Hierarchical Multi-Scale Convolutional Network for Murmurs Detection on PCG Signals

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Background: Computer-aided analysis is of great help in improving heart sound detection. However, due to different databases and processing approaches, it is hard to objectively evaluate the performance of the proposed classification methods. PhysioNet Challenge 2022 provides a platform for researchers to test and compare their algorithms.

Objectives: The aim of the Challenge is twofold. The primary aim is to design an algorithm to detect murmurs in the heart sound (T1), and the secondary aim is to identify the clinical outcomes from the recordings (T2).

Methods: This study proposes a recording quality assessment method based on frequency density distribution for label correction to prevent the poor-quality recording segments from misleading network optimisation. After the label correction, the spectrograms of 3s segments are input to the designed hierarchical multi-scale convolutional neural network (HMS-Net) to conduct both the T1 and T2 detections. HMS-Net extracts convolutional features from the spectrograms on multiple scales (with different resolutions) and fuses them through its hierarchical architecture. The network builds long short-term independencies between multi-scale features and improves the detection performance. Finally, the prediction of a patient is based on the ensembled segment predictions by sliding window.

Results: In the five-fold cross-validation by patients, the proposed algorithm performed an average weighted accuracy of 0.81 (best 0.853) on T1 and an average challenge score of 10808 (best 9250) on T2. In the Challenge blind test, our team (HearTech) achieved 0.782 weighted accuracy on T1 and 9886 challenge score on T2.

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