Filtration of ECG signal By Using Various Filter

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Abstract : Baseline drift is a unwanted problem to achieve spike free ECG signal. To remove this problem we use various filter. In this paper we take an overview of all filters which remove baseline drift from ECG signal .Filter used like IR, Notch, Golay , adaptive filter etc. in this paper we survey on all type of filter which is used in to achieve noise free signal.

1.Introduction.

The ECG an instrument ,which records the electrical activity of heart. Electrical signals from the heart characteristically precede the normal mechanical function and monitoring of these signal has great clinical significance.ECG are used in catherization laboratories, coronary care units and for routine diagnostic applications in cardiology. cardiologist readily interprets the ECG waveforms and classifies them into normal and abnormal pattern.ECG signals are formed of P wave, QRS complex, T wave. The change in these parameters indicate illness of heart that may occur many reasons. For achieve spike free signal we use filter. A standard Scalar ECG shown in fig.1
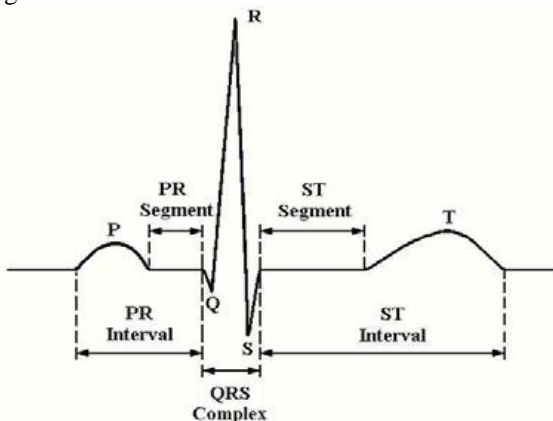

Fig.1

A filter is a circuit which amplifies some frequencies applied to its input and attenuates others. There are four common types of filter used which is high pass, which amplifies frequencies above a certain value, low pass filter which amplifies below certain value ,band pass filter which amplifies frequencies a certain band. Filters has two types which is analog and digital. Analog filter require more mathematical calculation but digital filter require no more calculation.

2.LITERATURE REVIEW

There are many technique to remove baseline drift from ECG signal . in this part of paper we discussed various type of filter which is used to remove baseline drift from ECG signal.

Raimon et al. in their work cascade adaptive filter was use to remove base line drift. This cascade filter works in two stage .the first stage was as adaptive notch filter at zero frequency. The Second stage was an adaptive impulse correlated filter that, using a QRS detector, estimates the ECG signal correlated with QRS occurrence. They analyzed the frequency response of filter showing that the filter can be seen as a comb filter without dc lobe This method may remove base line drift in real time without needing the calculate isoelectric levels[1].

Semma Rani et al. In their work Comparative study were presented . Comparison was working of FIR and IIR filter .according to him the order of performed IIR filter 2 and it takes less computation power can easily implemented comparison FIR filter. The computational complexity FIR filter is far greater than IIR Filter. It increase the memory requirement and power dissipation of FIR filter so IIR filter can be better choice for removal of baseline drift[2].

Lisette et al. in their work adaptive real time bidirectional baseline drift suppression filter is used .The filter optimized minimal delay, minimal non linear phase shift ,minimal power calculation and maximal signal to noise ratio. It is not possible to filter with 150 ms delay using known techniques ;250 ms is the theoretical minimum for a 0.5 Hz cut- off frequency linear filter and 333 ms for butterworth

implementation. The real time bidirectional base line drift suppression filter has 358 ms delay. Due to this signal to noise ratio is improve[3].

Sander et al. in their work digital notch filter was used. They designed a 50/60Hz notch filter to eliminate baseline drift from high resolution ECG Signal. This special filter causes only minimal distortions of the power spectra and provide the spike free ECG signal without change the frequency distribution of the original signals. Since the filter is based on an integer coefficient filter technique, the calculation time is relatively low and programming effort is very low[4].

Choy TT,Leung PM. et al.In their work 50Hz notch filter was used for real time application on ECG signal. It is found that the filter can filtering of 40 db noise. Bandwidth was used is 4 HZ and cause the attenuation in the QRS complex[5].

Pei SCTseng CC describe that when a notch filter is used to eliminate power line interference in recording of ECG signal .The performance of notch filter with transient suppression is better than that of the conventional notch filter with arbitrary initial condition[6].

Yunfeng Wu et al in their work he presented a two stage moving filter , comb filtering of power line interference with an infinite impulse response comb filter, an additive white noise generator to test the system performance in terms of signal to noise ratio and UNAR model that is used to estimate the noise which is subtracted from the contaminated ECG signal . In this work shows that UNAR model is better than Least mean square filter. It provide better signal to noise ratio[7].

A kam , A cohen worked on IIR Adaptive filtering. IIR adaptive filtering differs from the conventional FIR filtering It is called ARMA filter. This filter has advantage that this can describe better transformation because this adopts pole and zero both. The adaptive ARMA filter may be implemented as a transversal filter it may be also as ARMA lattice filter[8].

Shing-Hong Liu worked on also adaptive filter. In their work he propose a portable ECG recorder which uses a triaxial accelerometer to detect the subject movement. The portable used Bluetooth to transmit data and adaptive filter provide spike free ECG signal and find the QRS complex of the filtered ECG be clearly appeared[9].

Bertram N Ezenwa et al in their work baseline drift reduction in ECG by high pass digital/analog filter at frequency higher than .5 Hz distort the wave shape of the ECG signal[10].

Mahesh S. Chauhan et al . it works on deals with real time application of the Chebyshev I IIR filter to the ECG signal. The three filters namely low pass, High pass and band pass have been designed for the order such that filter gives the stable response. The power line interference and baseline drift is the classical problem in the ECG processing, which produces the art factual dada that makes it difficult to measure the ECG parameters accurately. In the paper responses if designed filters and their cascade combination is depicted. The resulted here clearly shows that filter works satisfactorily for the sample frequency 1000Hz. The complete design is in the Math lab and using computer interfacing add-on card 711-B for the real time application. Using power Spectrum and other Parameters of the signal performance of the filter studied[11].

ZHANG Hongjun worked on low pass filter out of low frequency, high pass filter out of high pass frequency ,Butterworth filter [12].

LD Avendano – Valencia et al their worked on Kalman filter. The power line interference is a challenging research. It provide amplitude, phase, frequency variation. Kalman filter which uses an state space model for the noisy signal and allows adequate discrimination between the ECG signal perturbation, even non stationeries[13].

Ying-Wen Bai, et al their works on adjustable 60hz notch filter. After the analog ECG signal is transferred into digital signal the digital filter can be used to suppress the 60 Hz noise. The use of finite impulse response filter with a linear phase property to obtain noise reduction without introducing the phase distortion. In this method a notch filter with pole/zero cancellation and comb notch filter is used[14].

Md. Abdul awal works on Golay filter. ECG signal can potentially corrupted by various types of noise which lead to incorrect the diagnosis. Many types of filters are available to smoothing the noisy ECG signal Golay is one of the filter which can smoothen out the signal without destroying its original properties[15].

Hejjel L used the analog digital notch filter for the reduction of power interference in the ECG signal for the heart rate variability analysis. Artificial ECG recording with predefined parameters were simulated

by a computer and a data acquisition card consecutively filtered by an analog notch filter[16].

Yung fen et al. according to him an unbiased adaptive filter is used to eliminate high frequency random noise in ECG The ULAF does not contain a bias in its summation unit and filter coefficient are normalized. The result shows that ULAF provide spike free ECG signal [17].

Markovsky et al used Band pass, Kalman ,adaptive filter for removal of resuscitation artifacts from human ECG signal. A database of separately recorded human ECG was used for evaluation of this method. This method provide high signal to noise ratio[18].

Table 1

Comparison of Butterwoth filter

Filter order	Signal power before filtration in db	Signal power after filtration in db	Effect on P,QRS, T
4	-10	-27	Not modified
5	-38	-56	Modified

Table 2

Comparison of Chebyshev I filter

Filter order	Signal power before filtration in db	Signal power after filtration in db	Effect on P,QRS, T
4	-30.93	-52	Not modified
5	-50	-75	Modified

3. FUTURE ENHANCEMENT

An ECG is a recording of electrical activity on the body of surface generated by heart. The ECG detection which shows the information of heart and cardiovascular condition to enhance the patient living quality and proper treatment. The future enhancement is to design a filter which provide accurate spike free signal.

Table 3

Comparison of Butterwoth filter

Filter order	Signal power before filtration in db	Signal power after filtration in db	Effect on P,QRS, T
4	-56	-60	modified
5	-79	-93.47	Modified

Table 4

Comparison of Elliptic filter

Filter order	Signal power before filtration in db	Signal power after filtration in db	Effect on P,QRS, T
4	59.71	-64.89	Less modified
5	-56	-79	Less Modified

4.Conclusion

The ECG is the record of time varying bio – electric potential generated by electrical activity of heart. Various filter have been used to achieve spike free signal. This paper provide an overview of various filter. The future work primarily focus on to designing a filter which provide spike free or accurate ECG signal. Table 1,Table 2 ,Table3, Table4 shows order 4 and order 5 which generate an effect on P,QRS,T wave.

5. References

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