Karlsruhe Institute of Technology

Institute of Biomedical Engineering

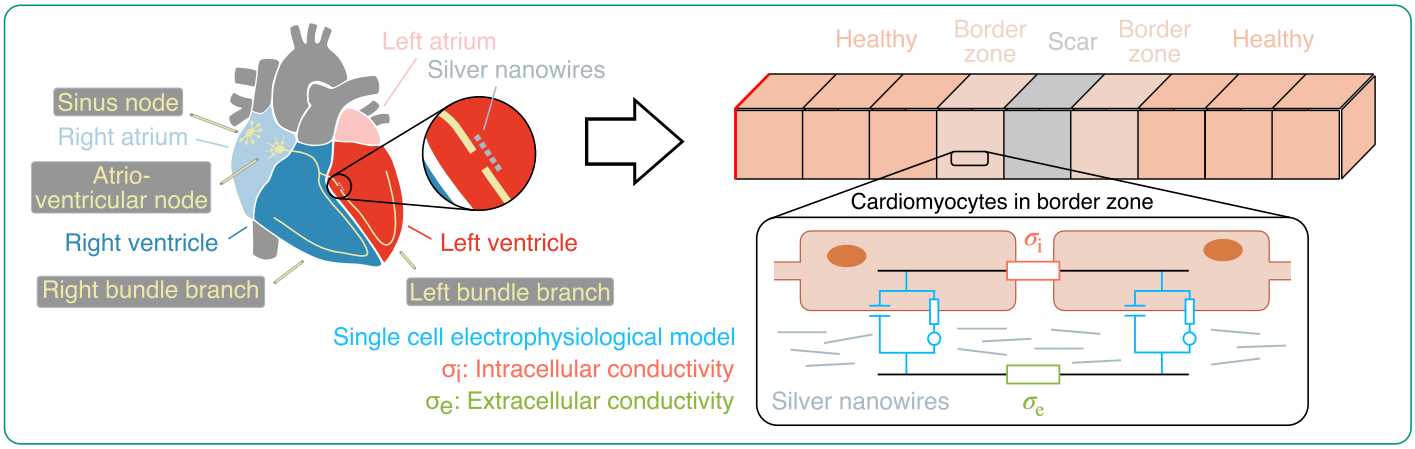
Restoring cardiac conduction in left bundle branch block using silver nanowires

Bachelor thesis

Motivation

Left bundle branch block is a cardiac conduction disorder in which electrical signals are delayed or blocked while traveling through the left bundle branch of the His-Purkinje system, causing the ventricles to contract out of sync. This dyssynchronous activation can worsen heart function, drives adverse cardiac remodeling and is linked to progressive ventricular dysfunction, arrhythmias, heart failure and higher mortality, particularly in patients with underlying heart disease.

1-2% of the general population are affected by left bundle branch block, with an increased prevalence in older adults which continues to grow with an aging population. While cardiac resynchronization therapy (biventricular pacing), can restore synchrony in many eligible patients, up to one-third of patients do not respond, and current treatments are limited by invasive implantation procedures, strict eligibility criteria, and the need for more personalized, physiologic pacing strategies. Inserting highly conductive material (silver nanowires) into areas of delayed or blocked electrical conduction to restore impaired conductivity may offer an interesting alternative to cardiac resynchronization therapy. As a less invasive and simpler intervention, this approach is expected to reduce procedure time and may benefit a wider range of patients.



Student Project

Building on initial findings, you will elaborate the potential of silver nanowires for treating different manifestations of left bundle branch block by considering a range of tissue configurations. Within these configurations, the effects of key (yet uncertain) parameters will be systematically analyzed, including tissue conductivity in the affected region, remodeling- or medication-induced changes in specific ionic currents, and electrophysiological interactions with fibroblasts. Based on these investigations, the primary objective of the thesis is to identify the scenarios in which modifying tissue conductivity with silver nanowires is most effective and to derive optimized strategies for nanowire placement and target conductivity for each identified use case.

Notes

Basic knowledge of cardiac electrophysiology is desirable.
Programming skills in Python are a plus.
The thesis can be conducted in English or German.
Application documents: Curriculum vitae and transcript of records

Research Area

Computational Cardiac Modeling

Course of Studies

Computer Science, Computational Engineering, BME, ETIT, MIT

Starting Date

As soon as possible

Posted Date

15.07.2026

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