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Design of High Pass FIR Filter using Rectangular and Taylor Window Method

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Abstract: ***In this paper a window function has been defined and simulated. In the initial section the frequency response of the four basic types of FIR filter have been simulated using the window function. Then the fir filter responses are compared with those using Taylor window and Rectangular window function. Improved frequency response have been observed, the frequency response of the new window function will be compared with other common window function in near future with generalized and quantized experimental results.***
Keywords: ***DSP, Digital Filter, High Pass Filter, FIR, Rectangular Window and Taylor Window.***

I. INTRODUCTION

Signal processing is a method of extracting information the signal which in turn depends on the type of signal and the nature of information it carries. Thus signal processing is concerned with representing signals in mathematical terms and extracting the information by carrying out the algorithmic operation on the signal [1].
Digital processing of a signal facilitates the shearing of a signal processor among a number of signal by time- shearing .This reduces the processing cost, size, weight and maintenance per signal. Also DSP can save both filtered and unfiltered data for further use [2].
A digital filter is a mathematical algorithm implemented in hardware/software that operates on a digital input to produce digital output. Digital filter play very important roles in DSP [3].

A. Advantages

1) Digital filters can have characteristics are not possible with analog filters such as linear phase response.
2) Several input signals can be filtered by one digital filter without the need to replicate the hardware.
3) Digital filters can be used at very low frequencies.

B. Disadvantages

Speed limitation , Finite word length effects and Long design and development time.

C. Applications Of DSP

1) Signal Processing Applications: There are numerous applications of signal processing that we often encounter in our daily life without being aware of them. Originally the signal processing algorithms used in these applications were carried out in the continuous time domain. It is not possible to discuss all of these applications. However an overview of selected applications is presented.

a) *Sound Recording Application*: The recording of most musical programs now a day is usually made in acoustically inert studio. The sound from each instrument is picked up by its own microphone closely placed to the instrument and is recorded on a single track in a multi-track tape recorder containing us many us 48 tracks. The signals from individual tracks in the master recording are then edited and combined by the sound engineer in a mix-down system to develop a two-track stereo recording.
b) *Telephone Dialing Application:* Signal processing plays a key role in the detection and generation of signaling tones for push-button[DAR76]. Seven frequencies are used to code the 10 decimal digits and the two special buttons marked " * " and " # " . The low – band frequencies are 697 Hz, 770 Hz, 852 Hz, and 941 Hz. The remaining three frequencies belonging to the high band are 1209 Hz, 1336 Hz and 1477 Hz.
c) *FM Stereo Applications:* For wireless transmission of a signal occupying a low frequency range, such as an audio signal, it is necessary to transform the signal to a high frequency range by modulating it onto a high frequency carrier. At the receiver , the modulated signal is demodulated to receiver the low frequency signal. The signal processing operations used for wireless

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transmissions are modulations, demodulations, and filtering

II. WINDOW METHOD

These are the window method frequency sampling method and optimal or minimax design. The window method involves a straight forward analytical procedures, however, in some cases, iteration is necessary to obtained the desired results. Several windows are considered.

A. *Rectangular Window*

The relation expressed in equation can also be obtained by multiplying the sequence $h_d(n)$ by the sequence $w_R(n)$ defined by

$$W_R(n) = \begin{cases} 1 & 0 \le n \le N-1 \\ 0 & otherwise \end{cases}$$

because of its appearance $W_R(n)$ is called rectangular window.

B. *Taylor Window*

The Taylor window function for total number of samples, N = 10 is shown in figure. The sample points (n) are indicated along x – axis and the corresponding amplitude levels along y – axis respectively

PARAMETER	VALUES
Sampling Frequency(f_s)	35000
Cut off Frequency(f_c)	8200
Order(N)	10

Table 1: Parameter Specification.

C. *Simulation and Result*

S. No.	Frequency	Window Method	
		Rectangular (In dB)	Taylor (In dB)
1.	0.1π	9.5502	9.6756
2.	0.2π	7.0171	7.8320
3.	0.3π	5.0901	-9.7399
4.	0.4π	3.0329	-9.5389
5.	0.5π	2.9796	-10.8655
6.	0.6π	1.0134	-11.6542
7.	0.7π	0.3965	-11.9767

Table 2: Filter Magnitude of Rectangular and Taylor Window Technique .

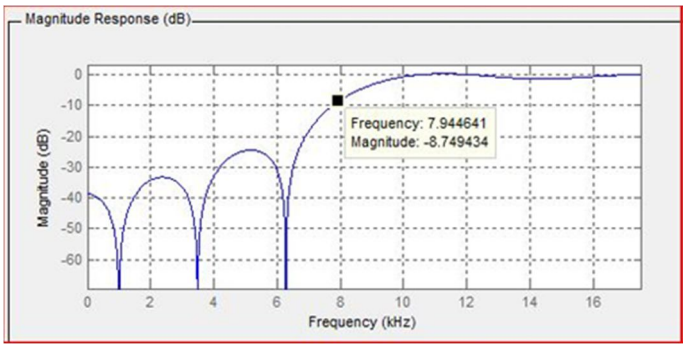

Figure 1: Magnitude response of Rectangular Window Technique.

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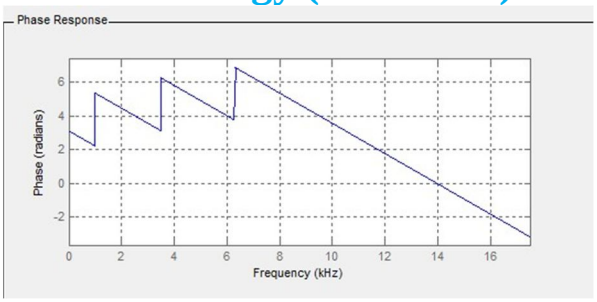

Figure 2: Phase response of Rectangular Window Technique.

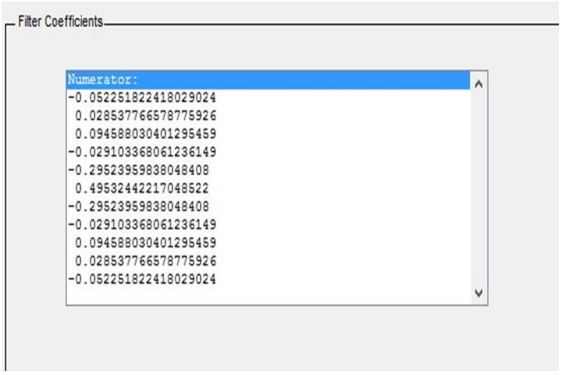

Figure 3: Filter coefficient of Rectangular Window Technique.

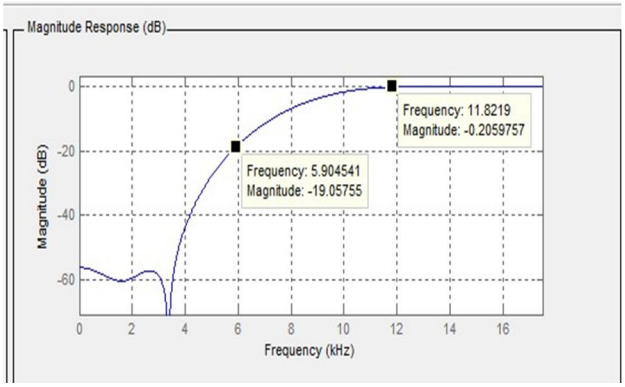

Figure 4: Magnitude response of Taylor Window Technique.

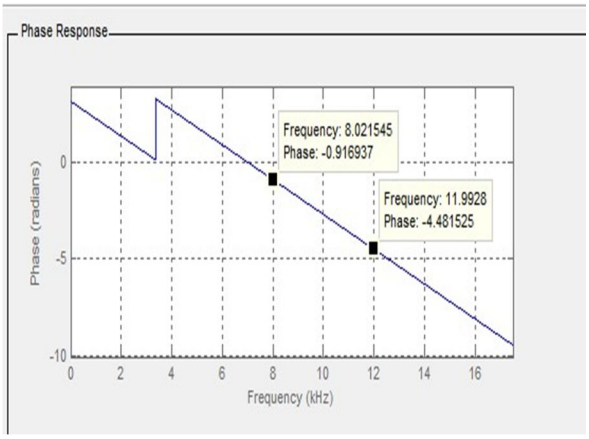

Figure 5: Phase response of Taylor Window Technique.

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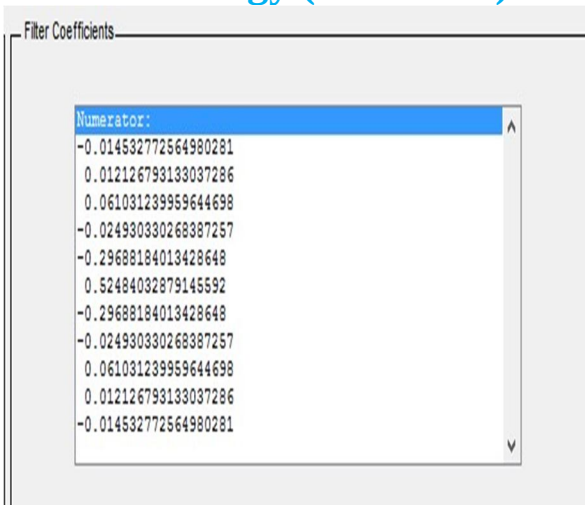

Figure 6: Filter coefficient of Taylor Window Technique.

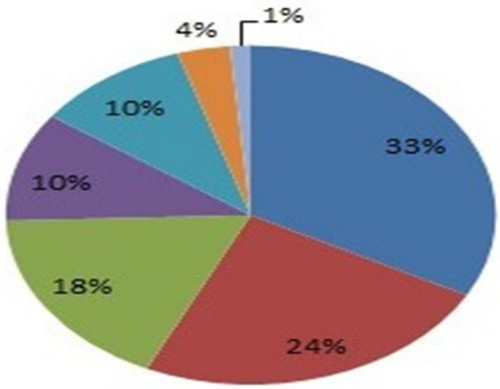

Figure 7: Magnitude and Frequency plot of Rectangular Window Technique.

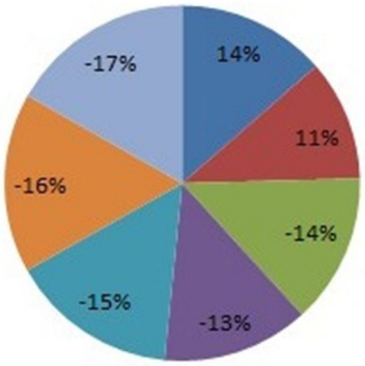

Figure 8: Magnitude and Frequency plot of Taylor Window Technique.

III. CONCLUSIONS

In this research paper High pass FIR Filter has been designed by using Rectangular and Taylor Window Technique. We observed that Taylor Window Technique shows better response than Rectangular Window Technique in terms of magnitude and phase responses.

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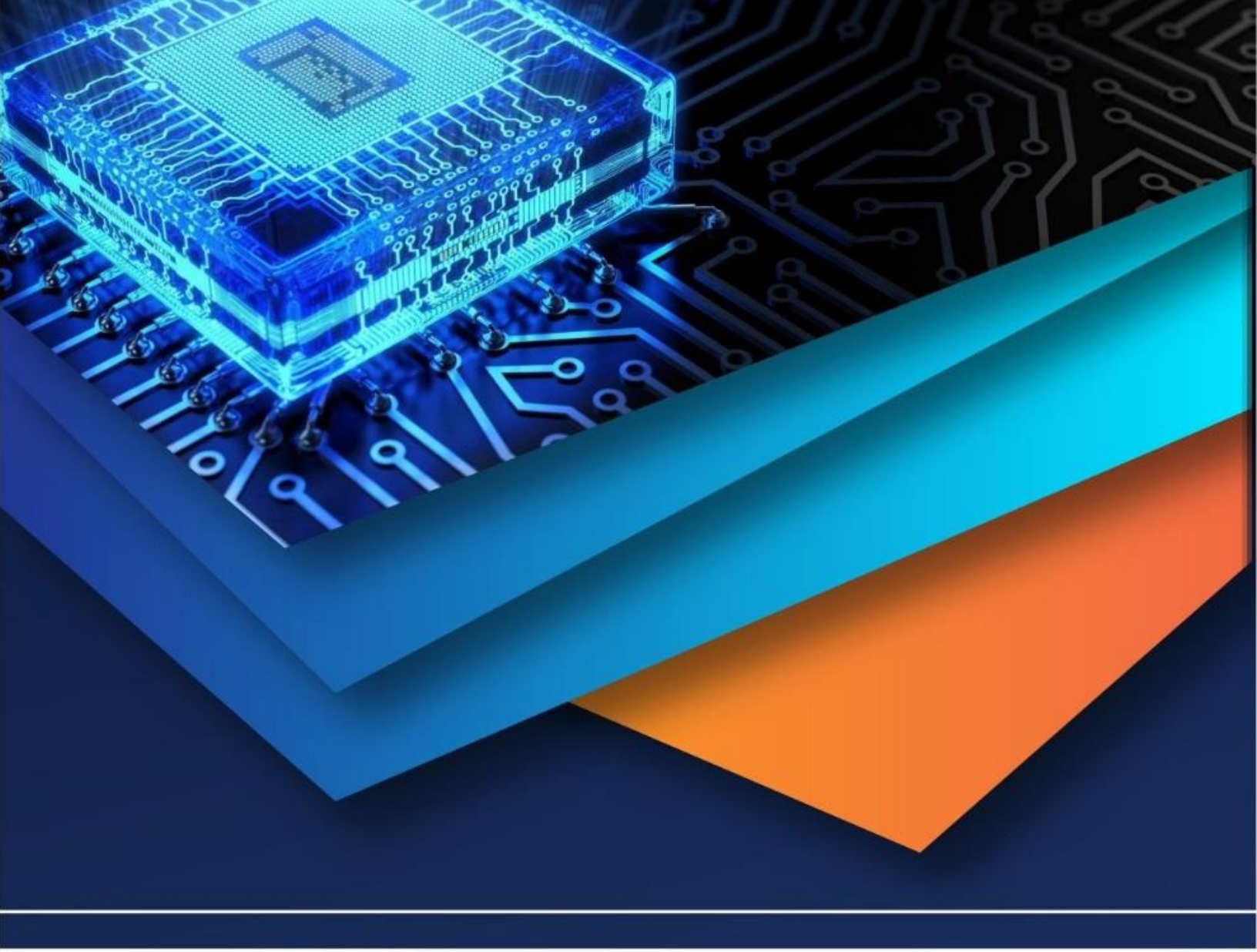

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