



Computational biology of the heart

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Computational Biology Of The Heart

Andrew McCulloch



Computational Biology Of The Heart:

Computational Biology of the Heart Alexander V. Panfilov, Arun V. Holden, 1997-03-28 Modelling the genesis and propagation of electrical activity in the heart in quantitative terms is one of the most important recent applications of mathematical modelling in biology The main research direction and the most important for biological and medical applications is the development of realistic models of electrical activity in cardiac tissue and the whole mammalian heart Recent progress in nonlinear dynamics advances in computer technology and experiments on cardiac tissue have made feasible the construction of such models *Computational Biology of the Heart* is the first book to provide a comprehensive survey of recent research together with a systematic overview of the subject The contributions all written by experts in the different areas of the subject cover all main aspects of whole heart modelling from excitation in single cells to two and three dimensional models of cardiac tissue and the whole heart Various computational models and techniques are described and then applied to reconstruct and visualise modelled activity in both normal and pathological heart tissues The models are nonlinear and use techniques of ordinary differential equations partial differential equations and eikonal equations The book also provides a review of modelling cardiac contraction mapping electrical activity from electrocardiograms and recent experimental observations of wave propagation in the whole heart Graduate students and researchers in such areas as applied mathematical biology clinical physiology and cardiology will find this book to be an invaluable resource for their work

High-performance Computing for Computational Biology of the Heart Ross McFarlane, 2010 This thesis describes the development of Beatbox a simulation environment for computational biology of the heart Beatbox aims to provide an adaptable approachable simulation tool and an extensible framework with which High Performance Computing may be harnessed by researchers Beatbox is built upon the QUI software package which is studied in Chapter 2 The chapter discusses QUI s functionality and common patterns of use and describes its underlying software architecture in particular its extensibility through the addition of new software modules called devices The chapter summarises good practice for device developers in the Laws of Devices Chapter 3 discusses the parallel architecture of Beatbox and its implementation for distributed memory clusters The chapter discusses strategies for domain decomposition halo swapping and introduces an efficient method for exchange of data with diagonal neighbours called Magic Corners The development of Beatbox s parallel Input Output facilities is detailed and its impact on scaling performance discussed The chapter discusses the way in which parallelism can be hidden from the user even while permitting the runtime execution user defined functions The chapter goes on to show how QUI s extensibility can be continued in a parallel environment by providing implicit parallelism for devices and defining Laws of Parallel Devices to guide third party developers Beatbox s parallel performance is evaluated and discussed Chapter 4 describes the extension of Beatbox to simulate anatomically realistic tissue geometry Representation of irregular geometries is described along with associated user controls A technique to compute no flux boundary conditions on

irregular boundaries is introduced The Laws of Devices are further developed to include irregular geometries Finally parallel performance of anatomically realistic meshes is evaluated

Computational Biology of the Heart Andrew McCulloch,1998 *Computational Biology of the Heart* ,1998 *Modelling the Human Cardiac Fluid Mechanics. 4th Ed* Herbert Oertel (jr.),Sebastian Krittian,2011 With the Karlsruhe Heart Model KaHMo we aim to share our vision of integrated computational simulation across multiple disciplines of cardiovascular research and emphasis yet again the importance of Modelling the Human Cardiac Fluid Mechanics within the framework of the international STICH study The focus of this work is on integrated cardiovascular fluid mechanics and the potential benefits to future cardiovascular research and the wider bio medical community

Functional Imaging and Modeling of the Heart Alejandro F. Frangi,2005-05-31 This book constitutes the refereed proceedings of the Third International Workshop on Functional Imaging and Modeling of the Heart FIMH 2005 held in Barcelona Spain in June 2005 The 47 revised full papers presented were carefully reviewed and selected from numerous submissions The papers are organized in topical sections on modeling of the heart anatomy extraction and description electro physiology and electro and magnetography modeling of the cardiac mechanisms and functions and cardiac motion estimation

Analytical and Quantitative Cardiology S. Sideman,Rafael Beyar,2012-12-06 The tenth Henry Goldberg Workshop is an excellent occasion to recall our goals and celebrate some of our humble achievements Vision and love of our fellow man are combined here to 1 Foster interdisciplinary interaction between leading world scientists and clinical cardiologists so as to identify missing knowledge and catalyze new research ideas 2 relate basic microscale molecular and subcellular phenomena to the global clinically manifested cardiac performance 3 apply conceptual modelling and quantitative analysis to better explore describe and understand cardiac physiology 4 interpret available clinical data and design new revealing experiments and 5 enhance international cooperation in the endless search for the secrets of life and their implication on cardiac pathophysiology The first Goldberg Workshop held in Haifa in 1984 explored the interaction of mechanics electrical activation perfusion and metabolism emphasizing imaging in the clinical environment The second Workshop in 1985 discussed the same parameters with a slant towards the control aspects The third Goldberg Workshop held in the USA at Rutgers University in 1986 highlighted the transformation of the microscale activation phenomena to macro scale activity and performance relating electrophysiology energy metabolism and cardiac mechanics The fourth Goldberg Workshop continued the effort to elucidate the various parameters affecting cardiac performance with emphasis on the ischemic heart The fifth Workshop concentrated on the effect of the inhomogeneity of the cardiac muscle on its performance The sixth Workshop highlighted new imaging techniques which allow insight into the local and global cardiac performance

Electrocardiology '96: From The Cell To The Body Surface: Proceedings Of The Xxiii International Congress On Electroc J Liebman,1997-07-01 This conference had as its focus the phrase From the Cell to the Body Surface It comprised five minisymposia which concentrated on some of the major issues of the day for basic scientists and clinicians In

addition to the invited papers the proceedings contain volume presentations and posters selected from among abstracts sent in by some of the most important investigators in electrocardiology worldwide

Patient-Specific Modeling of the Cardiovascular System Roy C.P. Kerckhoffs, 2010-09-03 Peter Hunter Computational physiology for the cardiovascular system is entering a new and exciting phase of clinical application Biophysically based models of the human heart and circulation based on patient specific anatomy but also informed by population atlases and incorporating a great deal of mechanistic understanding at the cell tissue and organ levels offer the prospect of evidence based diagnosis and treatment of cardiovascular disease The clinical value of patient specific modeling is well illustrated in application areas where model based interpretation of clinical images allows a more precise analysis of disease processes than can otherwise be achieved For example Chap 6 in this volume by Speelman et al deals with the very difficult problem of trying to predict whether and when an abdominal aortic aneurysm might burst This requires automated segmentation of the vascular geometry from magnetic resonance images and finite element analysis of wall stress using large deformation elasticity theory applied to the geometric model created from the segmentation The time varying normal and shear stress acting on the arterial wall is estimated from the arterial pressure and flow distributions Thrombus formation is identified as a potentially important contributor to changed material properties of the arterial wall Understanding how the wall adapts and remodels its material properties in the face of changes in both the stress loading and blood constituents associated with inflammatory processes IL6 CRP MMPs etc

Cardiovascular Solid Mechanics Jay D. Humphrey, 2013-06-29 The vitality of the cardiovascular system which consists of the heart vasculature and blood depends on its response to a host of complex stimuli including biological chemical electrical mechanical and thermal The focus of this book however is on the response of the heart and arteries to mechanical loads from the perspective of nonlinear solid mechanics Through my own research in this field I have come to realize that studying the complex responses of cardiovascular cells tissues and organs necessarily requires a combined theoretical experimental and computational approach Theory is needed to guide the performance and interpretation of experiments as well as to synthesize the results experiment is needed to study the responses of the system to well controlled loads and to test candidate hypotheses and theories and due to the geometric and material nonlinearities inherent to cardiovascular mechanics computation is needed to analyze data as well as to solve boundary and initial value problems that correspond to either experimental or in vivo conditions One of the primary goals of this book is to introduce together basic analytical experimental and computational methods and to illustrate how these methods can and must be integrated to gain a more complete understanding of the biomechanics of the heart and vasculature Despite the focus on cardiovascular mechanics the fundamental methods indeed many of the specific results are generally applicable to many different soft tissues

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