

Evaluation of Feature Models for 12-lead ECG Classification

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Automatic ECG classification is a well-known problem with several classification models proposed in the last two decades. Those models were developed from the available two-lead ECG databases. The aim of this work is to evaluate the usefulness and robustness of multi-lead features derived from 12-lead ECG recordings, available in current databases. The St Petersburg Institute of Cardiological Technics 12-lead Arrhythmia Database (INCART) was used (available on Physionet) together with the AAMI recommendations for class labeling and results presentation. We used as reference a classification model developed and evaluated in two-lead recordings, achieving good performance in all databases available on Physionet for classification purposes. This model includes classical features based in the heart rhythm as well as features obtained from different scales of the wavelet transform (WT). This reference model was adapted to 12-lead recordings using a PCA approach, adding other features describing the VCG loop morphology. We used linear discriminant functions classifier. The performance evaluation was carried out via a 10-fold crossvalidation approach in the whole database, and specifically obtaining the global accuracy (A) sensibility (S) and positive predicivity value (P+). A 9-feature model was obtained, achieving for the normal class a S of 98% and P+ of 100%, for supraventricular beats S of 84% and P+ of 35%, for ventricular beats S of 93% and P+ of 96%. The global A was of 97% while the global S and P+ of 92% and 77% respectively. The multilead features added which describes the morphology of the VCG loop, together with the adaptation of the 2-lead features to 12-lead, resulted in an increase in the classification performance for each class with respect to the reference 2-lead classifier. The results obtained show the usefulness of extending the classification models to a 12-lead-multilead approach, but must be corroborated in other databases.