Karlsruher Institut für Technologie

Institut für Biomedizinische Technik

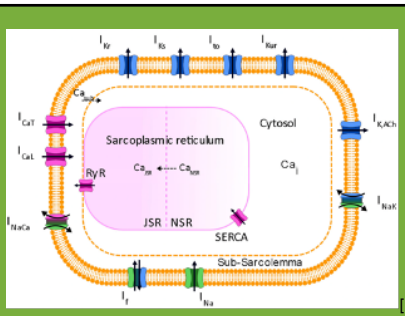
IBT

Masterarbeit

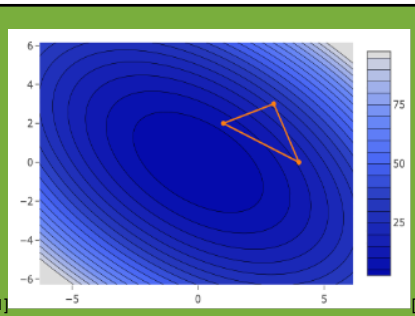
Parameter Optimisation of Electrophysiological Cellular Models

Motivation

Sudden cardiac death (SCD) in patients with chronic kidney disease (CKD) undergoing haemodialysis (HD) is a major clinical problem. While the underlying pathomechanisms are not fully understood, electrophysiological models offer a powerful tool to enhance the understanding of the physiological processes. Since the sinoatrial node (SAN), the driving force behind every single heart beat, is controlled by the influence of autonomic nervous system and affected by altered electrolyte concentrations typical for CKD patients, the combination of these two mechanisms could contribute to the high prevalence of SCD in HD patients.



[1]


[2]

[1] E. Ricci et al. – The virtual sinoatrial node: What did computational models tell us about the cardiac pacemaking?, 2022;

[2] http://wwwlab.cs.univie.ac.at/~a1105734/OPS/verfahren/verfahren.html

More specifically, cardiac (cellular) models describe the physical properties of cells and tissues using mathematical equations involving various parameters. To develop a relevant cellular model, the cell parameters of the model are adjusted based on the experimental data in order to accurately represent the observed cellular response. This could be accomplished through parameter optimisation which aims to minimise the discrepancy between experimental data and simulated results.

Task

The main goal of this project is to improve the predictive capabilities of a sinoatrial node cell (SANC) model by identifying a new set of parameters, taking into account experimental data on the stimulation of the cell via the autonomic nervous system. This will enable inferring the behaviour of the SANC under different health conditions, such as the chronic kidney disease, which is known to significantly increase the risk of SCD.

Hints

- Programming knowledge in Phython or similar language is advantageous
- Basic knowledge of cardiac physiology is advantageous

The weighting of the individual elements can be individually adapted to your ideas.

Research Area
Cardiac Modeling, Single Cell Simulation

Project
Effects of hypocalcaemia & autonomic nervous system stimulation on sinoatrial node cells

Key Words
Simulation, Modelling, Optimisation,

Project Start
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