Mathematical Foundations of Cardiac Electro Physiology

Overview: The bioelectric activity of the heart is the subject of a vast and still growing interdisciplinary literature in mathematical biology, medicine, physiology, bioengineering, chemistry, physics and bioinformatics.. Electrocardiology deals with the description of both intra-cardiac bioelectric phenomena and the extra-cardiac electric field generated in the animal or human body. The practice of modern medicine relies on noninvasive imaging technologies, such as CT, MRI and PET, for diagnostic purposes and for driving therapeutic procedures. Even though cardiac arrhythmias are among the major causes of death and disability, a noninvasive imaging technique yielding an accurate and reliable diagnosis of the electrophysiological state of the heart is not yet available. Clinic Electrocardiography deals with the detection and interpretation of noninvasive potential measurements collected from the time course of the usual electrocardiograms (ECG) at a few points on the body surface or from the evolution of body surface maps, i.e. potential distribution maps on the body surface reconstructed from measures at numerous electrodes. Since the electrode location of the ECG is centimetres away from the heart surface and the current conduction from heart to thorax yields a strong signal attenuation and smoothing, the information content of ECGs and body maps is limited and it is a difficult task to extract from these signals detailed information on pathological heart states associated with ischemia or sudden death. Indeed, the origin of arrhythmogenic activity or the existence of abnormal electrophysiological substrates in many cases may not be easily inferred from the sequence of cardiac excitation.

The scientific base of Electro cardiology is the so-called *Forward Problem of Electro cardiology*, i.e. modelling the bioelectric cardiac sources and the conducting media in order to derive the potential field. In the past few decades, experimental electrophysiology has been increasingly supported by the mathematical and numerical models of computational Electro cardiology. The formulation of models at both cellular and tissue levels provide essential tools in order to integrate the increasing knowledge of the bio electrochemical phenomena occurring through cardiac cellular membranes. Detailed cellular phenomena are described in microscopic membrane models and the latter are then inserted in macroscopic tissue models in order to investigate their effects at tissue level. These coupled models are then validated by comparing simulated results with experimental in vitro and in vivo data, generating a feedback loop that may lead to improved and more detailed models and/or the redesign of new experiments. As a further step, these electrophysiological models are being increasingly coupled and integrated with mechanical models of tissue deformation, hemodynamic models of cardiac blood flow and more in general with models of the cardiovascular system.

So this course aims at introducing on the basic elements of the mathematical modelling of cardiac electric activity which are emerging as a strong alternate approach to deal with cardiac arrhythmia in a virtual setup enabled by the computational power but based on patient specific data.

Course Details

Course Title	Mathematical Modelling of Cardiac Electro Physiology
Dates	Mar 19 – 24, 2018
Host Institute	IIT Kanpur
No. Of Credits	1
Max No. Of Participants	50
Eligibility	1) You are a Scientist/ Engineer with specific interest in Bio-Mechanics 2) You are involved in the work related to cardio Vascular Electrical & Mechanical Modeling 3) you are a student or faculty from academic institution interested Cardio-Electric Acvity 4) Medical Doctors with a reasonable liking for Applied Mathematics
Registration	**Registration Fees:** The participation fees for taking the course is as follows: **Student Participants:** Rs.2500 **Faculty Participants:** Rs.5000 **Government Research Organization Participants:** Rs.10000 **Industry Participants:** Rs.12000 The above fee is towards participation in the course, the course material, computer use for tutorials and assignments, and laboratory equipment usage charges. **Mode of payment:** Demand draft in favour of "Registrar, IIT Kanpur" payable at SBI, IIT Kanpur
Accommodation	The participants will be provided accommodation, depending on the availability, **on payment basis.** Request for accommodation should be sent to contact address.
Contact Details	Prof. B. V. Rathish Kumar, Co-ordinator, FB-555, Department of Mathematics & Statistics, IIT Kanpur Email: cea.2018@gmail.com Phone:0091-512-259-7660/7636 Fax: 0091-512-259-7500
Important Dates	Last Date for Registration: Jan 05, 2018 Selection List Announcement Date: Jan 10, 2018

Course Faculty	Professional Details
 **Prof. Luca Pavarino**	Prof. Luca Pavrino is currently working as Professor at Dipartmento di Mathematica, Universita di Pavia, Italy. His areas of specialization are Mathematical Modeling and Simulation of Cardia Electric Activity, High Performance Computing, Numerical Methods for Partial Differential Equations – Domain Decomposition Method, hp-Spectral Element Method, Iso-geometric Analysis. He has published several research papers in peer reviewed international journals and has written three books which are widely used by academic community. He has also delivered several invited and plenary talks in international conferences across the world.
 **Prof. B. V. Rathish Kumar** **Course Coordinator**	Prof B V Rathish Kumar is currently a Professor in the Department of Mathematics and Statistics at IIT Kanpur. He has made seminal contributions through the development of Numerical Methods for solving PDEs. He developed high performance computing strategies using parallel algorithms. He has designed and developed a wide spectrum of numerical solvers that employ Finite element, Finite volume and Wavelet based techniques for solving fluid dynamics, biomechanics problems of interest to both science and technology.