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 and implement **longitudinal features** across populations of cellular and 3D **cardiac models to represent different pathological stages**. These models will incorporate patient-specific variables—particularly **age and sex**, and comorbidities—to simulate both **atrial and ventricular arrhythmias**, to investigate their underlying electrophysiological and structural mechanisms, as well as design **personalized therapies**. The candidate will be contracted for four years and working in the frame of a national funded research project:
"Longitudinal **Co**mputational Models of A**r**rhythmia" (**LongCOR**) PID2025- 169391OB-C41, funded by Agencia Estatal de Investigación, Ministerio de Ciencia e Innovación y Universidades, Proyectos de Generación del Conocimiento.
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 ischemia, heart failure, atrial fibrillation, and mutations. 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 cellular and 3D ventricular disease patient-specific models and populations of models considering longitudinal features of the pathology, as well as sex and age. Using these models, the candidate will simulate arrhythmias to analyze the underlying mechanisms and assess the outcome of optimized therapies. Methods of image processing and mathematical modeling 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 and Populations of Longitudinal disease models. The candidate will personalize cardiac models to specific patients that will undergo interventions (e.g. cardiac ablation). Ventricular three-dimensional models will be developed from MRI and CT images, and ECG signals and endocardial and epicardial cartographic electrical mapping. The models will be built for different stages of the pathology considered (heart failure, myocardial infarction, atrial fibrillation of genetic diseases). 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. Sex and age will be considered in the models, as well as variability in specific parameters to build populations of models.

2. Analysis of arrhythmia mechanisms. Using the personalized models and the populations of models developed, different stages of the disease scenarios will be simulated to understand the main factors that influence the onset and maintenance of arrhythmias.

3. Optimization of therapeutic strategies. Ablation procedures, cardiac resynchronization therapy and drug effects will be simulated to in silico assess and optimize their outcome.

CONTRACT DETAILS:

Applications: September-October 2026
Initial date: December 2026-January 2027
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 and electromechanical 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 and machine learning software (MATLAB, C/C++, Fortran, Python).
- 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:

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