Fusion of multiple univariate data analysis based detectors to build a specific fingerprint of atrial fibrillation

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Aim: This study proposes an alternative way to diagnosis atrial fibrillation (AF) arrhythmia which is based on the combination of seven univariate data analysis based detectors followed by a majority voting in order to construct a digital fingerprint of AF.

Motivation: Automatic and fast AF diagnosis are still a major concern for the healthcare professional. Several algorithms based on univariate and multivariate analysis have been developed to detect AF. Even if the published results do show satisfactory detection accuracy, computational complexity of such methods is still questionable.

Methods: Four publicly-accessible sets of clinical data (AF Termination Challenge Database, MIT-BIH AF, Normal Sinus Rhythm RR Interval Database, and MIT-BIH Normal Sinus Rhythm Databases) were used for assessment. All time series were segmented in 10 s RR interval window. In our previous works, we have demonstrated that the first and second RR derivatives time series contained additional information for heart rhythm characterization. Herein, seven features (e.g., geometrical and nonlinear detectors) were initially extracted from the second derivative of RR time series. The features of the four databases were merged in order to give rise huge variability and therefore to better characterize AF rhythm. Afterwards, ROC curve analysis has been used to fix optimal thresholds for AF detection. Finally, the seven obtained detectors have been concatenated and then the majority rule was applied to yield a final decision on AF diagnosis.

Results: The results showed that this strategy performed better than some existing algorithms do, with 98.50% for sensitivity and 95.1 % specificity.

Conclusion: The fingerprint-based diagnosis approach holds several interesting properties and can be easily implemented in portable electronic devices.