Using Heart Rate Fragmentation and Heart Rate Asymmetry to Discriminate Congestive Heart Failure

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Background: Heart Rate Fragmentation (HRF) quantifies a pattern of irregular heart rate variability characterized by frequent, short-lived accelerations or decelerations in heart rate by analyzing beat-to-beat intervals. Furthermore, Heart Rate Asymmetry (HRA) quantifies heart rate acceleration and deceleration imbalance. This paper uses HRF and HRA to distinguish Congestive Heart Failure (CHF) from Normal Sinus Rhythm (NSR).
Methods: We have used 18 ECG recordings of subjects with CHF from the Physionet Congestive Heart Failure database and 18 ECG recordings of subjects in normal sinus rhythm from the Physionet Normal Sinus Rhythm database. Using 3000 RR intervals, three common HRA indexes (i.e., Porta Index-PI, Guzik Index-GI, and Slope Index-SI) and four HRF indexes (i.e., the percentage of inflection points- PIP, the inverse of the average length of the acceleration/deceleration segments-IALS, the percentage of short segments-PSS, and the percentage of RR intervals in alternation segments-PAS) were calculated. In three different feature configurations, a K-Nearest Neighbors (KNN) was trained on 70% of the data as a train set, and the accuracy was evaluated at 30% as a test set. All seven extracted features were used for classification in the first feature configuration. Only four HRF and three HRA parameters were used in training a classifier in the second and third cases, respectively.
Result: The classification accuracy for all features and HRF-only features was 100%, compared to the accuracy of 81% for HRA-only features.
Discussion: The results showed that although both HRF and HRA have promising results in diagnosing CHF, the parameters extracted from HRF alone can obtain the most accurate results to distinguish CHF from NSR. However, this study's results must be evaluated with a larger dataset.