Introduction:

Electrocardiogram is the most easily accessible bioelectric signal that provides the doctors with reasonably accurate data regarding the patient heart condition. Many of the cardiac problems are visible as distortions in the electrocardiogram (ECG). The major task in diagnosing the heart condition is analyzing each heart beat and co-relating the distortions found therein with various heart diseases.

ECG Filtering

Signal processing is a huge challenge since the actual signal value will be 0.5mV in an offset environment of 300mV. Other factors like AC power-supply interference, RF interference from surgery equipment, and implanted devices like pace makers and physiological monitoring systems can also impact accuracy. The main sources of noise in ECG are

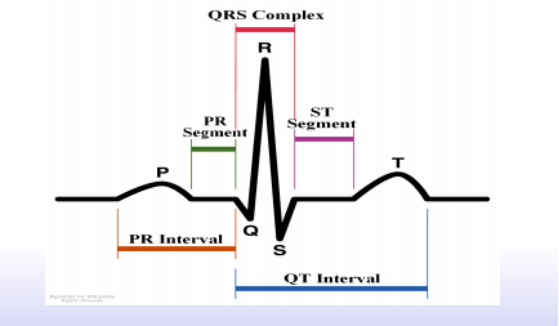
- Baseline wander (low frequency noise)
- Power line interference (50Hz or 60Hz noise from power lines)
- Muscle noise (This noise is very difficult to remove as it is in the same region as the actual signal. It is usually corrected in software.)
- Other interference (i.e., radio frequency noise from other equipment)

For further detail on noise http://www.eetimes.com/document.asp?doc_id=1278571.

Identifying Peaks in ECG Signal:

3 distinct waves are produced during cardiac cycle

- P wave caused by atrial depolarization
- QRS complex caused by ventricular depolarization
- T wave results from ventricular repolarization and relax



In order to uniquely identify these peaks we look for the rules.Identification of the normal QRS-complex from the P- and T-waves does not create difficulties because it has a characteristic waveform and dominating amplitude. This amplitude is about 1 mV in a normal heart and can be much greater in ventricular hypertrophy. The normal duration of the QRS is 0.08-0.09 s.

if the heart does not exhibit atrial hypertrophy, the P-wave has an amplitude of about 0.1 mV and duration of 0.1 s. For the T-wave both of these numbers are about double. The T-wave can be differentiated from the P-wave by observing that the T-wave follows the QRS-complex after about 0.2 s.`

The detection of peaks in signals is an important step in many signal processing applications. Up to now, many different methods have been developed, including those based on traditional

window-threshold techniques , wavelet transform , Hilbert transform , combining Hilbert and wavelet transform , artificial neural networks , techniques using templates , morphology filtering, nonlinear filtering Kalman filtering , Gabor filtering , Gaussian second derivative filtering , linear prediction analysis , higher-order statistics , K-Means clustering , fuzzy C-Means clustering , Empirical Mode Decomposition , hidden Markov models , and techniques using entropy , momentum , histogram/cumulativedistribution function , intensity weighted variance , stochastic resonance , or a smoothed nonlinear energy operator .

Measuring Distance between different peaks for Disease detection:

The ECG tool plays a vital role in diagnosing and treatment of several diseases related to cardiac. Doctors can provide the important information about status of disease and condition of patient by studying the ECG signals generated by heart. ECG1 signal consists of components like segments, intervals, and waves are studied and evaluated based on the size, and duration time. Cardiac rhythm type is determined by studying these different components. Abnormal rhythm of the heart called arrhythmia (or dysrhythmia) is indicated when above mentioned components vary with expected norm.

For Example the parameters used for the analysis of the QRS complex are QRS duration, R-R interval and heart rate of the signals. These parameters are described below.

Table 1. Values of QRS complex duration, RR intervals and heart rates of test and normal ECG signals

Signal	RR interval (seconds)	Heart rate (beats/min)	QRS duration (seconds)	Condition
Normal signal	0.791	75.84	0.094	STANDARD
Signal A	0.877	68.41	0.093	NORMAL
Signal B	0.911	65.83	0.088	NORMAL
Signal C	1.059	56.65	0.238	ABNORMAL
Signal D	0.80	75.00	0.080	NORMAL
Signal E	0.516	116.07	0.197	ABNORMAL
Signal F	0.78	76.90	0.083	NORMAL
Signal G	0.45	133.33	0.162	ABNORMAL

Link to Dataset

https://physionet.org/physiobank/database/html/mitdbdir/mitdbdir.htm