



# Mathematical Modelling Of Cardiac Electrical Activity

**Ramesh M. Gulrajani**



## **Mathematical Modelling Of Cardiac Electrical Activity:**

Mathematically Modelling The Electrical Activity Of The Heart: From Cell To Body Surface And Back Again Andrew Pullan, Martin L. Buist, Leo K. Cheng, 2005-09-07 This book on modelling the electrical activity of the heart is an attempt to describe continuum based modelling of cardiac electrical activity from the cell level to the body surface the forward problem and back again the inverse problem Background anatomy and physiology is covered briefly to provide a suitable context for understanding the detailed modelling that is presented herein The questions of what is mathematical modelling and why one would want to use mathematical modelling are addressed to give some perspective to the philosophy behind our approach Our view of mathematical modelling is broad it is not simply about obtaining a solution to a set of mathematical equations but includes some material on aspects such as experimental and clinical validation **Modeling and Simulating Cardiac**

Electrical Activity Trine Krogh-Madsen, David J. Christini, 2020-12-03 This book provides a thorough introduction to the topic of mathematical modeling of electrical activity in the heart from molecular details of ionic channel dynamics to clinically derived patient specific models It discusses how cellular ionic models are formulated introduces commonly used models and explains why there are so many different models available The chapters cover modeling of the intracellular calcium handling that underlies cellular contraction as well as modeling molecular level details of cardiac ion channels and specialized topics such as cardiomyocyte energetics and signalling pathways It is an excellent resource for experienced and specialized researchers in the field but also biological scientists with a limited background in mathematical modelling and computational methods Key Features Thorough introduction to the topic of mathematical modeling of electrical activity in the heart Focuses on use of experimental data in mathematical modeling and on explanations rather than equations In addition to being experts in the field the contributing authors are expert science communicators **Mathematically Modelling the Electrical**

**Activity of the Heart** Andrew J. Pullan, Leo K. Cheng, Martin L. Buist, 2005 This book on modelling the electrical activity of the heart is an attempt to describe continuum based modelling of cardiac electrical activity from the cell level to the body surface the forward problem and back again the inverse problem Background anatomy and physiology is covered briefly to provide a suitable context for understanding the detailed modelling that is presented herein The questions of what is mathematical modelling and why one would want to use mathematical modelling are addressed to give some perspective to the philosophy behind our approach Our view of mathematical modelling is broad it is not simply about obtaining a solution to a set of mathematical equations but includes some material on aspects such as experimental and clinical validation

**Mathematical Modelling of the Human Cardiovascular System** Alfio Quarteroni, Luca Dede', Andrea Manzoni, Christian Vergara, 2019-05-09 Addresses the mathematical and numerical modelling of the human cardiovascular system from patient data to clinical applications Mathematical Modelling of Cardiac Electrical Activity Within a Heterogeneous Bidomain Framework Thushka Maharaj, 2008 **An Introduction to Mathematical Modeling in**

**Physiology, Cell Biology, and Immunology** James Sneyd, American Mathematical Society, 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

**Complex Systems in Biomedicine** A. Quarteroni, L. Formaggia, A. Veneziani, 2007-03-20  
Mathematical modeling of human physiopathology is a tremendously ambitious task It encompasses the modeling of most diverse compartments such as the cardiovascular respiratory skeletal and nervous systems as well as the mechanical and biochemical interaction between blood flow and arterial walls and electrocardiac processes and electric conduction in biological tissues Mathematical models can be set up to simulate both vasculogenesis the aggregation and organization of endothelial cells dispersed in a given environment and angiogenesis the formation of new vessels sprouting from an existing vessel that are relevant to the formation of vascular networks and in particular to the description of tumor growth The integration of models aimed at simulating the cooperation and interrelation of different systems is an even more difficult task It calls for the setting up of for instance interaction models for the integrated cardiovascular system and the interplay between the central circulation and peripheral compartments models for the mid to long range cardiovascular adjustments to pathological conditions e.g. to account for surgical interventions congenital malformations or tumor growth models for integration among circulation tissue perfusion biochemical and thermal regulation models for parameter identification and sensitivity analysis to parameter changes or data uncertainty and many others

[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

**Modeling and Simulating Cardiac Electrical Activity** Trine Krogh-Madsen, 2020-12-03 This book provides a thorough introduction to the topic of mathematical modeling of electrical activity in the heart from molecular details of ionic channel dynamics to clinically derived patient specific models It discusses how cellular ionic models are formulated introduces commonly used models and explains why there are so many different models available The chapters cover modeling of the intracellular calcium handling that underlies cellular contraction as well as modeling molecular level details of cardiac ion channels and specialized topics such as cardiomyocyte energetics and signalling pathways It is an excellent resource for experienced and specialized researchers in the field but also biological scientists with a limited background in mathematical modelling and computational methods

**Key Features** Thorough introduction to the topic of mathematical modeling of electrical activity in the heart Focuses on use of experimental data in

mathematical modeling and on explanations rather than equations In addition to being experts in the field the contributing authors are expert science communicators Finite Element Modeling of Cardiac Activation Dynamics Jack Moss Rogers,1993 **Computing the Electrical Activity in the Heart** Joakim Sundnes,Glenn Terje Lines,Xing Cai,Bjørn Frederik Nielsen,Kent-Andre Mardal,Aslak Tveito,2007-06-26 The heart is a fantastic machine during a normal lifetime it beats about 2.5 billion times and pumps 200 000 tons of blood through an enormous system of vessels extending 160 000 kilometres throughout the body For centuries man has tried to understand how the heart works but there remain many unsolved problems problems that have captured the attention of thousands of researchers worldwide There is for example a huge amount of research being devoted to the analysis of single heart cells Other areas of research include trying to understand how it works as a complete muscle and how blood flows through the heart The entire process is extremely complex The history of bioelectricity can be traced back to the late eighteenth century and the experiments of Luigi Galvani A century later in 1887 Augustus Wallers managed to measure the electrical signal generated by the heart at the surface of the body 142 His dog Jimmy earned a place in history by being the first to have his heart measured in this way see Figure 1.1 In 1903 Willem Einthoven developed the first commercial device for recording electrocardiograms ECGs see Figure 1.2

**Mathematical Approaches to Cardiac Arrhythmias** José Jalife,1990 New Advances in Gastrointestinal Motility Research L. K. Cheng,A. J. Pullan,G. Farrugia,2013-06-01 Research into gastrointestinal motility has received renewed interest in part due to recent advances in the techniques for measuring the structure and function of gastrointestinal cells tissue and organs The integration of this wealth of data into biophysically based computation models can aid in interpretation of experimental and clinical measurements and the refinement of measurement techniques The contents of this book span multiple scales from cell tissue organ to whole body and is divided into four broad sections covering i gastrointestinal cellular activity and tissue structure ii techniques for measuring analyzing and visualizing high resolution extra cellular recordings iii methods for sensing gastroelectrical activity using non invasive bio electro magnetic fields and for modulating the underlying gastric electrical activity and finally iv methods for assessing manometric and videographic motility patterns and the application of these data for predicting the flow and mixing behavior of luminal contents by using computational fluid dynamic techniques This book aims to provide both an overview of historical and existing research techniques as well as to highlight future directions and challenges for the community as a whole It will be suitable for clinicians to understand the cellular and biophysical underpinnings of gastric emptying gastroenterologists surgeons bioengineers and all scientists with interests in gastrointestinal motility research Spatial Estimation of the 12-lead Electrocardiogram Using Linear Least-squares Modeling Techniques Julie Ann Scherer,1994 **A Discrete-Event Simulation Model of Myocardial Electrical Activity: Mathematical Electrophysiology**,1994 This work unit was opened to provide a channel for in house work on mathematical modeling and computer simulation of the electrocardiogram ECG and its underlying electrophysiology

This work was intended to complement work being done in contracted efforts aimed at model based enhancement of ECG diagnostic criteria for detection of coronary artery disease in USAF aircrew members Both the contract and in house efforts have been terminated due to funding constraints and organizational shifts in research focus In this technical paper we report on the development of a simulation model of the depolarization and repolarization processes in the ventricles which was to be used as a cardiac electrical source model in simulations of the ECG as well as attempt to provide some commentary regarding the relation of these efforts to broader contexts A Model for the Mapping of Cardiac Events Onto the Electrocardiogram (ECG) in the Case of Coronary Artery Disease Abraham Tat Chang Wong,1980 Bioelectricity and Biomagnetism Ramesh M. Gulrajani,1998-10-30 Many vital medical techniques are based on fundamental bioelectric and biomagnetic phenomena electrocardiographs and cardiac pacemakers are two examples This book examines the fundamental science underlying these techniques *Computer Techniques in Clinical Medicine* Peter W. Macfarlane,1985

**Pacemaker Activity and Intercellular Communication** Jan D. Huizinga,1995-02-06 The book focuses on enhancing our understanding of pacemaker systems and associated mechanisms of intercellular communication Three different physiological systems are compared the cardiac system the cells of the pancreas and the gastrointestinal tract Experts in all three areas highlight the parallels and comparisons among the systems Emphasis is placed on finding precise characteristics of all cell types involved in pacemaker activity The interpretation of data on single isolated cells in light of tissue function receives thorough discussion Ion channel characteristics involved in the generation of action potential and pacemaker components are described in detail A fascinating but largely unexplored area is touched upon the electrical and metabolic coupling of different cell types A most valuable feature is that most investigators have explored a variety of techniques to examine cell function patch clamp studies intracellular voltage recording intracellular calcium measurements gap junction conductance measurements dye spread techniques and more Various aspects of the molecular biology of gap junction and ion channels are explored Multimodal Cardiovascular Imaging: Principles and Clinical Applications Olle Pahlm,Galen Wagner,2011-03-24 A complete guide to using multimodal imaging in cardiac practice Interactive DVD includes moving images from the text 4 STAR DOODY S REVIEW In addition to compiling the various imaging modalities used for clinical diagnosis in cardiovascular disease the book also summarizes the present and future applications of combined imaging modalities for better understanding the underlying pathophysiologic basis of cardiovascular diseases This book is unique in the way it comprehensively reviews both the current and future applications of multiple imaging modalities Doody s Review Service Multimodal Cardiovascular Imaging Principles and Clinical Applications offers a unique matrix approach to help you choose the most appropriate combination of imaging modalities for the management of patients with cardiovascular disease The book discusses the various options available how they work the benefits and drawbacks of each and what modalities will best work in conjunction with each other for a specific condition Featuring contributions from more than 60 international

authors and enriched by 225 half tone modality images and 130 full color illustrations Multimodal Cardiovascular Imaging Principles and Clinical Applications is divided into three sections Section 1 contains chapters that focus on the use of ten specific clinically available diagnostic modalities and their broad application to clinical cardiology Modalities discussed include Echocardiography Phonocardiography Myocardial Perfusion SPECT and PET Coronary Angiography Cardiac CT Section 2 includes six chapters that present visions of the future for combining multiple diagnostic modalities They form the foundation for understanding the pathophysiologic basis of clinical cardiovascular conditions using prototypes simulations models and tutorials Section 3 considers several cardiovascular conditions and how multimodal imaging can provide diagnostic and therapeutic decision support to optimize the clinical care for each of them Some chapters in this section also include case reports of how clinicians scientists are using multimodal imaging modalities to improve their clinical therapeutic decision support Conditions include Congenital Heart Disease Ischemic Heart Disease Acute Myocardial Infarction Aortic Disease Atrial Fibrillation

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