of computational neurobiology to an

understanding of the development and functioning of the nervous system.

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