Anti-interference Ability Analysis for Common Atrial Fibrillation Features

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In the past decades, a number of RR rhythm-based atrial fibrillation (AF) features were developed. Combining with these features and machine learning methods, we can obtain high classification accuracy for AF and normal rhythm on clean ECG recordings. In dynamic ECG monitoring scenario, accurate location for QRS complexes is challenging, resulting in a deviation between calculated and true RR interval sequences. However, the effect of RR sequence deviation caused by QRS detection on the AF features has not been quantified. This study addressed this concern and analyzed the anti-interference ability of 14 commonly used AF features, including mRR, minRR, maxRR, SDNN, RMSSD, medHR, PNN50, LFn, HFn, LF/HF, COSEn, NFEn, MAD, AFEv.

MIT-BIH AF database was used and RR interval sequence was segmented as 30-beat episode for both AF and non-AF rhythms. Two types of experiments were simulated to add the interference into the raw RR interval sequence. Experiment A: randomly moving forward or back several (0-15) labelled QRS locations to stimulate false detections of QRS locations, where the interference follows a normal distribution. Experiment B: randomly missing several (0-9) labelled QRS locations to stimulate missed QRS detections. The results showed that features of SDNN, RMSSD reported good anti-interference abilities in the Experiment A test but not in the Experiment B test. Anti-interference abilities of features of HF, LF, LF/HF, mRR, maxRR and medHR were stable with the increase of interference proportion but their classification accuracy was low. Features of AFEv, MAD, NFEn, COSE, minRR and PNN50 showed high anti-interference abilities in both Experiment A and B. Combing these six features with SVM, we obtained a classification accuracy of 99.8% for AF and non-AF rhythms in the clinical wearable ECGs, which was much higher than any of the single feature when used alone.