Project title: Accurate electro-anatomical mapping driven by statistical shape models

Project reference: DT4H_03_2022

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2nd supervisor – Steven Williams - School of Biomedical Engineering & Imaging Sciences

Aim of the project

The overarching goal is to improve the diagnosis and therapy planning for cardiovascular arrhythmic conditions. The specific objective is to enable an accurate and reliable non-invasive mapping of the electrophysiology activity from the torso recordings to the heart. The approach to achieve it is to predict the patient-specific cardiac anatomy for a coarse set of demographics and observations.

Project description

Background: Cardiac arrythmias affect millions of people. Among them, atrial fibrillation results in hundreds of thousands of deaths worldwide. Better technologies for a refined diagnosis and therapy planning are needed. The electrocardiogram is the conventional observation of the electrophysiological (EP) activity of the heart that drives the management of arrythmias. One revolutionary technology with the potential to improve this practice is the mapping of the body surface EP activity into the actual surface of the heart inside the body using the digital twin of the patient. The Acorys mapping system from Corify (https://corify.es/solution/) uses this approach to provide the non-invasive EP imaging without the need of MRI or CT scans.

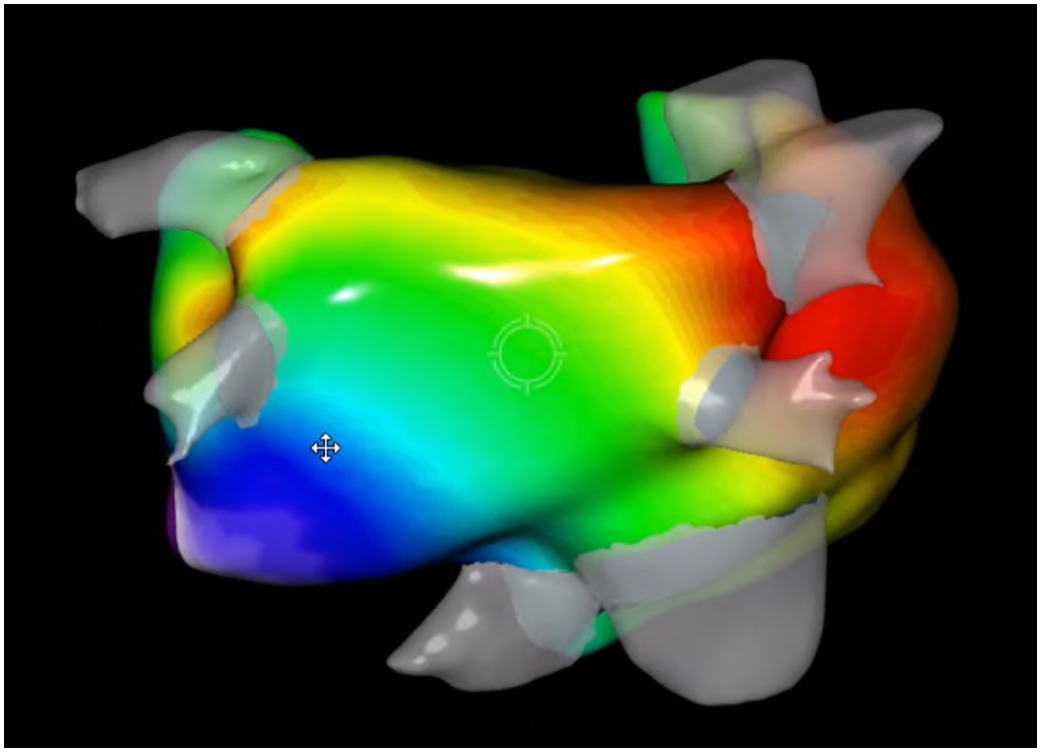
Problem statement and overarching hypothesis: There is an opportunity to improve the accuracy and reliability of the non-invasive inference of the electrical activity in the heart for an improved management of cardiac arrythmias. Recent advances in computational anatomy technologies developed at KCL now allow for the study of how the shape and orientation of the heart changes across the population. And the UK BioBank provides an unprecedented possibility to observe a >100.000 subjects cross-sectional cohort of subjects. In this context, the overarching hypothesis is that the inference of the EP activity in the heart is improved by an accurate previous inference of the digital twin of the each individual patient.

Project objective: to develop a solution to personalise the digital twin of the patient from a set of demographic (e.g. gender, race, age, lifestyle choices) and clinical (cardiac conditions and co-morbidities) factors, and to use this solution to improve the accuracy and reliability of the inference of the EP activity in the heart.

Expected outcomes and skills: publication in top scientific journals, translation into actual patient benefit through the integration of solutions into clinically approved products. The student will acquire the skills for model personalisation, model inference and uncertainty propagation, model verification and validation, cardiac electrophysiology and arrythmias.

Supervisory team and sponsorship: the student will be guided by an excellent blend of academic (Prof. Lamata), clinical (Dr. Williams) and industrial (Dr. Zacur) supervisors. The project will be co-sponsored by Corify, with meaningful secondments in their headquarters in Valencia, Spain.

Expected academic background of the candidate: any computer science related background will be ideal (maths, physics, engineering…). Coding proficiency is desirable.



Reconstruction of the electrical activity in the surface of the left atria