A NEW CLASS OF FIR FILTERS FOR SIGNAL PROCESSING USING NOVEL WINDOW TECHNIQUES

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Abstract
FIR filters are designed with windowing techniques which will improve spectral response of filter. In this paper new class window functions are proposed for FIR filter design. The new class of window functions is obtained using conventional windows and higher order polynomial windows which improve spectral response of filter than existing conventional windowing techniques in terms of RSA (Relative side lobe attenuation).

Keywords: polynomial windows

I. INTRODUCTION

Any physical quantity that carries some information can call as signal. Signal can also be defined as any physical quantity that varies with time, space or any other independent variable. Signal processing is any operation that changes the characteristics of a signal. These characteristics include amplitude, shape, phase and frequency content of signal. Filter is one, which rejects unwanted frequencies and noise from the input signal and allows only the desired frequencies to obtain the required shape of output signal. In digital signal processing filters.FIR filters are designed with conventional windows like Bartlett, Hamming windows which will reduce the Gibb's phenomenon but less efficient for noise removal from the signal so new class of windows are proposed for better noise removal by improving RSA.

II. CONCEPT OF POLYNOMIAL WINDOWS

The time domain equation of polynomial window [1] is

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

Where

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

The frequency domain equation of polynomial windows is

$$W_m(\omega) = 2K_m \sum_{n=0}^{m} \mathcal{I}_{2m-n-1} A_{m,n} \frac{(2m-n+1)(2m-n)}{\omega^2}, \quad m > 0.$$

III. PROPOSED CONCEPT

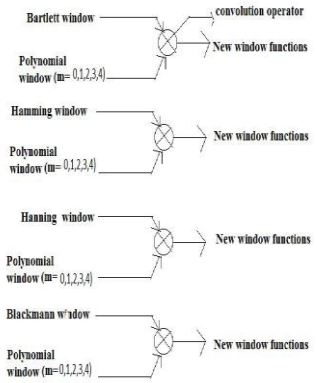

Figure-1

Here new windows are designed with the help of conventional windows and polynomial windows. As we know that convolution in time domain leads to multiplication in frequency domain. Here convolution of two window sequences leads to the production of new window sequence which is better than the conventional windows in many aspects such as relative side lobe attenuations, noise reduction. By using these new windows FIR filters are designed which have better responses in both pass band as well as in stop band compare to the filters that are designed with the help of conventional windows.

IV. CONCEPT OF NEW FILTER DESIGN

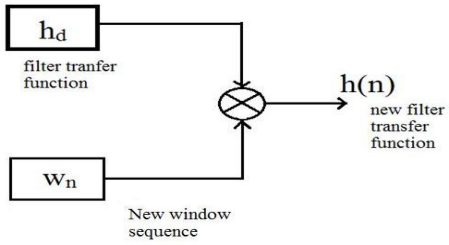

Figure-2

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From figure-2, it is clear that new filter transfer function is obtained by multiplying filter impulse response with new window sequence which is the combination of conventional window and higher order polynomial windows for improving the spectral response

V. FREQUENCY RESPONSE OF POLYNOMIAL WINDOWS:

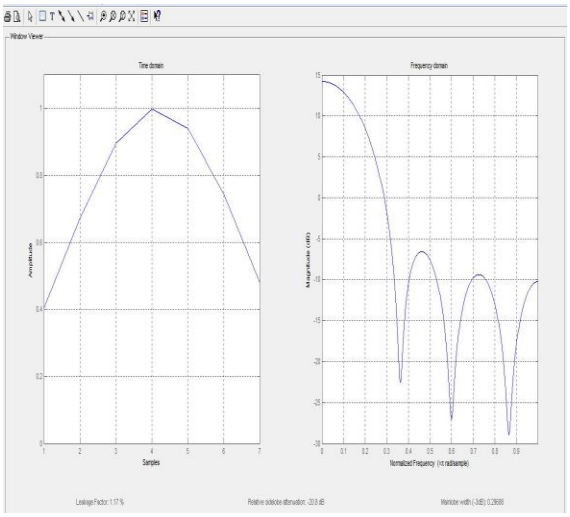

Figure-3 Frequency response of polynomial window for m=0

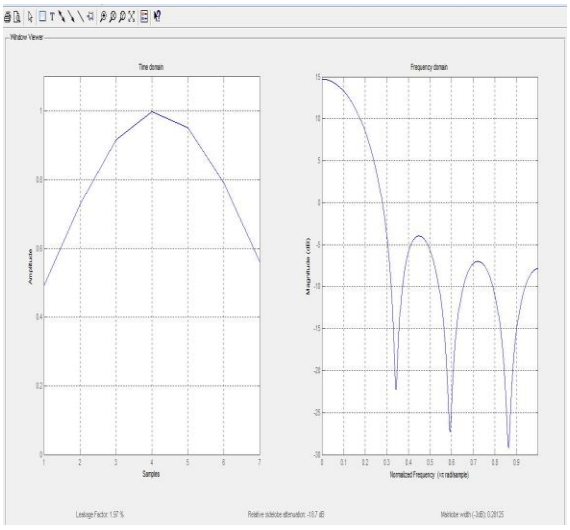

Figure-4 Frequency response of polynomial window for m=1

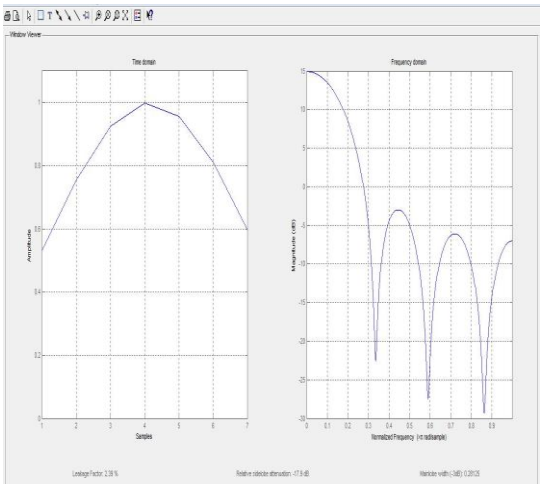

Figure-5 Frequency response of polynomial window for m=2

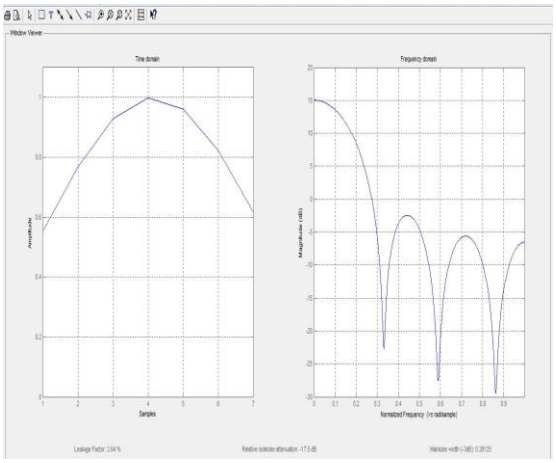

Figure-6 Frequency response of polynomial window for m=3

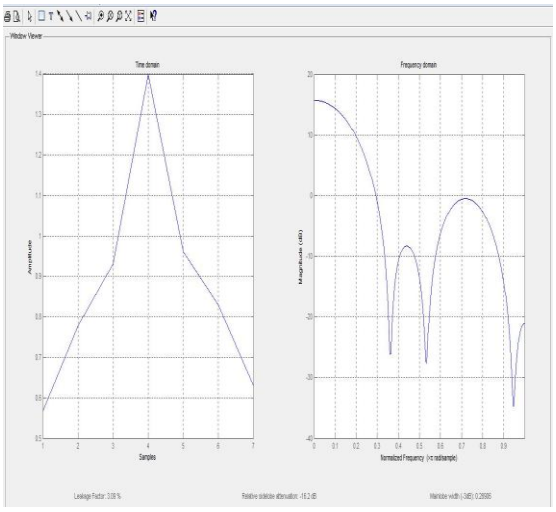

Figure-7 Frequency response of polynomial window for for m=4

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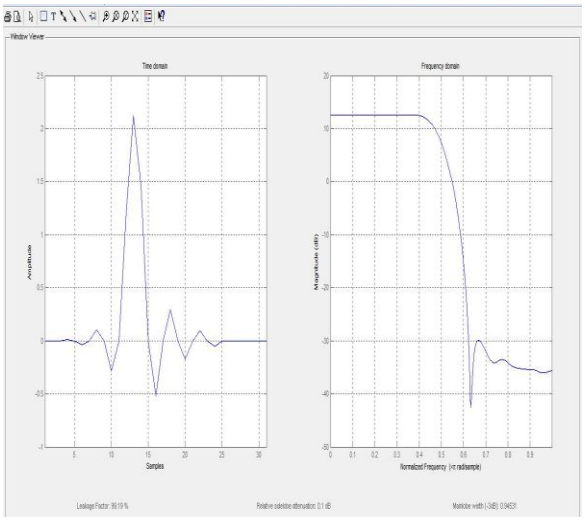

Figure -8 Response of low pass filter with Hamming window

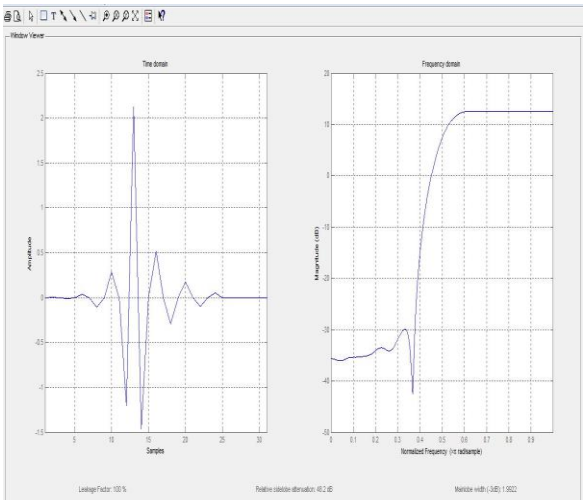

Figure-10 new high pass filter with proposed concept

VI. RESUTS

1) FIR CONVENTIOAL HGIH PASS FILTERS:

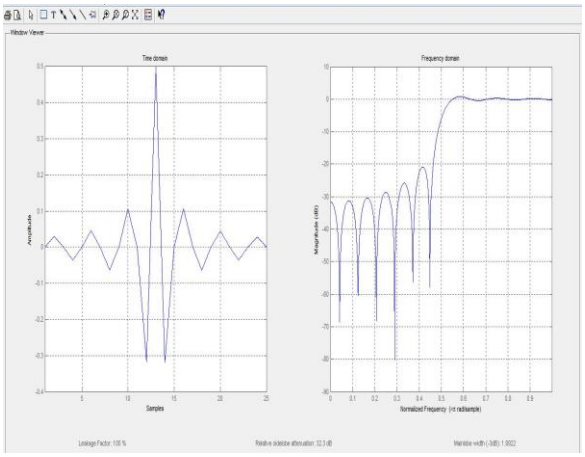

Figure-9 conventional high pass filter

VII. CONCLUSION:

In this paper we derived the higher order polynomial windows and by using conventional & polynomial windows we designed new windows which have more side lobe attenuations. By using these windows FIR filters like high pass filters were designed. The spectral responses of these FIR filters are good which exhibits high noise reduction and reduces ripples in both stop band. So these filters can use in many applications like speech recognition, ECG analysis etc in which we can improve spectral response

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