PREDOCTORAL CONTRACT PROPOSAL

The Cardiac Modeling Group belongs to the Electronics Engineering Department of the Polytechnical University of Valencia (UPV), Spain. The group is integrated by 5 faculty members and a variable number of post-doctoral and PhD students. We seek a highly motivated **PhD candidate** to develop mathematical models of the electrical activity of the heart from 1D to 3D level of both patient-specific EP models of patients suffering genetic deseases and population of models to perform in silico trials. These models will be used to predict the outcome of different therapies in the treatment of cardiac arrhythmias and to assess the safety and efficacy of drugs. The candidate will be contracted for four years and working in the frame of a national funded research project: **"In silico clinical trials for precision medicine in cardiology" (PCarTrials) PID2022-140553OB-C41, funded by Ministerio de Ciencia e Innovación, Proyectos de I+D+i Retos Investigación.**

The candidate will be fully integrated in the group as an active member. The group has an ample experience in modeling and simulating the electrical activity of the heart. Throughout our cardiac simulation work, we have developed and analyzed cardiac action potential (AP) models of different tissues (atrium, ventricle, and Purkinje) and different animal species (dog, rabbit, guinea pig, and human) under normal and under several pathological conditions, such as mutations, ischemia, heart failure, and atrial fibrillation. The group also has a valuable experience in modeling the effects of drugs on different ionic channels. Moreover, we have developed computational tools for the simulation of the electrophysiological activity of a variety of tissue structures (unicellular, one-dimensional, bi-dimensional and tri-dimensional).

ROLE SUMMARY:

The candidate will develop 3D disease personalized models to simulate arrhythmias, to optimize therapies and to assess the safety and efficacy of different drugs. Methods of mathematical modeling and image processing will be used to achieve the objectives. The candidate will receive data from our collaborators from the clinical field to build realistic and personalized models.

CANDIDATE RESPONSIBILITIES:

1. Build personalized multi-scale models. The candidate will personalize cardiac models to specific patients with genetic mutations. Three-dimensional models will be developed from MRI and CT images, and ECG signals and endocardial and epicardial cartographic electrical mapping in some cases. Moreover, patients' genetic diseases, such as long QT syndromes (LQT) and hypertrophic cardiomyopathy, will be modeled. The clinical data will be provided by the hospitals involved in our research projects. The 3D models developed will be suitable to simulate the electrical activity of the heart. In collaboration with the Barcelona Supercomputing Center, the cardiac electrical activity of the heart will be coupled to the its mechanical behavior, so that electromechanical models will be built.

2. Improvement of precision therapies in patients with genetic diseases. Different therapeutic procedures will be simulated to study their efficacy depending on the specific genetic mutation of the patient.

3. Improvement of the prediction of the cardiac safety of drugs. Drug cardiac safety in the presence of mutations will be investigated by performing in-silico trials, which will help reduce adverse drug effects in these subjects,

CONTRACT DETAILS:

Tentative Application date: Sepember-October 2023
Contrato de investigación FPI asociado al proyecto RETOS de Investigación:
PID2022-140553OB-C41

Tentative initial date: October-November 2023
Duration: 4 years at full and exclusive dedication.

QUALIFICATIONS:

- Master Degree in Biomedical Engineering, Applied Mathematics, Physics, other Engineering degrees or related discipline with strong numerical components focusing on mathematical modeling, simulation, and image processing.
- Knowledge of image processing.
- Training and/or experience in mechanistic modeling of electrophysiological systems is preferred.
- Understanding of ordinary and partial differential equations and how these can be applied in the development of complex models of electrophysiological models.
- In-depth, hands-on knowledge of modeling and simulation software (MATLAB, C/C++, Fortran).
- Keen interest in learning new computational skills.
- Self-directed with ability to work independently.
- Excellent communication and writing skills in English.
- Keen interest in living in the sunny Valencia.

CONTACT:

If interested, please contact Lucia Romero, lromero@ci2b.upv.es