

CLASSIFICATION OF HEART SOUNDS BASED ON THE LEAST SQUARES SUPPORT VECTOR MACHINE

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ABSTRACT. *The heart is of crucial significance to human beings. Auscultation with a stethoscope is regarded as one of the pioneer methods used in the diagnosis of heart diseases. However, the fact that auscultation via a stethoscope depends on the skills of the physician's auscultation or his/her experience may lead to some problems in diagnosis. Therefore, the use of an artificial intelligence method in the diagnosis of heart sounds may help the physicians in a clinical environment. In this study, primarily, heart sound signals in numerical format were separated into sub-bands through discrete wavelet transform. Next, the entropy of each sub-band was calculated by using the Shannon entropy algorithm to reduce the dimensionality of the feature vectors with the help of the discrete wavelet transform. The reduced features of three types of heart sound signals were used as input patterns of the least square support vector machines and they were classified by least square support vector machines. In the method used, 96.6% of the classification performance was obtained. The classification performance of the method used was compared with the classification performance of previous studies which were applied to the same data set, and the superiority of the system used was demonstrated.*

Keywords: Least squares support vector machine, Discrete wavelet transform, Shannon entropy, Heart sounds

1. Introduction. The heart is one of two organs which are crucial for human life. Therefore, a disorder of the heart is of great importance to human health. All over the world, in the period between 1985 and 2006, the mortality rate stemming from heart diseases ranked second after brain embolisms [1].

The heart is a hollow muscle which pumps the blood through all the body [2]. The primary and most important duty of the heart is that it delivers blood into the circulatory system [3]. This shows us how crucial it is for human life. The cycles of the heart are known as the systole and diastole. The stage occurring when the heart contracts is called the systole, and the stage occurring when the heart relaxes is called the diastole. The heart sounds heard as “lub, dub” occur because of the closing of the heart valves. “Lub” is known as the first heart sound (S1) and “dub” is known as the second heart sound (S2). The third heart sound (S3) occurs immediately after the S2, and it is of lower energy than the second one. The fourth heart sound (S4) occurs before the S1 and it has a lower scale of amplitude than the other sounds [2]. In addition, the sounds due to the flow of blood