Chapter 8
Introduction to Heart

ABSTRACT

The heart is an important organ in the human body, for pumping the blood throughout the body. An electrocardiogram (ECG) is a diagnosis tool that reports the electrical operation of the heart, recorded by skin electrodes at specific locations on the body. The introduction of computer-based methods for the purpose of quantifying different ECG signal characteristics is the result of a desire to improve measurement accuracy as well as reproducibility. In this chapter, the author explains the basic definitions in heart studies and the electrocardiogram signals. In addition, the importance of interpretation and measuring the effective features in heart signals to detect the heart disorders is described. Finally, some of the common disorders of heart are briefly explained.

1 OVERVIEW

The heart generates signals which hide information in their structure. This signal information is very useful to physicians for heart disorder detection, but is not easily perceived by them. Therefore, it is necessary that the signals be decoded to be useful for interpretation by specialists. The interpretation process is sometimes easy when it only involves visual inspection of the signal. However, there are signals whose complexity is high due to the heart disorders, which affect the decoded form of signals. Automated methods can assist specialists in accurate diagnosis and therefore,

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automated heart signal processing becomes a reliable tool for finding important information that is hidden in the signal (Adlam & Hampton, 1997).

An important issue in designing an analysis method for heart disorder diagnosis and avoiding the risk of overlooking useful information of the heart signals is to have the knowledge about the physiology of the human body. Early use of computers in the medicine area was limited to the automation, but this goal has been changed over the years, because specialists must be responsible for the taken diagnosed disorders. Nowadays, the automated system goal is to help physicians for better decision making. (Fitzgibbon, Berger, Tsitlik, & Halperin, 2002).

The motivation for this work is the desire to improve measurement accuracy that would lead to development of better automatic methods for the purpose of detecting the heart signal disorders. Another challenge for biomedical signal processing is feature extraction to for understanding and identification the hidden information in a signal. These feature extraction methods can be designed to support the physician diagnosis by extracting information that is not easily available through simple visual assessment. Most of the current computerised methods aim to mimic the manual procedures that the physician follows for measuring the features in the signal (Moein, Monadjemi, & Moallem, 2008). However, there are small measures in the heart signal that are not perceivable by the human eye and they are very useful for heart disorder detection and thus, need to be explored.

An emphasis of the problem is noise removal as the heart signal is usually corrupted with noise from various sources, including machine malfunction, electrical noise from elsewhere in the body, respiration and muscle contractions (Behbahani, 2007). The noise consists of low-frequency and high-frequency components such as baseline wander and powerline interference, respectively (Karl, Isis, Roberto, & Hakan, 2004). The recorded signal is distorted in a way that it could be difficult to perform any automatic diagnosis. The next sections present explanation on the function of the heart, the electrocardiogram, objectives, aims and contributions of this research work.

2 HEART FUNCTION

The heart is an organ in the human body for providing blood and oxygen. It is divided into 2 halves containing four chambers, as shown in Figure 1. As seen, left and right atria are upper chambers, while the left and right ventricles are the lower chambers. There are fibrous, non-conductive tissues for joining the atria to the ventricles to isolate the ventricles from atria electrically. In order to pump the blood to the lung, the right atrium and the right ventricle cooperate together. The blood is forced into the right ventricle by the right atrium. In order to oxygenate the