Karlsruher Institut für Technologie

Institute of Biomedical Engineering

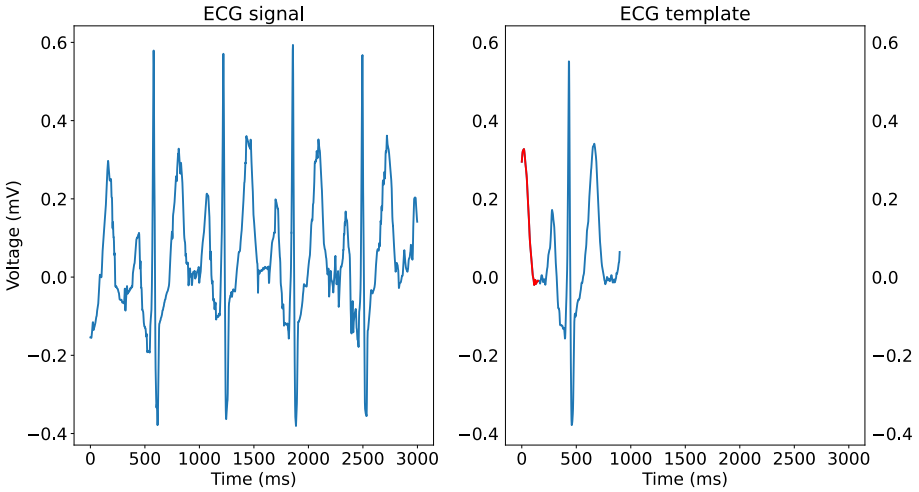
IBT

Bachelor Thesis

Improving ECG Template Robustness for Atrial Cardiomyopathy Diagnosis

Motivation

Atrial cardiomyopathy (ACM) is associated with slow-conducting low-voltage areas and therefore prolonged total atrial conduction time. Jadidi et al. demonstrated that total atrial conduction time correlates with amplified P-wave duration (APWD). Consequently, APWD measured in a 12-lead-ECG can be used to diagnose atrial cardiomyopathy.
To determine APWD, a template of a single heartbeat from a longer 12-lead ECG signal is generated, eliminating P-wave variances. The quality of this template is crucial for accurate automatic detection of APWD.



Task

The goal is to enhance an existing workflow for creating ECG templates, with particular emphasis on improving robustness in cases of sinus tachycardia and extrasystoles. Signal processing tools will be employed to identify and address the current workflow's weaknesses. Additionally, a signal quality check will be implemented to ensure that each wave appears only once in the template.
Data for this project will be sourced from open databases such as PTB-XL and MIMIC-IV, alongside ECG recordings from the University Heart Center Freiburg – Bad Krozingen.
We hypothesize that the improved template will enhance the accuracy of automatic AI-based APWD measurements compared to the original template. The effectiveness of the new template will be validated using automatic APWD annotations from another dataset provided by Bad Krozingen, which includes expert APWD labels. The results from both the original and the new template will be compared to evaluate any statistically significant reduction in the absolute error of APWD measurements when compared with expert annotations.

Notes

- Programming skills in Python are advantageous
- Basic knowledge of cardiac physiology is beneficial

The weighting of individual elements can be customized according to your preferences.

Area of Research
Signal processing

Project
ECG Signal Processing and AI for Atrial Arrhythmias

Applicable Study Fields
Electrical Engineering,
Physics,
Computer Science,
Mathematics

Start
As soon as possible

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