Abstract

Traditionally, abnormal heart sounds are detected using stethoscopes, which are subjective and requires the expertise of listener for accurate detection of abnormalities. The computerized methods of heart sound analysis provide a deeper way to analyze heart sounds for diagnostic purposes. The primary aim of this thesis is to use signal processing tools to improve the diagnostic value. More specifically, it presents four different noble approaches for recognition of fundamental heart sounds. For the automated cardiac screening system, the proposed techniques are independent of time-interval information between S_1 and S_2 or electrocardiogram signal as a reference. This framework is built on (i) support vector machine (SVM) with variational mode decomposition (VMD) based spectral and convex hull features, (ii) stacked autoencoder with combinatory feature, (iii) SVM with VMD-derived higher-order spectral features, and (iv) a 1-D convolutional neural network. Experiments on both publicly available and recorded heart sound signals for the validation of the proposed methods have shown promising results over the state of the art techniques. Lung sounds obscure the interpretation of heart sounds. A novel approach for the separation of heart and lung sounds is presented based on the nonlinear decomposition technique. As the third heart sound, S_3 is an important clinical sign of cardiac failure in elderly patients, a new technique is proposed for its detection. This method is built on the VMD and the smoothed pseudo Wigner-Ville distribution. A noble framework that employs a cascaded VMD and acoustic-based features for the detection of pathological heart murmurs is also presented. The analysis shows the promising outcome on both the balanced and imbalanced datasets in the correct recognition of heart murmurs thereby paving a way to assist cardiologists for the diagnosis of heart diseases.

Keywords: Heart sounds, Variational mode decomposition, Feature extraction, Stacked autoencoder, Convolutional neural network.