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mathematics of cell electrophysiology

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Alan C. Krinik, Randall J. Swift



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Chudnovsky,Richard D. Jenks,1990-05-25 Talks from the International Conference on Computers and Mathematics held July 29 Aug 1 1986 Stanford U Some are focused on the past and future roles of computers as a research tool in such areas as number theory analysis special functions combinatorics algebraic geometry topology physics **An Introduction to**

Mathematical Modeling in Physiology, Cell Biology, and Immunology James Sneyd,2002 In many respects biology is the new frontier for applied mathematicians This book demonstrates the important role mathematics plays in the study of some biological problems It introduces mathematicians to the biological sciences and provides enough mathematics for bioscientists to appreciate the utility of the modelling approach The book presents a number of diverse topics such as neurophysiology cell biology immunology and human genetics It examines how research is done what mathematics is used what the outstanding questions are and how to enter the field Also given is a brief historical survey of each topic putting current research into perspective The book is suitable for mathematicians and biologists interested in mathematical methods in biology *Mathematical Cardiac Electrophysiology* Piero Colli Franzone, Luca Franco Pavarino, Simone

Scacchi,2014-10-30 This book covers the main mathematical and numerical models in computational electrocardiology ranging from microscopic membrane models of cardiac ionic channels to macroscopic bidomain monodomain eikonal models and cardiac source representations These advanced multiscale and nonlinear models describe the cardiac bioelectrical activity from the cell level to the body surface and are employed in both the direct and inverse problems of electrocardiology The book also covers advanced numerical techniques needed to efficiently carry out large scale cardiac simulations including time and space discretizations decoupling and operator splitting techniques parallel finite element solvers These techniques are employed in 3D cardiac simulations illustrating the excitation mechanisms the anisotropic effects on excitation and repolarization wavefronts the morphology of electrograms in normal and pathological tissue and some reentry phenomena The overall aim of the book is to present rigorously the mathematical and numerical foundations of computational electrocardiology illustrating the current research developments in this fast growing field lying at the intersection of mathematical physiology bioengineering and computational biomedicine This book is addressed to graduate student and researchers in the field of applied mathematics scientific computing bioengineering electrophysiology and cardiology

Mathematical Physiology James Keener,James Sneyd,2006-04-18 Divided into two parts the book begins with a pedagogical presentation of some of the basic theory with chapters on biochemical reactions diffusion excitability wave propagation and cellular homeostasis The second more extensive part discusses particular physiological systems with chapters on calcium dynamics bursting oscillations and secretion cardiac cells muscles intercellular communication the circulatory system the immune system wound healing the respiratory system the visual system hormone physiology renal

physiology digestion the visual system and hearing

Mathematical Aspects of Hodgkin-Huxley Neural Theory Jane Cronin, 1987-08-28 This book is an introduction to the study of mathematical models of electrically active cells which play an essential role in for example nerve conduction and cardiac functions In the book Dr Cronin synthesizes and reviews this material and provides a detailed discussion of the Hodgkin Huxley model for nerve conduction which forms the cornerstone of this body of work

Zipes and Jalife's Cardiac Electrophysiology: From Cell to Bedside, E-Book Jose Jalife, William Gregory Stevenson, 2021-12-16 Fully updated from cover to cover Zipes and Jalife's Cardiac Electrophysiology From Cell to Bedside 8th Edition provides the comprehensive multidisciplinary coverage you need from new knowledge in basic science to the latest clinical advances in the field Drs Jos Jalife and William Gregory Stevenson lead a team of global experts who provide cutting edge content and step by step instructions for all aspects of cardiac electrophysiology Packs each chapter with the latest information necessary for optimal basic research as well as patient care Covers new technologies such as CRISPR protein research improved cardiac imaging optical mapping and wearable devices Contains significant updates in the areas of molecular biology and genetics iPSCs induced pluripotent stem cells embryonic stem cells precision medicine antiarrhythmic drug therapy cardiac mapping with advanced techniques and ablation technologies including stereotactic radioablation Includes 47 new chapters covering both basic science and clinical topics Discusses extensive recent progress in the understanding diagnosis and management of arrhythmias including new clinical insights on atrial fibrillation and stroke prevention new advances in the understanding of ventricular arrhythmias in genetic disease and advances in implantable devices and infection management Features 1 600 high quality photographs anatomic and radiographic images electrocardiograms tables algorithms and more with additional figures tables and videos online Recipient of a 2018 Highly Commended award from the British Medical Association Enhanced eBook version included with purchase Your enhanced eBook allows you to access all of the text figures and references from the book on a variety of devices

Mathematical Modelling Murray S. Klamkin, 1987-01-01 Designed for classroom use this book contains short self contained mathematical models of problems in the physical mathematical and biological sciences first published in the Classroom Notes section of the SIAM Review from 1975 1985 The problems provide an ideal way to make complex subject matter more accessible to the student through the use of concrete applications Each section has extensive supplementary references provided by the editor from his years of experience with mathematical modelling

Evolution Equations, Semigroups and Functional Analysis Brunello Terreni, 2002 Brunello Terreni 1953 2000 was a researcher and teacher with vision and dedication The present volume is dedicated to the memory of Brunello Terreni His mathematical interests are reflected in 20 expository articles written by distinguished mathematicians The unifying theme of the articles is evolution equations and functional analysis which is presented in various and diverse forms parabolic equations semigroups stochastic evolution optimal control existence uniqueness and regularity of solutions inverse problems as well as applications Contributors P Acquistapace V

Barbu A Briani L Boccardo P Colli Franzone G Da Prato D Donatelli A Favini M Fuhrmann M Grasselli R Illner H Koch R Labbas H Lange I Lasiecka A Lorenzi A Lunardi P Marcati R Nagel G Nickel V Pata M M Porzio B Ruf G Savar R Schnaubelt E Sinestrari H Tanabe H Teismann E Terraneo R Triggiani A Yagi Quantitative Cardiac Electrophysiology David Rosenbaum, 2002-08-13 Provides an in depth study of the theoretical and engineering principles behind the methods and technologies used to solve problems in experimental and clinical cardiac electrophysiology Each chapter gives an extensive description of the principles underlying a simple method or technology and illustrates how it can be applied to solve problems in **Mathematical modelling and electrophysiological monitoring of the regulation of cochlear amplification** Greg A. O'Beirne, 2005-08-30 The cochlea presumably possesses a number of regulatory mechanisms to maintain cochlear sensitivity in the face of disturbances to its function Evidence for such mechanisms can be found in the time course of the recovery of CAP thresholds during experimental manipulations and in observations of slow oscillations in cochlear micromechanics following exposure to low frequency tones the bounce phenomenon and other perturbations To increase our understanding of these oscillatory processes within the cochlea and OHCs in particular investigations into cochlear regulation were carried out using a combination of mathematical modelling of the ionic and mechanical interactions likely to exist within the OHCs and electrophysiological experiments conducted in guinea pigs The electrophysiological experiments consisted of electrocochleographic recordings and in some cases measurement of otoacoustic emissions during a variety of experimental perturbations including the application of force to the cochlear wall exposure to very low frequency tones injection of direct current into scala tympani and intracochlear perfusions of artificial perilymph containing altered concentrations of potassium sodium and sucrose To obtain a panoramic view of cochlear regulation under these conditions software was written to enable the interleaved and near simultaneous measurement of multiple indicators of cochlear function including the compound action potential CAP threshold amplitude and waveshape at multiple frequencies the OHC transfer curves derived from low frequency cochlear microphonic CM waveforms distortion product otoacoustic emissions DPOAEs the spectrum of the round window neural noise SNN and the endocochlear potential EP The mathematical model takes into account the known electrical properties of OHC and includes the effect of fast and slow motility of the cell body on transducer operating point and apical conductance Central to the operation of the model is a putative intracellular 2nd messenger system based on cytosolic calcium which is involved in regulation of i the operating point of OHC MET channels via slow motility and axial stiffness ii the permeability of the basolateral wall to potassium via calcium sensitive potassium channels and iii the cytosolic concentration of calcium itself via modulation of its own sequestration into and release from intracellular storage organelles and extrusion from the cell The model was constructed in a manner which allowed simulation of different cochlear perturbations and the comparison of results from these simulations to experimental data The mathematical model we have developed provided a physiologically plausible and internally consistent explanation for the

time courses of the cochlear changes observed during a number of different perturbations We show that much of the oscillatory behaviour within the cochlea is consistent with underlying oscillations in cytosolic calcium concentration We conclude that a number of the discrepancies between the simulation results and the experimental data can be resolved if the cytosolic calcium functions as two distinct pools one which controls basolateral permeability and one which controls slow motility This two calcium pool model is discussed

Mathematics for Large Scale Computing Julio Diaz,2020-06-29 During recent years a great deal of interest has been devoted to large scale computing applications This has occurred in great part because of the introduction of advanced high performance computer architectures The book contains survey articles as well as chapters on specific research applications development and analysis of numerical algorithms and performance evaluation of algorithms on advanced architectures The effect of specialized architectural features on the performance of large scale computation is also considered by several authors Several areas of applications are represented including the numerical solution of partial differential equations iterative techniques for large structured problems the numerical solution of boundary value problems for ordinary differential equations numerical optimization and numerical quadrature Mathematical issues in computer architecture are also presented including the description of grey codes for generalized hypercubes The results presented in this volume give in our opinion a representative picture of today s state of the art in several aspects of large scale computing

Mathematical and Numerical Modeling of the Cardiovascular System and Applications Daniele Boffi, Luca F. Pavarino, Gianluigi Rozza, Simone Scacchi, Christian Vergara, 2018-11-03 The book comprises contributions by some of the most respected scientists in the field of mathematical modeling and numerical simulation of the human cardiocirculatory system It covers a wide range of topics from the assimilation of clinical data to the development of mathematical and computational models including with parameters as well as their efficient numerical solution and both in vivo and in vitro validation It also considers applications of relevant clinical interest This book is intended for graduate students and researchers in the field of bioengineering applied mathematics computer computational and data science and medicine wishing to become involved in the highly fascinating task of modeling the cardiovascular system

Methods in Ring Theory Vesselin Drensky, 2021-02-27 Furnishes important research papers and results on group algebras and PI algebras presented recently at the Conference on Methods in Ring Theory held in Levico Terme Italy familiarizing researchers with the latest topics techniques and methodologies encompassing contemporary algebra

Mathematical Logic and Formal Systems Alcantara, 1985-04-25 This unique collection of research papers provides an important contribution to the area of Mathematical Logic and Formal Systems Exploring interesting practical applications as well as problems for further investigation this single source reference discusses the interpretations of the concept of probability and their relationship to statistical methods illustrates the problem of set theoretical foundations and category theory treats the various aspects of the theory of large cardinals including combinatorial properties of some sets naturally related to them

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Cardiac Electrophysiology Methods and Models Paul A. Iaizzo, Michael D. Eggen, Tinen L. Iles, 2024-12-24 Cardiovascular disease is the major cause of mortality and morbidity around the world While significant progress has been made in treating a major sub category of cardiac disease and arrhythmias significant unmet needs remain Every day thousands of patients die due to arrhythmias in the U S alone and atrial fibrillation is the most common arrhythmia that affects millions of Americans at any given time Therefore there is an urgent public need to continue to develop new and better therapies for arrhythmias This book reviews key research methods and protocols in cardiac electrophysiology with a focus on advantages and pitfalls It will discuss new developments as well as traditional treatments and methods Chapters will focus on practical implementation and collaborative cross functional research methods The book will contain contributions from scientists and clinicians from various academic and industrial research institutions The inclusion of industrial experts expands the scope and potential audience of this book and provides important perspective beyond basic science Contributors will include researchers and clinicians from academic institutions such as the University of Minnesota Harvard Washington University Case Western Indiana University and Manchester University Methods and Models in Cardiac Electrophysiology will be a must have resource for clinical academic scientists engineers from industry Biotech Pharma and Medical Device undergraduate and graduate students physicians biomedical engineers and high school and college teachers interested in studying cardiac electrophysiology and cardiac function The book may also be of interest to students in the fields of physiology molecular biology cellular biology biomedical engineering mechanical engineering electrical engineering and related areas

Dynamical Systems, PDEs and Networks for Biomedical Applications: Mathematical Modeling, Analysis and Simulations André H. Erhardt, Krasimira Tsaneva-Atanasova, Glenn Terje Lines, Erik Andreas Martens, 2023-02-15

Stochastic Processes and Functional Analysis Alan C. Krinik, Randall J. Swift, 2004-03-23 This extraordinary compilation is an expansion of the recent American Mathematical Society Special Session celebrating M M Rao's distinguished career and includes most of the presented papers as well as ancillary contributions from session invitees This book shows the effectiveness of abstract analysis for solving fundamental problems of stochas

Representations of Algebras Fla'vio Ulhoa Coelho, 2019-05-20 This volume contains the proceedings of the Conference on Representations of Algebras Sao Paulo CRASP held at the Instituto de Matematica e Estatistica of the Universidade de Sao Paulo Brazil It discusses Hopf tubular quasischurian wild hereditary concealed canonical Artin Brauer star and Koszul algebras

Hopf Algebras and Quantum Groups Stefaan Caenepeel, Freddy Van Oystaeyen, 2000-04-05 This volume is based on the proceedings of the Hopf Algebras and Quantum Groups conference at the Free University of Brussels Belgium It presents

state of the art papers selected from over 65 participants representing nearly 20 countries and more than 45 lectures on the theory of Hopf algebras including multiplier Hopf algebras and quantum groups

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