Evaluation of Features from Multi-lag Poincare Plot for Discrimination between Normal Sinus Rhythm and Atrial Fibrillation

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Background:
Poincare plot is a geometrical representation of RR time series to demonstrate patterns of heart rate dynamics. Analysis of different lags of Poincare plot provides interesting insights into the autonomic control of the heart. In this research, the distribution of heart rate time series in 10 different lags of Poincare plot is considered for discrimination between normal sinus rhythm (NSR) and atrial fibrillation (AF).
Methods:
For each lag of Poincare plot, traditional (SD1, SD2, and SD1/SD2) and new features were extracted. New features such as angle, area, perimeter and the average of point's distances relative to the line of identity proposed to quantify points' dispersion in this Poincare plot. For evaluating the new features and their usefulness in arrhythmia classification, two groups of 15 subjects using the Physionet database (AF and NSR) were used.
Result:
Kruskal-Wallis test was used to define the level of significance of each feature for two groups of subjects to demonstrate the usefulness of the proposed method. The results show that features were significantly different between two groups ($p<0.001$). Then, *K* nearest neighbor was trained on 70% of data as a train set, and the accuracy was evaluated on 30% of data as a test set. Accuracy of classification were 91%.
Discussion:
The results show that by increasing the lags in Poincare plot, the point's distribution focused on the center of the line of identity while in the smaller lags, the shape of the point's dispersion is more stretched. So, by increasing the lags, the angle increase while the area decrease.