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Effects of the Window Size and Feature Extraction Approach for Arrhythmia Classification

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Abstract. Arrhythmia, a common form of heart disease, can be detected from an electrocardiogram (ECG) signal. This research work presents a comparative study between five feature extraction methods applied separately on two window sizes for detecting three ECG pulse types, namely normal and two arrhythmia variations. The library support vector machine (LIBSVM) was used to classify the three classes of the ECG pulses. The ECG signals were obtained from MIT-BIH database. The ECG dataset was normalized and filtered to remove any noise and after that the signals were windowed into two window sizes (long window and short window). Five approaches were used to extract the features from the ECG signals. These approaches are scalar Autoregressive model coefficients, Haar discrete wavelet transform (DWT), Daubechies (db) DWT, Biorthogonal (bior) DWT, and principal components analysis (PCA). Each approach was applied separately on the two window sizes. The results of the classification show that scalar Autoregressive model coefficients, Haar, db, and bior are better approaches to catch the ECG features for short window than the long window. However, PCA gave the closest and highest results for the two window sizes than other approaches. That mean the PCA is the better feature extraction approach for both window sizes.

Introduction

The number of deaths due to heart disease especially arrhythmia, induces researchers and research institutes to find and develop new, cost-effective, accurate, and efficient automated arrhythmia detection approaches based on electrocardiogram (ECG) signal. These methods vary in the material, methodology and results. There are many methods of arrhythmia detection reported with differences in ECG signal window size, filtration process, extracting of the features and classification approaches.

Arrhythmia is an irregular heart rhythm which manifests as either fast heartbeat, slow heartbeat, too early beat or irregular heartbeat. Quite often, the arrhythmia is not harmful but some of the arrhythmias can be life threatening and must be diagnosed and treated [1]. Some of the diagnosis methods for arrhythmias require long-term monitoring as in the case of bedridden patients. With this condition, the automated classification of an arrhythmia is needed to determine the arrhythmia as it occurs.

Some of the studies proposed a number of methods to detect and classify arrhythmias. Ge et al. [2] proposed a detection method of normal ECG, and five arrhythmias types, namely atrial premature contraction (APC), premature ventricular contraction (PVC), supraventricular tachycardia (SVT), ventricular tachycardia (VT), and ventricular fibrillation (VF). The ECG signals