Heart Murmur Detection using Ensemble of Boosted Classifiers for Phonocardiograms Recorded from Multiple Auscultation Locations

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Background: Phonocardiogram (PCG) is the primary tool for diagnosing heart malfunctioning caused by congenital and acquired heart disease at point-of-care settings. The 2022 PhysioNet/CinC Challenge aims to encourage algorithm development for murmur detection using PCG recorded from multiple auscultation locations. This article proposes an ensemble of boosted classifiers for PCGs recorded from pulmonary valve (PV), aortic valve (AV), mitral valve (MV), and tricuspid valve (TV) locations for heart murmur detection.

Method: The algorithm was trained on available training dataset (presence= 695, absence= 179, and unknown= 68) and validated on hidden validation dataset. Data was first resampled (1000Hz) and band-pass filtered (between 25-400Hz) and then segmented to the PCG states (S1, S2, Systolic, and diastolic) using segmentation developed by Springer et al.. Seventy-six features, including demographics (age, sex, height, and weight) and time (PCG intervals and amplitudes) and frequency (e.g., power across different frequency bands) features from each PCG state of each cardiac cycle were extracted. The resulting features in each recording location were independently used with a Random Undersampling Boosting (RUSBoost) classifier, an effective classifier for imbalanced data. For final murmur detection, an ensemble of trained classifiers for PV, AV, MV, and TV was created by maximum voting or selecting the most confident class when there was no dominant class. The challenge score on the cross-validation and hidden validation datasets was used for assessing the performance.

Results: The best challenge score achieved by our team at the unofficial phase of the challenge for cross-validation and hidden validation data set was 501 and 877, respectively (Team: Life_Is_Now).

Discussion: This study proposes an ensemble of boosted classifiers trained with hand-crafted features for murmur detection. The result of the unofficial phase is promising, but we plan to improve the algorithm's performance in the official phase by adding more features (e.g., deep learning-based features).