End-To-End Model for Detecting Murmurs from Phonocardiograms Using Asymmetric Loss

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Aims: This study aims to detect murmurs from Phonocardiograms using a deep learning approach via a convolutional neural network (CNN) model. Murmurs are abnormal waves caused by turbulent blood flow in the heart and vascular structures. These abnormal waves are closely associated with certain diseases.

Method: The training dataset consists of 942 patients who have 3163 recordings from the George B. Moody PhysioNet Challenge 2022. In order to detect murmurs, we have combined the recordings belonging to the same patient, and then generated a Mel-Spectrogram. It is then plugged into our custom 4 layers of 2D CNN model to determine whether the murmurs are present, absent, or unknown. because of the high class imbalance (695 with absent murmurs, 179 with present murmurs, and 68 with unknown murmurs), we have used an asymmetric loss function to reduce the model's bias towards the majority class.

Results: To test our proposed method, we used 5 fold cross validation and computed the AUROC, AUPRC, F1-score and challenge score outlined by the PhysioNet Challenge as the main benchmark. The challenge score is based on the efficiency and performance of the algorithm where the lower score the better. As can be seen in the below table, the asymmetric cross entropy has the similar results in terms of AUROC, AUPRC, and F1-score but there is a huge gap in the challenge score, meaning that this new loss improves the model performance.

Table 1. Results of the Challenge. CE refers to cross entropy

Model	AUROC	AUPRC	F1-score	Challenge score	Challenge score (Validation set)
CE	0.60	0.42	**0.45**	1,485	-
Asymmetric CE	**0.61**	0.42	0.39	**967**	1,006

Conclusion: In the challenge score, asymmetric loss functions show to improve on the model performance. Further analysis could help boost the model performance such as adding auxiliary losses or performing data augmentation on the sounds during training and testing.