Chapter 7
Artificial Intelligence Applications on Classification of Heart Sounds

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ABSTRACT

The aim of this chapter is to classify normal and extra systole heart sounds using artificial intelligence methods. Initially, both heart sounds have been passed from Butterworth, Chebyshev, Elliptic digital filter in specific frequency values to remove noise. Afterwards, features of heart sounds have been obtained for classification. For this process, wavelet transform and Mel-frequency cepstral coefficients (MFCC) methods have been applied. Training and test data have been created for classifier by taking means and standard deviation of gained feature. Support vector machine (SVM) and artificial neural network (ANN) methods have been used for classification of these heart sounds. Using wavelet and MFCC features, classification success of SVM has been obtained as 93.33% and 100%, respectively. Using wavelet and MFCC features, classification success of ANN has been obtained as 83.33% and 90%, respectively.

INTRODUCTION

Biological signal is defined as the signal taken from living body through transducer. These signals have provided lots of information about the living body. These signals are split in two, in that some of its are based on electricity origin or some of its are physical origin. Heart sounds (HS) is defined as physical biomedical signals. HS are occurred from result of mechanical movement of heart. These sounds can be occurred with different properties because of different heart disease.

According to WHO (World Health Organization), heart diseases is the first cause of death around the world. Every year, most people lose their life because of heart diseases more than other reasons. In 2004 nearly 17.1 million people have been died due to heart diseases. This number points a rate of 29%

DOI: 10.4018/978-1-5225-4769-3.ch007

of all deaths in that year. But unfortunately this number is expected to be 23.4 million in 2030 (WHO, 2004). In Europe, heart diseases form 42% of all deaths and expenditure for treatment of the diseases is almost 192 billion € in total (Allender et al., 2008).

Early diagnosis of heart diseases is crucial importance in treatment. Early discern and short time diagnosis of heart disorder is vital importance for preventing serious heart disease. Furthermore, it plays effective role in decrease of total treatment expenditure. Doppler ultrasonography and ECG (Electrocardiography) are the systems that require time and expert knowledge. HS are gained by result of auscultation and these sounds are one of the related basic medical techniques used by doctors in diagnosis for heart disease. Moreover, auscultation is a method which is harmless, easier and faster for patient. In addition to this, it is vital importance to obtain medical information such as disease and other cardiac data of the patient with heart disease until patient is taken to hospital. In this study, nature inspired artificial intelligence methods that is used classification of normal and extra systole HS are discussed. The flowchart of learning model using in this study is given in Figure 1. Besides, all MATLAB code belong to each step is explained throughout the study. Readers can use all of these codes in one m-file by combining and they can implement them in its own research.

BACKGROUND

As far as there are different studies in signal processing and classification of different heart sounds (HS). The methods in used in signal processing are wavelet transform for feature extractions in these studies. To classify, researcher use different methods of SVM and ANN. The main ones can be listed as follows. Zheng et al. (2015) have used least square support vector machine (LS-SVM) for the implementation of intelligent diagnosis of chronic heart failure. Patidar et. al. (2014) have classified cardiac sound signals using LS-SVM with various kernel functions for detection and identification of heart valve disorders. Lubaib et al. (2016) have classified normal and abnormal HS samples using SVM, K Nearest Neighbour (KNN), Bayesian and Gaussian Mixture Model (GMM) Classifiers. Güraksın et al. (2010), have classified HS using ANN (artificial neural network) on pocket computer which can run Windows OS. In their study, they have used Discrete Fourier Transform (DFT) to frequency analyzing of HS. It has

Figure 1. The learning model of heart sound classification systems