Optimization of Arrhythmia-based ECG-lead Selection for Computer-interpreted Heart Rhythm Classification

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The 12-lead ECG only has 8 independent ECG leads, which leads to diagnostic redundancy when using all 12 leads for heart arrhythmias classification. We have previously developed a deep learning (DL)-based computer-interpreted ECG (CIE) approach to identify an optimal 4-lead ECG subset for classifying heart arrhythmias. However, the clinical diagnostic criteria of cardiac arrhythmia types are often lead-specific, so this study is going to explore the selection of arrhythmia-based ECG-lead subsets rather than one general optimal ECG-lead subset, which could improve the classification performance for the CIE. The DL-based CIE model previously developed was used to learn 4 common types of heart arrhythmias (LBBB, RBBB, AF, and I-AVB) for identifying corresponding optimal ECG-lead subsets. A public dataset that splits into training (approx. 70%), validation (approx. 15%), and test (approx. 15%) sets from the PhysioNet Cardiology Challenge 2020 was used to explore the study. The results demonstrated that the DL-based CIE model identified an optimal ECG-lead subset for each arrhythmia: I, II, aVR, aVL, V1, V3, and V5 for I-AVB, I, II, aVR, and V3 for AF, I, II, aVR, aVF, V1, V3, and V4 for LBBB, and I, II, III, aVR, V1, V4, and V6 for RBBB. For each arrhythmia classification, the DL-based CIE model using the optimal ECG-lead subset significantly outperformed the model using the full 12-lead ECG set on the validation set and on the external test dataset. The results support the hypothesis that using an optimal ECG-lead subset instead of the full 12-lead ECG set can improve the classification performance of a specific arrhythmia when using the DL-based CIE approach.