
Handbook of Modern Biophysics

Series Editor

Thomas Jue
University of California, Davis
Davis, CA, USA

More information about this series at <http://www.springer.com/series/7845>

Thomas Jue
Editor

Modern Tools
of Biophysics
Volume 5

 Springer

Editor

Thomas Jue
Department of Biochemistry and Molecular Medicine
University of California, Davis
Davis, CA, USA

ISBN 978-1-4939-6711-7 ISBN 978-1-4939-6713-1 (eBook)
DOI 10.1007/978-1-4939-6713-1

Library of Congress Control Number: 2016960567

© Springer Science+Business Media LLC 2017

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made.

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer Science+Business Media LLC
The registered company address is: 233 Spring Street, New York, NY 10013, U.S.A.

Preface

The rapid growth in biophysics presents a unique challenge for educators, for they must introduce a burgeoning array of scientific ideas and tools. The “Handbook of Modern Biophysics” keeps pace with the development by introducing topics on modern tools in biophysics with a balanced format, which combines the need to understand the physical science/mathematics formalism with the demand to apprehend biomedical relevance. In the style of the past volumes, each chapter contains two major parts: The first part establishes the conceptual framework that underpins the biophysics instrumentation or technique. The second part illustrates current applications in biomedicine. With the additional sections on further reading, problems, and references, the chapter can serve as a didactic guide for interested reader to further explore different ideas.

In the fifth volume of the series “Tools of Modern Biophysics,” the authors have laid down a foundation in modern Biophysics. Leighton Izu opens the book with wave theory that explains image formation in a microscope. His description and practical explanation provide a framework to understanding modern microscopy. Ye Chen Izu describes the recording of ion currents in modern experiments, especially with respect to action potential clamp and onion-peeling technique. Chao-yin Chen provides a practical view of patch clamp techniques and application. Robert Fairclough moves deeper into the molecular world and introduces anomalous low angle X-ray scattering of membrane with lanthanides. Daisuke Sato introduces to the reader computer simulation of the nonlinear dynamics observed in cardiac action potential. He shows the efficacy of using graphics processing units (GPU) in modeling the dynamics. Finally, Benjamin Chatel discusses a timely topic about the appropriate interpretation of the popular near infrared spectroscopy (NIRS) method to measure tissue oxygenation.

Volume 5 continues then the philosophy behind the “Handbook of Modern Biophysics” series and provides the reader with a conceptual grasp of current biophysics and key biomedical perspectives.

Davis, CA, USA

Thomas Jue

Contents

1	Wave Theory of Image Formation in a Microscope: Basic Theory and Experiments	1
	Leighton T. Izu, James Chan, and Ye Chen-Izu	
2	Recording of Ionic Currents Under Physiological Conditions: Action Potential-Clamp and ‘Onion-Peeling’ Techniques	31
	Ye Chen-Izu, Leighton T. Izu, Bence Hegyi, and Tamás Bányász	
3	Patch Clamp Technique and Applications	49
	Chao-Yin Chen	
4	Structural Insights from Membrane Small-Angle X-ray Diffraction with Anomalous X-ray Scattering	65
	Robert H. Fairclough and Thomas E. Lee	
5	Computer Simulations and Nonlinear Dynamics of Cardiac Action Potentials	81
	Daisuke Sato	
6	Hemoglobin and Myoglobin Contribution to the NIRS Signal in Skeletal Muscle	109
	Benjamin Chatel, David Bendahan, and Thomas Jue	
	Index	119

Contributors

Tamás Bányász, M.D., Ph.D. Departments of Pharmacology, Biomedical Engineering, Internal Medicine/Cardiology, University of California, Davis, Davis, CA, USA

Department of Physiology, University of Debrecen, Debrecen, Hungary

David Bendahan, Ph.D. Aix-Marseille University, CNRS, CRMBM, Marseille, France

James Chan, Ph.D. Center for Biophotonics, University of California, Davis, Davis, CA, USA

Benjamin Chatel, M.Sc. Aix-Marseille University, CNRS, CRMBM, Marseille, France

Chao-Yin Chen, Ph.D. Department of Pharmacology, University of California, Davis, Davis, CA, USA

Robert H. Fairclough, Ph.D. Department of Neurology, School of Medicine, University of California Davis, Davis, CA, USA

Bence Hegyi, M.D., Ph.D. Department of Pharmacology, University of California, Davis, Davis, CA, USA

Leighton T. Izu, Ph.D. Department of Pharmacology, University of California, Davis, Davis, CA, USA

Ye Chen-Izu, Ph.D. Departments of Pharmacology, Biomedical Engineering, Internal Medicine/Cardiology, University of California, Davis, Davis, CA, USA

Thomas Jue, Ph.D. Department of Biochemistry and Molecular Medicine, University of California, Davis, Davis, CA, USA

Thomas E. Lee, Ph.D. VivoSecurity Inc., Los Altos, CA, USA

Daisuke Sato, Ph.D. Department of Pharmacology, University of California, Davis, Davis, CA, USA