Chapter 5
Filtration and Classification of ECG Signals

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ABSTRACT
Electrocardiogram (ECG) is a kind of process of recording the electrical activity/signals of the heart with respect to the time. ECG conveys a wide amount of information related to the structure and functions of the heart, its electrical conduction processes. ECG is a diagnostic tool that the doctors and medical professionals use to measure patients’ heart activity by paying attention to the electric current flowing in the heart. Due to the presence of noises, it needs to carry out the filtration process. Filtration is the process of keeping the components of the signals of desired frequencies by setting up an “fc” value and removing the components apart from the said “fc” frequency. It is required to eliminate the noise level from the ECG signal, such that the resultant ECG signal must be free from noises. All these techniques and algorithms have their advantages and limitations which are discussed in this chapter.

1. INTRODUCTION
Electrocardiogram (ECG), is the signature of electrical movement of the heart, expressed as the summation of electrical signals originating from different regions of the heart, measured over a time interval. ECG conveys a wide amount of information related to the anatomy and the electrophysiology of the heart. It has been a diagnostic tool of choice for doctors and medical professionals to diagnose or predict cardiac abnormalities. However, due to small magnitudes of cardiac voltages observed at the skin surface, the chances of the ECG signal getting corrupted with noise are high. Understanding of the nature of the noise vital towards deciding upon the approach for its removal. Various techniques have been developed for removal of the noise, including analog filters, digital filters and feature extraction.

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Filtration is the method of observance mechanism of the signals of required frequencies by setting up an ‘fc’ value and removing the components apart from the said ‘fc’ frequency. While in this process we need to eliminate the noise level from the ECG Signal, such that the resultant ECG signal must be free from noises.

Normal cardiac rhythm consists of P, QRS and T waves with parameters such as frequencies, time intervals and amplitudes well documented shown in Figure 1. However, the precise time intervals and wave shapes vary from one cardiac cycle to the other. Feature extraction mechanism determine the amplitude and intervals present in ECG signal for further analysis. Various techniques have been developed to analyze of the ECG signals. All these techniques and algorithms have their reward and restrictions which has been discussed in this chapter.

1.1 Biomedical Signals

Biomedical signals are time domain records of events such as flexing muscle or heartbeat. Any signals generated from a biological or health source can be called as Biosignals. The sources of the signal could be at molecular stage, cell level or organ level. These signals are commonly encountered in the clinic, research laboratory, sometimes even at home. Classification of biomedical signals shown in Figure 2.

Biomedical signal analysis deals with several interdisciplinary areas which helps in filtering, analysing and classifying the signals generated as a result of various physiological processes in the human body. These signals are primarily acquired for detecting specific physiological states for the purpose of diagnosis and evaluating therapy. However, these signals in raw form cannot provide much information

Figure 1. P Q R ST Waves

![Image of ECG waves and heartbeats]