Shape Analysis of Consecutive Beats May Help in the Automated Detection of Atrial Fibrillation

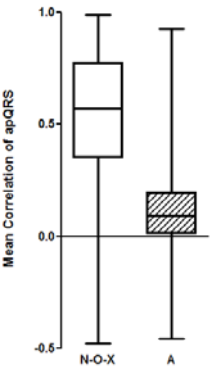
F. Plesinger[1], P. Andrla[1], I. Viscor[1], J. Halamek[1], V. Bulkova[2] and P. Jurak[1]

[1] The Czech Academy of Sciences, Institute of Scientific Instruments, Brno, Czech Republic
[2] Medical Data Transfer, Brno, Czech Republic

Background: Atrial fibrillation (AF) is associated with a higher risk of heart failure or death. Because AF may be episodic, patients with suspected AF are equipped with Holter ECG devices for several days. However, automated detection of AF in an ECG signal remains problematic, as was shown by the results of the PhysioNet Challenge 2017. In this work, we introduce a simple yet robust logistic regression model for AF detection.

Method: The signal is detrended, filtered (1-35 Hz) and normalized. QRS detection based on envelograms (10-35 Hz) reveals QRS complexes. Next, five features are extracted from the ECG signal: median R-R interval; mean and standard deviation of changes in R-R intervals; mean standard deviation of areas preceding each QRS complex (apQRS) over the whole recording and, finally, comparison of apQRS in consecutive beats using the Pearson correlation. Features were extracted for 1,517 recordings from the PhysioNet Challenge 2017 public dataset (758 AF recordings and 759 recordings with normal rhythm, other arrhythmia or noisy signal). The recordings were split in a 70/30% ratio for the purposes of training and testing.

Results: The results showed a sensitivity and specificity of 93% and 90%, respectively (AUC 0.95). In addition, the presented model was tested on the MIT-AFDB public database, showing sensitivity and specificity of 89% and 88%, respectively. However, tests on an independent private dataset revealed lower specificity when pathologies which are not widely present in the public PhysioNet Challenge 2017 dataset are present in the ECG signal. This limitation is further discussed as it may also apply to other algorithms trained with the same dataset.



The strongest model feature is mean apQRS correlation. N-O-X: normal rhythm, other arrhythmias and noise; A: atrial fibrillation.