The Potential of Wave Masking in 12-Lead Electrocardiogram Reconstruction

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There are various methodologies for 12-lead electrocardiogram (ECG) reconstruction. Following the understanding that ECG leads may not be linearly related, methods including the use of artificial neural networks (ANN) has become a popular norm. The intensive computing of ANNs can be reduced if simpler methodologies could be used to achieve the same results. This paper compares the performance of Wave Masked Linear Regression (WMLR) method to two ANNs, Long-Short Term Memory (LSTM) and Feed Forward Network (FFN).

These methodologies were compared on 80 patients from PTB database. The dataset included 30s ECG resampled to 500hz. The inputs for the 3 methods were leads I, II and V3, while the outputs were V1, V2, V4, V5 and V6. The WMLR method extracts the component waves (p wave, QRS and t wave) from the inputs and uses these waves in conjunction with the inputs as predictor variables in a linear equation to find each of the outputs (figure 1). LSTM uses the past 100 samples of each given input sample to predict the output sample. FFN uses an ensemble of 50 individual neural networks to perform predictions. Each method was used to build a generic reconstruction model on the dataset. Pearson correlation was used to compare the reconstruction of each model to the original signal.

WMLR performed as good as the ANNs. Paired t-tests on all leads produced p-values greater than 0.05 between the methods. Mean correlation and standard deviation of WMLR, LSTM, and FFN methods were 0.926±0.103, 0.912±0.126, and 0.870±0.226 respectively. This showed that linear models can perform as good as ANNs when wave masking is used to alter the pipeline.

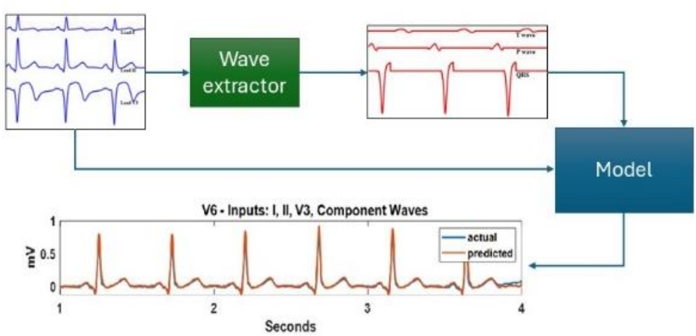

Figure 1: Pipeline for the WMLR model