Evaluating Electrograms Domain Knowledge for Enhancing Catheter Ablation Outcomes Based on Time Series Features

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Introduction: Performance of ablation of persistent atrial fibrillation (persAF) targets based on spectral analysis of electrograms (EGMs) have been suboptimal. Machine learning tools may be useful to predict the catheter ablation responses to electrograms by evaluating three EGM signal domains.

Methods*:* 3206 EGMs were collected from 10 patients undergoing left atrium catheter ablation using non-contact mapping catheter for a duration of five minutes using (Ensite array, St Jude Medical) system, and sampled at 512Hz. 1716 EGMs had negative catheter ablation responses and 1490 EGMs positive responses. QRST subtraction process was applied to reduce the effect of ventricular far-field activities from each EGMs. Features from each EGM signal domains (spectral, temporal and statistical) were extracted using time series feature extraction library (TSFEL) in python.Highly correlated and low variances features were removed from the feature list. Afterwards, features from each EGM signal domains were used as inputs separately to logistic regression (LR) classifier to classify the EGMs based on positive or negative responses to catheter ablation defined by atrial cycle length changes. LR classifier was trained and tested using 5-fold cross validation (CV). Five evaluations matrices (CV accuracy, sensitivity, specificity, precision and F1_score) were used to assess the performance of classifier for each domain features.

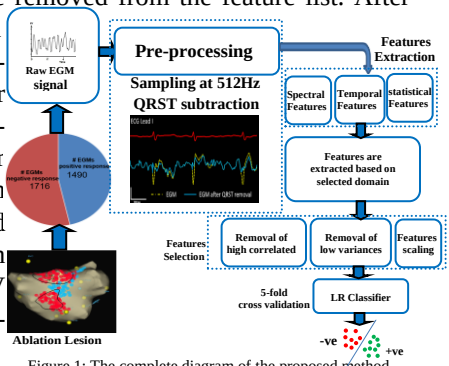

Figure 1: The complete diagram of the proposed method

Results: CV accuracies of 91.64%, 72.68% and 67.34% were achieved based on spectral, temporal and statistical features, respectively. The four-remaining evaluation metrics ranged between (90%-92%) for spectral, (66%-78%) for temporal, and from 65% to 69% for statistical features.

Conclusions: The highest performance was achieved with spectral, followed by temporal, whereas statistical features achieved the lowest performance. Hence, it can be concluded that spectral characteristics of EGMs are the more important of these 3 domains to predict catheter ablation responses to EGMs.