

Research-Report - Tiago Paggi de Almeida

Research activities conducted during the stay

The two weeks research conducted in collaboration with the Institute of Biomedical Engineering (IBT), at the Karlsruhe Institute of Technology (KIT) – supported by the International Scholars & Welcome Office (IScO), subdivision of International Affairs, through the Re-Invitation Grant for Research Alumni of KIT – contributed to the progress of the work initiated during the first visit of the applicant to the IBT. The IBT has hosted Dr Almeida for six months from 01 September 2018 to 28 February 2019. During these six months, biological markers that better explain atrial fibrillation (AF) behaviour to guide AF ablation using the computer modelling proposed by the IBT were investigated, resulting in a work presented and published at the Annual Meeting of the IEEE Engineering in Medicine and Biology Society held in Berlin, from July 23–27, 2019, as a first step.

AF is the most common sustained arrhythmia found in the clinical practice and is one of the main causes of stroke. AF is characterised by the uncoordinated activation of the upper chambers of the heart. We currently observe a lack of understanding about the initiation and perpetuation mechanisms of this arrhythmia. Cardiac electrophysiological investigations help in the understanding of the underlying pathophysiology of AF. The identification of patient-specific AF drivers gained evidence to design tailored ablation strategies. Radiofrequency catheter ablation could be a method of therapy to cure the disease, but it is still not clear where to effect ablation lesions in order to stop the arrhythmia and prevent reoccurrence, mostly due to the complex mechanisms involved in AF perpetuation – particularly in the chronic form of the arrhythmia.

Biophysical models provide a controlled environment in which the ground truth for AF initiation and perpetuation are known, which allows for the validation of methods for atrial mapping and/or ablation target identification prior to the application of such methods in clinical studies. Under the supervision of Dr Axel Loewe, the IBT at KIT has an extensive track record in the implementation and study of cardiac computational models that can be used to identify optimal biomarkers that will improve target identification to guide AF ablation.

The 2-weeks stay at the IBT helped to accelerate the progress of this already fruitful collaboration, fomenting cooperation, exchanging results and discussions, accordingly:

1. *In-silico* databases from four different cardiac computational models were created and exchanged, each of which investigating different aspects of the arrhythmia. These databases will continue to be investigated by Dr Almeida in his research in Brazil.
2. A draft for a joint journal paper – to be submitted to the IEEE Transactions on Biomedical Engineering – was elaborated during these two weeks. The work describes the application of a method introduced to the IBT by Dr Almeida – recurrence quantification analysis – for the investigation of the underlying dynamics of cardiac events.
3. A plan for this collaborative research was delineated aiming at the preparation of a research project to be submitted to the Humboldt Research Fellowship for Postdoctoral Researchers. If granted, Dr Almeida should join the IBT as a Postdoctoral Researcher by 2021 and continue the investigations initiated during the two visits to the IBT.