Myocardial Ischemia Detection Using Body Surface ECG Recordings and Machine Learning

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Recent improvements in detecting acute myocardial ischemia via body surface recordings have been driven by modern machine learning and artificial intelligence methods. Most successful research relies primarily on computationally intensive models such as convolutional or recurrent neural networks, making clinical interpretability difficult. While extensive research has been done using single and 12 lead ECGs, almost no models have incorporated body surface recordings. We created two contrasting machine learning models, logistic regression implemented in Pytorch and the XGBoost Classifier from the XGBoost package, and trained them on experimentally acquired body surface recordings with ground truth ischemia measurements recorded from within the heart. When evaluated against unseen data, these models achieved a mean accuracy of 96.46% and 97.63%, as well as a mean AUC of 99.27% and 99.72% for the Logistic Regression and XGBoost classifiers respectively. We then reduced the size of the training data and model by as much as 97% by training both models on only a subset of the total ECG leads available from the original recordings, with some of these subsets corresponding to common clinical measurement areas such as pre-cordial ECG leads. We observed that some subset models are capable of performance comparable to those models trained on data containing all available ECG lead recordings. Specifically, we observed that the XGBoost algorithm achieved an AUC of 98.4% using data containing only 3 ECG lead recordings. This suggests that some known anatomical lead locations likely highly contribute to ischemia detection while other leads may be less important. The impressive performance of these machine learning models in detecting ischemia using small numbers of leads suggests possible clinical applications.

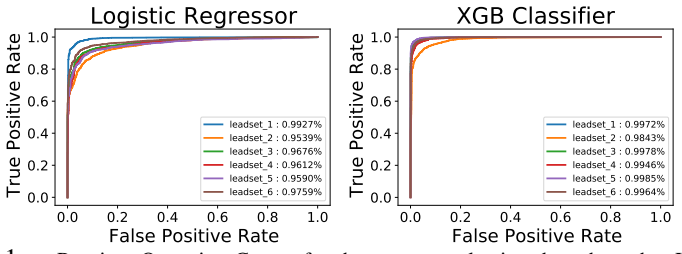

Figure 1. Receiver Operating Curves for the unseen evaluation data show that XGBoost achieves a 98.4% AUC on a leadset with only 3 ECG lead recordings.