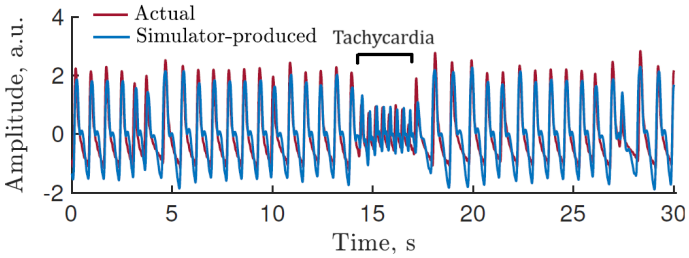
Simulation of Ventricular Tachycardia in Photoplethysmogram: Hardware Implementation

Andrius Sološenko*, Saulius Daukantas, Daivaras Sokas, Vaidotas Marozas, Andrius Petrėnas

Biomedical Engineering Institute, Kaunas University of Technology, Kaunas, Lithuania

Introduction: Despite the potential of photoplethysmography-based wearables for arrhythmia detection, the development of ventricular tachycardia detectors is hindered by the lack of databases with photoplethysmogram (PPG) signals containing annotated arrhythmia episodes. This study investigates the hardware implementation of the PPG signal simulator, which can facilitate the testing of wearable devices during their development phase, eliminating the need for patient participation.

Methods: The simulator utilizes beat-to-beat interval series as an input, allowing for the utilization of publicly available ECG databases to simulate PPG signals that include episodes of ventricular tachycardia. A subset of 39 recordings with ventricular tachycardia from the PhysioNet/CinC Challenge 2015 training dataset was used to evaluate the accuracy of the hardware simulator-produced signals in comparison to the actual PPG signals.



Simulator-produced and actual PPG signals with ventricular tachycardia

Results: The simulator-produced PPG signals, acquired using a wrist-worn device, exhibited an RMS error of 0.72 a.u. for the episodes of ventricular tachycardia and 0.69 a.u. for the entire signal when compared to actual PPG signals. Additionally, the correlation coefficient between the heart rate derived from ECG and that derived from simulator-produced PPG signals was 0.98.

Conclusion: The hardware simulator is anticipated to be valuable in the development and testing of PPG-based wearable devices intended for monitoring individuals at elevated risk of ventricular tachycardia.