Detection of atrial fibrillation from short ECGs: minimalistic complexity analysis for feature-based classifiers

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Aims: In order to facilitate data-driven solutions for early detection of atrial fibrillation (AF), the 2017 CinC conference challenge was devoted to automatic AF classification based on short ECG recordings. The proposed solutions concentrated on maximizing the classifiers' F1-score, whereas the complexity of the classifiers was not considered. However, we argue that this must be addressed as complexity places restrictions on the applicability of inexpensive devices for AF monitoring outside hospitals. Therefore, this study aims to investigate the feasibility of complexity reduction by analyzing one published solution from the competition.

Motivation: We believe that the deployment of AF classifiers should be done on resource-limited devices. Local processing is preferable because of intermittent connectivity and data privacy. However, this demands simple computations (preprocessing, feature extraction, classification), i.e., the practical limitation is the computational complexity of the solution.

Methods & Results: We focused on a random forest classifier, where complexity was analyzed in terms of number of features. Each of the 8528 recordings in the published data from the competition was represented by 171 features (https://github.com/fernandoandreotti/cinc-challenge2017). The performance was measured with accuracy and mean F1-score using 5-fold cross-validation (10 simulations average). Recursive Feature Elimination, based on a feature ranking criterion, was used to identify the best feature sets. Results (Table 1) showed that 5 best features worsened accuracy by 6.0% and F1-score by 6.7% (compared to results for 171 features). The difference to the full classifier when using 10 features was only 2.4% and 1.3% respectively. There was no performance degradation for 15&20 features. Accuracy for 8 temporal features was comparable to 5 best features but F1-score was 7.1% worse.

Classification performance of random forest classifier for different number of features.

Number of features	Accuracy	F1-score
5	0,78	0,70
8 (time domain)	0,78	0,65
10	0,81	0,74
15	0,82	0,75
20	0,83	0,75
171	0.83	0.75

Conclusion: We postulate the feasibility of Recursive Feature Elimination for decreasing the classification complexity (both the number of features and the need for signals transformations), thus increasing the possibility of deployment on resource-limited devices.