ISSN: 2278 – 7798
International Journal of Science, Engineering and Technology Research (IJSETR)
Volume 5, Issue 4, April 2016

POLY-FIR filtered ECG for better diagnosis of cardiac disorders

K.krishnamraju[1] M.Chaitanyakumar[1] M.Balakrishna[1] L.Rambabu[1]
Assistantprofessor Assistantprofessor Assistantprofessor Assistantprofessor

[1] Department of Electronics and Communications Engineering, Aditya Institute of Technology y & management, Tekkali, Andhra Pradesh, India.

Abstract

ECG(Electro Cardio Gram) is a biomedical signal used for diagnosis of cardiac patients. ECG recording process is contaminated by power line noise because power line fluctuations from mains AC supply. This will create problem for doctors while analyzing the ECG graph to diagnose correctly the problems of heart as regular pattern of ECG is affected. Here an attempt is made to filter power line noise with a new concept of polynomonial with existing conventional windows.

I. Introduction

Filtering is the process by which the frequency spectrum of the signal can be modified, reshaped or manipulated to achieve some desired objectives such as:

- To eliminate noise contaminated in signal
- To remove signal distortion due to imperfect transmission channel
- To separate two or more distinct signals which were purposely mixed for maximizing channel utilization
- To resolve signals into their frequency components
- To demodulate the signals which were modulated at the transmitter end
- To convert digital(discrete-time) signals into analog signals

II. Concept of Windows

In signal processing, a window function (also known as an apodization function or tapering function) is a mathematical function that is zero-valued outside of some chosen interval. For instance, a function that is constant inside the interval and zero elsewhere is called a *rectangular window*, which describes the shape of its graphical representation. When another function or a signal (data) is multiplied by a window function, the product is also zero-valued outside the interval: all that is left is the part where they overlap; the "view through the window". Applications of window functions include spectral analysis, filter design, and beam forming.

III CONCEPT OF POLYNOMIAL WINDOWS:

$$w_m(t) = 1 - K_m \sum_{n=0}^{m} A_{m,n} |t|^{2m-n+1}, \quad -1 \le t \le 1. \quad \text{....................(1)}$$

where

$$K_m = \frac{(2m+1)!(-1)^m}{(m!)^2} \qquad A_{m,n} = \frac{(-1)^n \, {}^mC_n}{2m-n+1}.$$

IV CONCEPT OF CONVENTIONAL WINDOWS:

Rectangular window:

$$w(n) = 1 \quad \text{.. (2)}$$

Hamming window:

$$w(n) = 0.54 - 0.46 \cos\left(\frac{2\pi n}{N-1}\right)$$

- Note that:

$$w_0(n) \stackrel{\text{def}}{=} w\left(n + \tfrac{N-1}{2}\right) = 0.54 + 0.46 \cos\left(\frac{2\pi n}{N-1}\right) \quad \text{.... (3)}$$

Triangular windows:

With non-zero end-points:

$$w(n) = \frac{2}{N+1} \cdot \left(\frac{N+1}{2} - \left| n - \frac{N-1}{2} \right| \right)$$ ....(4)

Bartlett window:

Triangular window with zero-valued end-points:

$$w(n) = \frac{2}{N-1} \cdot \left(\frac{N-1}{2} - \left| n - \frac{N-1}{2} \right| \right)$$ .... (5)

V ELECTRO CARDIO GRAM:

The electrocardiogram (ECG or EKG) is a diagnostic tool that measures and records the electrical activity of the heart in exquisite detail. Interpretation of these details allows diagnosis of a wide range of heart conditions. These conditions can vary from minor to life threatening.

ECG WAVE:

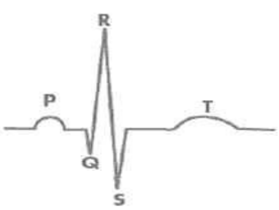

Figure-1 sample ECG

The electrical cavity results in p, QRS, and T waves that are of different sizes and shapes. When viewed from different leads, these waves can show a wide range of abnormalities of both the electrical conduction system and the muscle tissue of the hearts 4 pumping chambers.

VI PROPOSED CONCEPT:

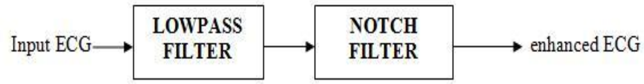

Figure-2

Our ECG signal is applied to a LOWPASS filter for which the output will be an ECG with the removal of frequencies above 120 Hz interference. Then the resulting signal is applied to the NOTCH filter with 60 Hz where the power line interference is removed. The enhanced ECG signal with the removal of power line interference is collected at the output.

VII PROPOSED FILTER

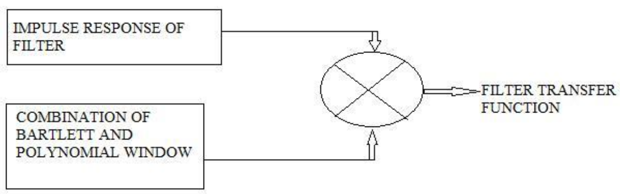

Figure-3

The required filter is designed by multiplying the impulse response of the filter with Bartlett window in combination with different orders of polynomial windows so as to obtain filter transfer function. Now the noisy ECG [2] signal is allowed through filter for removal of power line interference.

VIII RESPONSE OF PROPOSED WINDOWS:

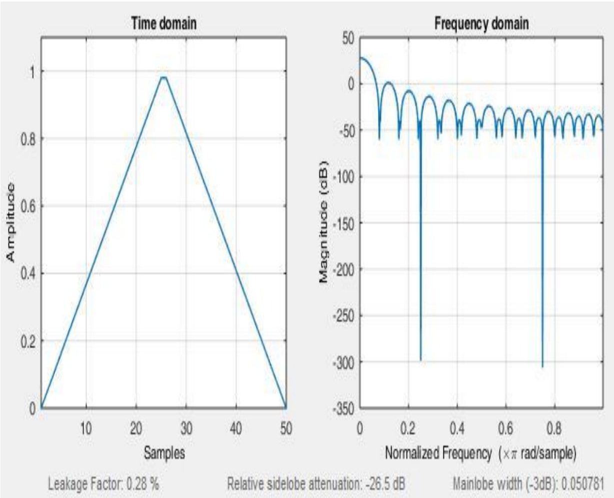

Figure-4 :Response of bartlett window

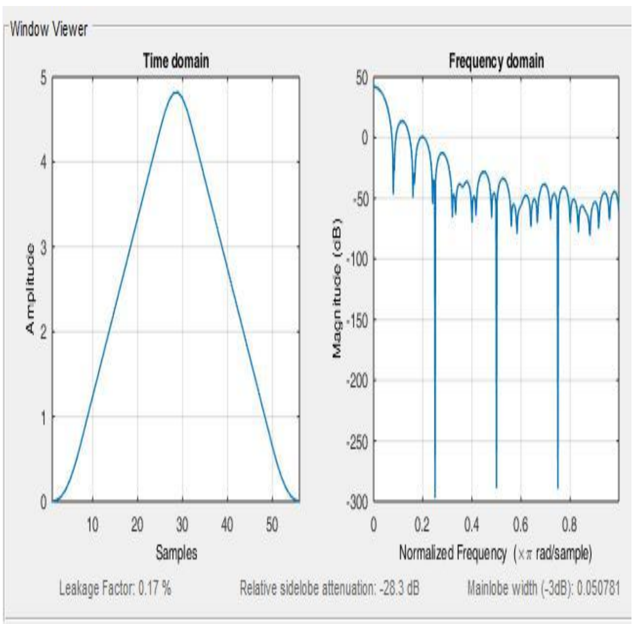

Figure -5: Combination of Bartlett window and polynomial window with order zero

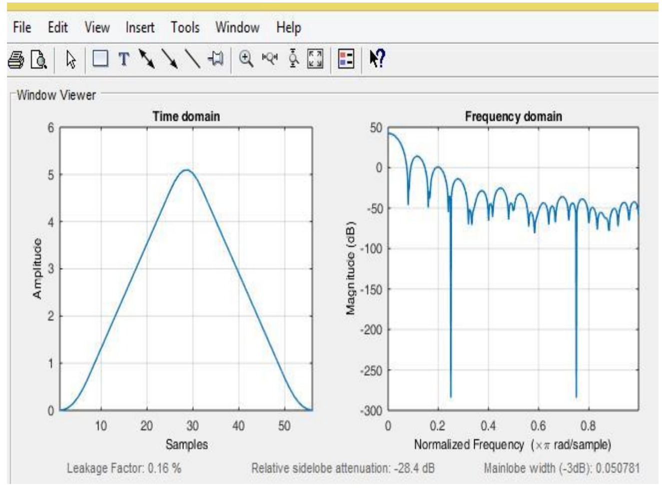

Figure-6: Combination of Bartlett window with polynomial window with order one

TABLE-1 NUMERICAL ANALYSIS OF PROPOSED WINDOWS

WINDOW	SFLR	BANDWIDTH
Bartlett window	26.5	050781
Bartlett and polywindow with m=0	28.3	050781
Bartlett and polywindow with m=1	28.4	050781
Bartlett and polywindow with m=2	28.5	050781

It is observed from the table -1 that SFLR (side lobe fall of ratio) is more compared with Bartlett and polynomial windows than individual Bartlett. So combination of polynomial windows with different conventional windows (here Bartlett window is taken) enable us for better filtering of noisy signals than with individual conventional windows.

IX RESPONSE OF LOWPASS FILTER:

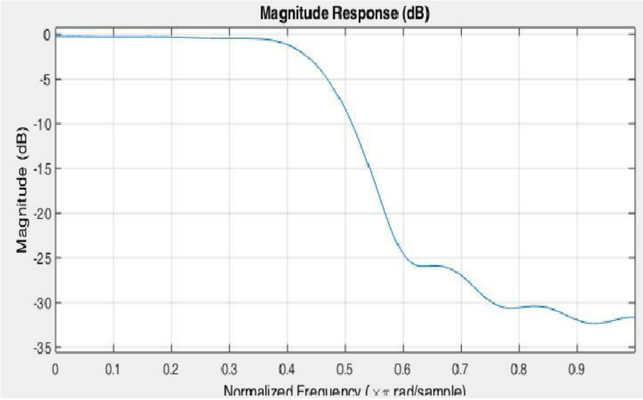

Figure-7: Response of low pass with 120 Hz cutoff

X RESPONSE OF BANDREJECT FILTER:

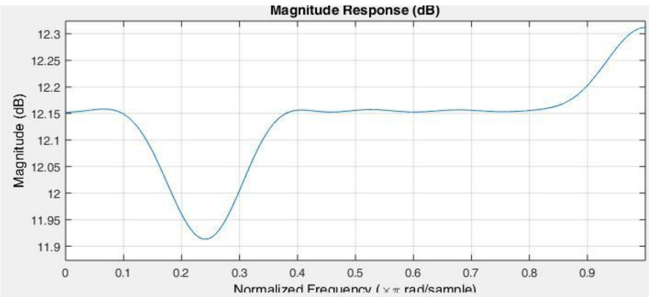

Figure-8:Response of low pass with 60hz cutoff

XI RESULTS:

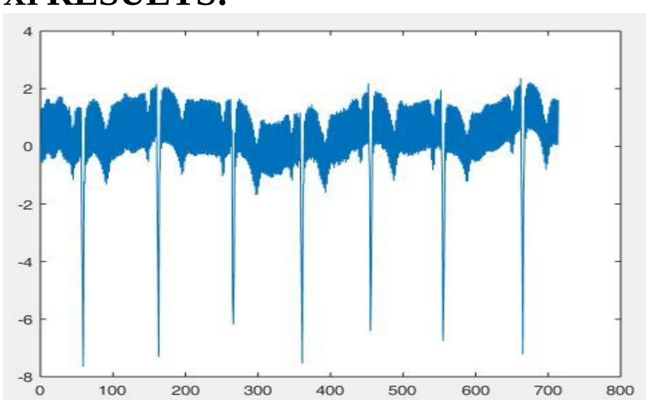

Figure-9: Noisy ECG signal

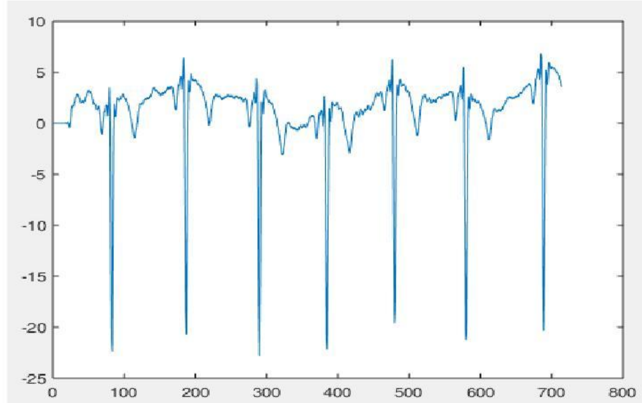

Figure-10: filtered ECG signal output from the proposed filter

CONCLUSION

From figure 10 is very clear that the proposed filter eliminates power line interference very effectively. In our paper attempt is made only eliminate power line interference similarly many more artifacts of ECG can be removed with our proposed filter which can be encouraged.

REFERENCES:

1. 'Desired Order Continuous Polynomial Time Window Functions for Harmonic Analysis' Puneet Singla, *Member*, *IEEE*, and Tarunraj Singh IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT, VOL. 59, NO. 9, SEPTEMBER 2010.

2. MIT-BIH database directory.

3. Sarkar, N. (2003): Elements of digital signal Processing: Khanna

4. J.G. Proakis and D.G. Manolakis on Digital signal processing, Prentice-Hall of India, New, Pages 360 – 365. 2006