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Multivariate Data Analysis for Automatic Atrial Fibrillation Detection

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Abstract : Atrial fibrillation (AF) has been considered as the most common cardiac arrhythmia, and a major public health burden associated with significant morbidity and mortality. Nowadays, telemedical approaches targeting cardiac outpatients situate AF among the most challenged medical issues. The automatic, early, and fast AF detection is still a major concern for the healthcare professional. Several algorithms based on univariate analysis have been developed to detect atrial fibrillation. However, the published results do not show satisfactory classification accuracy. This work was aimed at resolving this shortcoming by proposing multivariate data analysis methods for automatic AF detection. 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 1 min RR intervals window and then four specific features were calculated. Two pattern recognition methods, i.e., Principal Component Analysis (PCA) and Learning Vector Quantization (LVQ) neural network were used to develop classification models. PCA, as a feature reduction method, was employed to find important features to discriminate between AF and Normal Sinus Rhythm. Despite its very simple structure, the results show that the LVQ model performs better on the analyzed databases than do existing algorithms, with high sensitivity and specificity (99.19% and 99.39%, respectively). The proposed AF detection holds several interesting properties, and can be implemented with just a few arithmetical operations which make it a suitable choice for telecare applications.

Keywords : atrial fibrillation, multivariate data analysis, automatic detection, telemedicine
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