Arrhythmia Detection and Classification of 12-lead ECGs Using a Deep Neural Network

Electrocardiogram (ECG) plays a critical role in the clinical diagnoses, and the algorithmic paradigm of deep learning present an opportunity to improve the accuracy and scalability of arrhythmia detection and classification. The goal of the 2020 Challenge is to identify clinical diagnoses from 12-lead ECG recordings. And the training set consists of 6,877 (male: 3,699; female: 3,178) 12-ECG recordings lasting from 6 seconds to 60 seconds.

Firstly, we split initial the training set into training(70%),validation(10%),testing sets(20%). we develop an end-to-end deep neural network to classify 9 rhythm classes. The model is a modified version of Squeeze and Excitation (SE) networks, which can explicitly model channel-interdependencies within modules and selectively enhance useful features and suppress less useful ones. We combine the SE networks and ResNet into the deep neural network , which is called SE-ResNet. We use the 1 dimensional convolutional filter to extract the features among the different 12-lead ECGs channel and the convolutional network is a standard 34-layers ResNet. Then, we use the SE networks to apply the channel attention to explore the spatial enhancement. Finally, we also concatenate some statistical features from the ECGs and the deep features from the SE-ResNet to classify the arrhythmia and Normal sinus rhythm.

The evaluation metrics consider multiple evaluation metrics that assign different weights to different classes and classification errors. The first scoring function is a general class-weighted F-score and the second score is G-score calculated over all recordings, weighted by the relative importance of the diagnosis. The final ranking is the Geometric Mean of F-score and G-score. The best performance of our submission in unofficial phase is 0.715, where F-score is 0.827 and G-score is 0.619.

If confirmed in clinical settings, this approach could reduce the rate of misdiagnosed computerized ECG interpretations and improve the efficiency of expert human ECG interpretation.