

Lecture Notes in Biomathematics

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G. Sampath
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Stochastic Models for Spike Trains
of Single Neurons



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Stochastic Models For Spike Trains Of Single Neurons

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Stochastic models for spike trains of single neurons G. Sampath, S. K. Srinivasan, 1977 *Stochastic Models for Spike Trains of Single Neurons*

G. Sampath, 1974 **Analysis of Parallel Spike Trains** Sonja Grün, Stefan Rotter, 2010-08-18 Solid and transparent data analysis is the most important basis for reliable interpretation of experiments The technique of parallel spike train recordings using multi electrode arrangements has been available for many decades now but only recently gained wide popularity among electro physiologists Many traditional analysis methods are based on firing rates obtained by trial averaging and some of the assumptions for such procedures to work can be ignored without serious consequences The situation is different for correlation analysis the result of which may be considerably distorted if certain critical assumptions are violated The focus of this book is on concepts and methods of correlation analysis synchrony patterns rate covariance combined with a solid introduction into approaches for single spike trains which represent the basis of correlations analysis The book also emphasizes pitfalls and potential wrong interpretations of data due to violations of critical assumptions *Single Neuron Computation* Thomas M. McKenna, Joel L. Davis, Steven F. Zornetzer, 2014-05-19 This book contains twenty two original contributions that provide a comprehensive overview of computational approaches to understanding a single neuron structure The focus on cellular level processes is twofold From a computational neuroscience perspective a thorough understanding of the information processing performed by single neurons leads to an understanding of circuit and systems level activity From the standpoint of artificial neural networks ANNs a single real neuron is as complex an operational unit as an entire ANN and formalizing the complex computations performed by real neurons is essential to the design of enhanced processor elements for use in the next generation of ANNs The book covers computation in dendrites and spines computational aspects of ion channels synapses patterned discharge and multistate neurons and stochastic models of neuron

dynamics It is the most up to date presentation of biophysical and computational methods Spiking Neuron Models Wulfram Gerstner, Werner M. Kistler, 2002-08-15 Neurons in the brain communicate by short electrical pulses the so called action potentials or spikes How can we understand the process of spike generation How can we understand information transmission by neurons What happens if thousands of neurons are coupled together in a seemingly random network How does the network connectivity determine the activity patterns And vice versa how does the spike activity influence the connectivity pattern These questions are addressed in this 2002 introduction to spiking neurons aimed at those taking courses in computational neuroscience theoretical biology biophysics or neural networks The approach will suit students of physics mathematics or computer science it will also be useful for biologists who are interested in mathematical modelling The text is enhanced by many worked examples and illustrations There are no mathematical prerequisites beyond what the audience would meet as undergraduates more advanced techniques are introduced in an elementary concrete fashion when needed Neural and Brain Modeling Ronald MacGregor, 2012-12-02 Neural and Brain Modeling reviews models used to study neural interactions The book also discusses 54 computer programs that simulate the dynamics of neurons and neuronal networks to illustrate between unit and systemic levels of nervous system functions The models of neural and brain operations are composed of three sections models of generic mechanisms models of specific neuronal systems and models of generic operations networks and systems The text discusses the computational problems related to galvanizing a neuronal population through an activity in the multifiber input system The investigator can use a computer technique to simulate multiple interacting neuronal populations For example he can investigate the case of a single local region that contains two populations of neurons namely a parent population of excitatory cells and a second set of inhibitory neurons Computer simulation models predict the various dynamic activity occurring in the complicated structure and physiology of neuronal systems Computer models can be used in top down brain mind research where the systemic global and emergent properties of nervous systems are generated The book is recommended for behavioral scientists psychiatrists psychologists computer programmers students and professors in human behavior *Correlated neuronal activity and its relationship to coding, dynamics and network architecture* Tatjana Tchumatchenko, Ruben Moreno-Bote, 2014-12-03 Correlated activity in populations of neurons has been observed in many brain regions and plays a central role in cortical coding attention and network dynamics Accurately quantifying neuronal correlations presents several difficulties For example despite recent advances in multicellular recording techniques the number of neurons from which spiking activity can be simultaneously recorded remains orders magnitude smaller than the size of local networks In addition there is a lack of consensus on the distribution of pairwise spike cross correlations obtained in extracellular multi unit recordings These challenges highlight the need for theoretical and computational approaches to understand how correlations emerge and to decipher their functional role in the brain Biomedical Signal Processing Arnon Cohen, 2019-07-17 First published in 1986 The presentation of the

material in the book follows the flow of events of the general signal processing system After the signal has been acquired some manipulations are applied in order to enhance the relevant information present in the signal Simple Optimal and adaptive filtering are examples of such manipulations The detection of wavelets is of importance in biomedical signals they can be detected from the enhanced signal by several methods The signal very often contains redundancies When effective storing transmission or automatic classification are required these redundancies have to be extracted

Mathematical Models of the Dynamics of the Human Eye R. Collins,T. J. van der Werff,2013-03-08 A rich and abundant literature has developed during the last half century dealing with mechanical aspects of the eye mainly from clinical and experimental points of view For the most part workers have attempted to shed light on the complex set of conditions known by the general term glaucoma These conditions are characterised by an increase in intraocular pressure sufficient to cause de generation of the optic disc and concomitant defects in the visual field which if not controlled lead to inevitable permanent blindness In the United States alone an estimated 50 000 persons are blind as a result of glaucoma which strikes about 2% of the population over 40 years of age Vaughan and Asbury 1974 An understanding of the underlying mechanisms of glaucoma is hindered by the fact that elevated intraocular pressure like a runny nose is but a symptom which may have a variety of causes Only by turning to the initial pathology can one hope to understand this important class of medical problems

Trends in Biomathematics: Modeling Epidemiological, Neuronal, and Social Dynamics Rubem P. Mondaini,2023-07-24 This volume gathers together selected peer reviewed works presented at the BIOMAT 2022 International Symposium which was virtually held on November 7 11 2022 with an organization staff based in Rio de Janeiro Brazil Topics touched on in this volume include infection spread in a population described by an agent based approach the study of gene essentiality via network based computational modeling stochastic models of neuronal dynamics and the modeling of a statistical distribution of amino acids in protein domain families The reader will also find texts in epidemic models with dynamic social distancing with no vertical transmission and with general incidence rates Aspects of COVID 19 dynamics the use of an SEIR model to analyze its spread in Brazil the age dependent manner of modeling its spread pattern the impact of media awareness programs and a web based computational tool for Non invasive hemodynamics evaluation of coronary stenosis are also covered Held every year since 2001 The BIOMAT International Symposium gathers together in a single conference researchers from Mathematics Physics Biology and affine fields to promote the interdisciplinary exchange of results ideas and techniques promoting truly international cooperation for problem discussion BIOMAT volumes published from 2017 to 2021 are also available by Springer

[Biomathematics and Related Computational Problems](#) L.M. Ricciardi,2012-12-06 Biomathematics emerged and rapidly grew as an independent discipline in the late sixties as scientists with various backgrounds in the mathematical biological and physical sciences gathered together to form Departments and Institutes centered around this discipline that many at that time felt should fall between the cracks of legitimate science For various reasons some of these

new institutions vanished in the mid seventies particularly in the U S the main reason for their demise being economic Nevertheless good biomathematical so that the range research has been ceaselessly carried on by numerous workers worldwide of this activity appears now as truly impressive from useful and effective mathematical statements about problems that are firmly rooted in the wet reality of biology to deep theoretical investigations on outstanding basic questions It is also interesting to take note that some ideas and theories set forth by paleo biomathematicians almost a quarter of century ago are now becoming highly appreciated also by scientists engaged in quite different research fields For instance neural nets is the hot topic in computer science these days Well aware of the growing interest in this relatively new field years back I organized a small workshop on Biomathematics Current Status and Future Perspectives which was held at the University of Salerno during the middle of April 1980 *Introducing Computation to Neuroscience* Ad Aertsen, Sonja Grün, Pedro E. Maldonado, Günther Palm, 2022-11-10 This book brings together a selection of papers by George Gerstein representing his long term endeavor of making neuroscience into a more rigorous science inspired by physics where he had his roots Professor Gerstein was many years ahead of the field consistently striving for quantitative analyses mechanistic models and conceptual clarity In doing so he pioneered Computational Neuroscience many years before the term itself was born The overarching goal of George Gerstein s research was to understand the functional organization of neuronal networks in the brain The editors of this book have compiled a selection of George Gerstein s many seminal contributions to neuroscience be they experimental theoretical or computational into a single comprehensive volume The aim is to provide readers with a fresh introduction of these various concepts in the original literature The volume is organized in a series of chapters by subject ordered in time each one containing one or more of George Gerstein s papers [The Neurobiology of Computation](#) James M. Bower, 2012-12-06 This volume includes papers presented at the Third Annual Computation and Neural Systems meeting CNS 94 held in Monterey California July 21 July 26 1994 This collection includes 71 of the more than 100 papers presented at this year s meeting Acceptance for meeting presentation was based on the peer review of preliminary papers by at least two referees The papers in this volume were submitted in final form after the meeting As represented by this volume CNS meetings continue to expand in quality size and breadth of focus as increasing numbers of neuroscientists are taking a computational approach to understanding nervous system function The CNS meetings are intended to showcase the best of current research in computational neuroscience As such the meeting is fundamentally focused on understanding the relationship between the structure of nervous systems and their function What is clear from the continued expansion of the CNS meetings is that computational approaches are increasingly being applied at all levels of neurobiological analysis in an ever growing number of experimental preparations and neural subsystems Thus experimental subjects range from crickets to primates sensory systems range from vision to electroreception experimental approaches range from realistic models of ion channels to the analysis of the information content of spike trains For this reason the CNS meetings represent an opportunity

for computational neurobiologists to consider their research results in a much broader context than is usually possible

Neural Information Processing. Theory and Algorithms Kevin K.W. Wong, B. Sumudu U. Mendis, Abdesselam Bouzerdoum, 2010-11-18 The two volume set LNCS 6443 and LNCS 6444 constitutes the proceedings of the 17th International Conference on Neural Information Processing ICONIP 2010 held in Sydney Australia in November 2010 The 146 regular session papers presented were carefully reviewed and selected from 470 submissions The papers of part I are organized in topical sections on neurodynamics computational neuroscience and cognitive science data and text processing adaptive algorithms bio inspired algorithms and hierarchical methods The second volume is structured in topical sections on brain computer interface kernel methods computational advance in bioinformatics self organizing maps and their applications machine learning applications to image analysis and applications

Modelling of Patterns in Space and Time W. Jäger, J.D. Murray, 2013-03-13 This volume contains a selection of papers presented at the work shop Modelling of Patterns in Space and Time organized by the 80nderforschungsbereich 123 8tochastische Mathematische Modelle in Heidelberg July 4 8 1983 The main aim of this workshop was to bring together physicists chemists biologists and mathematicians for an exchange of ideas and results in modelling patterns Since the mathe matical problems arising depend only partially on the particular field of applications the interdisciplinary cooperation proved very useful The workshop mainly treated phenomena showing spatial structures The special areas covered were morphogenesis growth in cell cultures competition systems structured populations chemotaxis chemical precipitation space time oscillations in chemical reactors patterns in flames and fluids and mathematical methods The discussions between experimentalists and theoreticians were especially interesting and effective The editors hope that these proceedings reflect at least partially the atmosphere of this workshop For the convenience of the reader the papers are ordered alpha betically according to authors However the table of contents can easily be grouped into the main topics of the workshop For practical reasons it was not possible to reproduce in colour the beautiful pictures of patterns shown at the workshop Since a larger number of half tone pictures could be included in this volume the loss of information has however been kept to a minimum The workshop has already stimulated cooperation between its parti cipants and this volume is intended to spread this effect

Biophysics of Computation Christof Koch, 2004-10-28 Neural network research often builds on the fiction that neurons are simple linear threshold units completely neglecting the highly dynamic and complex nature of synapses dendrites and voltage dependent ionic currents Biophysics of Computation Information Processing in Single Neurons challenges this notion using richly detailed experimental and theoretical findings from cellular biophysics to explain the repertoire of computational functions available to single neurons The author shows how individual nerve cells can multiply integrate or delay synaptic inputs and how information can be encoded in the voltage across the membrane in the intracellular calcium concentration or in the timing of individual spikes Key topics covered include the linear cable equation cable theory as applied to passive dendritic trees and

dendritic spines chemical and electrical synapses and how to treat them from a computational point of view nonlinear interactions of synaptic input in passive and active dendritic trees the Hodgkin Huxley model of action potential generation and propagation phase space analysis linking stochastic ionic channels to membrane dependent currents calcium and potassium currents and their role in information processing the role of diffusion buffering and binding of calcium and other messenger systems in information processing and storage short and long term models of synaptic plasticity simplified models of single cells stochastic aspects of neuronal firing the nature of the neuronal code and unconventional models of sub cellular computation Biophysics of Computation Information Processing in Single Neurons serves as an ideal text for advanced undergraduate and graduate courses in cellular biophysics computational neuroscience and neural networks and will appeal to students and professionals in neuroscience electrical and computer engineering and physics **Mathematics of Biology**

G. Koch,Michiel Hazewinkel,2013-11-11 *Advances in Neural Information Processing Systems 12* Sara A. Solla,Klaus-Robert Müller,Todd K. Leen,2000 The annual conference on Neural Information Processing Systems NIPS is the flagship conference on neural computation It draws preeminent academic researchers from around the world and is widely considered to be a showcase conference for new developments in network algorithms and architectures The broad range of interdisciplinary research areas represented includes computer science neuroscience statistics physics cognitive science and many branches of engineering including signal processing and control theory Only about 30 percent of the papers submitted are accepted for presentation at NIPS so the quality is exceptionally high These proceedings contain all of the papers that were presented **Cumulated Index Medicus** ,1968

The book delves into Stochastic Models For Spike Trains Of Single Neurons. Stochastic Models For Spike Trains Of Single Neurons is an essential topic that must be grasped by everyone, ranging from students and scholars to the general public. This book will furnish comprehensive and in-depth insights into Stochastic Models For Spike Trains Of Single Neurons, encompassing both the fundamentals and more intricate discussions.

1. This book is structured into several chapters, namely:
 - Chapter 1: Introduction to Stochastic Models For Spike Trains Of Single Neurons
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 - Chapter 4: Stochastic Models For Spike Trains Of Single Neurons in Specific Contexts
 - Chapter 5: Conclusion
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 3. In chapter 2, the author will delve into the foundational concepts of Stochastic Models For Spike Trains Of Single Neurons. This chapter will elucidate the essential principles that need to be understood to grasp Stochastic Models For Spike Trains Of Single Neurons in its entirety.
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 6. In chapter 5, this book will draw a conclusion about Stochastic Models For Spike Trains Of Single Neurons. The final chapter will summarize the key points that have been discussed throughout the book.
- This book is crafted in an easy-to-understand language and is complemented by engaging illustrations. It is highly recommended for anyone seeking to gain a comprehensive understanding of Stochastic Models For Spike Trains Of Single Neurons.

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Stochastic Models For Spike Trains Of Single Neurons Introduction

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