DESIGNING A HIGH PASS FIR FILTER BY USING HAMMING AND HANNING WINDOW

[1]Jyoti Kharsan, [2]Pramod Yadav, [3]Shivani Yadav, [4]Pranay Kumar Rahi
[1,2,3] B.E. Scholar, [4]Assistant Professor,
[1,2,3,4] Department of Electrical and Electronics Engineering,
Institute of Technology Korba, Chhattisgarh, India

ABSTRACT

In this paper a High Pass FIR Filter has been presented using Windowing method based on HAMMING and HANNING Window the Magnitude Response or demonstrated for different design method at particular cut- off frequency and different order. In this paper we represent the signification of filter in our daily life. The result Window technique provides better result in term of Magnitude and phase response of High Pass FIR filter.

Keyword – *DSP, FIR, high pass FIR Digital Filter, HAMMING window and HANNING window.*

1. INTRODUCTION

The development of Digital Signal Processing algorithm and their implementation are influenced by the integrate circuit (IC) technology, the available of integration and the demands of the application. DSP is used is numerous application such as telephone, mobile radio, satellite communications, speech processing, multimedia, video and image processing, biomedical application, radar and sonar. All this application required different sample rates. Real time implementation of DSP system requires design of hardware or code for existing hardware so that the system can meet the sample rate requirements of the applications. In other words ones the system can meet the sample rate requirement of the application, this is no advantage in design a faster or larger system [1].

Thus signal processing is connected with representing signals in mathematical terms and extracting the information carried out the algorithmic operations on the signal. Mathematically, a signal can be represented in terms of basis function in the domain of the original independent variable or it can be represented in terms of basis function in a transformed domain. Similarly, the information contain in the signal can also be extract either in the original domain or in the transformed domain [2].

For this purpose filters are mainly used. This filter is used to describe a linear time-invariant system used to perform spectrum shaping or frequency-selective filtering. Filter is used in digital signal processing is widely used in a number of ways, such as renewal of undesirable noise from desire signal, spectral shaping such as equalization of communication channels, signal detection in radar, sonar and communications, and for performing analysis of the spectra of a variety of signals [3].

Application of digital signal processing (DSP)

1. Military – radar signal processing, sonar signal processing, navigation, secure communication and missile guidance.
2. Consumer electronics – digital audio/TV, electronic music synthesiser educational toys, FM stereo application and sound recording application.
3. Signal filtering – removal of unwanted background noise, removal of interference, separation of frequency bands and shaping of the signal spectrum.
4. Instrumentation and control – spectrum analysis, position and rate control, noise reduction, data compression, digital filter, function generator servo control, robot control and process control.
5. Medicine – medical diagnostic instrumentation such as computerized tomography (CT), X-ray, magnetic resonance imaging, spectrum analysis of ECG and EEG signals to detect various disorders in heart and brain, scanners, patient monitoring and X-ray storage/ enhancement [2].

2. WINDOW TECHIQUES

In signal processing, a window function a mathematical function that is zero-values outside of some chosen interval. For instance, a function that is constant inside the interval and zero elsewhere is called rectangular window, which describe the shape of its graphical representation. When another function or wave form/data sequence 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 function include FIR filter design. In typical application, the window functions used are non-negative smooth' bell shaped' curves, though rectangle, triangle and other function can be used. [4]. Many different window functions are used in digital signal processing (DSP) for FIR filters design. Some of them are rectangular window, hamming window, HANNING window, triangular window, Bartlett window, Kaiser Window, Taylor window etc. Previous works of the author include generation of a new window function and its comparison with the hamming and the Bartlett –HANN windows respectively [5].

3. WINDOWS AND THEIR TYPES

1. HAMMING window
2. HANNING window

3.1. HAMMING WINDOW

Richard W. hamming observed that the side lobes of the rectangular and HANNING windows are phase reversed relative to each other, so a linear combination of the two would tend to cause them to cancel each other. He searched for the linear combination that minimized the maximum side lobe amplitude and came up with the following formulation, which represents a raised cosine on a rectangular pedestal [6];

$$\omega[n] = \begin{cases} 0.54 - 0.46\cos\left(\frac{2\pi n}{M}\right), 0 \le n \le M \\ 0, \quad otherwise \end{cases}$$

3.2 HANNING WINDOW

The HANNING window (or more properly, the von HANN window) is nothing more than raised cosine:

$$\omega[n] = \begin{cases} 0.5 - 0.5\cos\left(\frac{2\pi n}{M}\right), 0 \le n \le M \\ 0, \quad otherwise \end{cases}$$

The HANNING window has the same main lobe width as the Bartlett window, but its side lobe is attenuated further [6].

4. SIMULATION AND RESULT

PARAMETER	VALUES
Sampling frequency(Fs)	48000
Cut-off frequency(Fc)	10800
Order	10

Table 1: Parameter Specification

Frequency	Window Technique	
	HAMMING	HANNING
0.1π	13.8164	12.8146
0.2π	8.5689	6.6669
0.3π	0.0454	0.1572
0.4π	-7.8855	-0.8734
0.5π	-17.6298	-8.0685
0.6π	-26.4576	-20.9256
0.7π	-34.4400	-40.7581
0.8π	-43.5742	-50.8518
0.9π	-53.5033	-36.3339
π	-41.8153	-26.4676

Table 2: Frequency and Magnitude

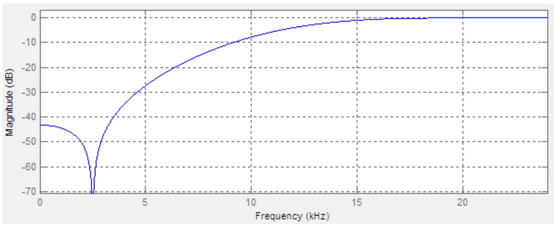

Figure 1: Magnitude Response of Hamming Window Technique

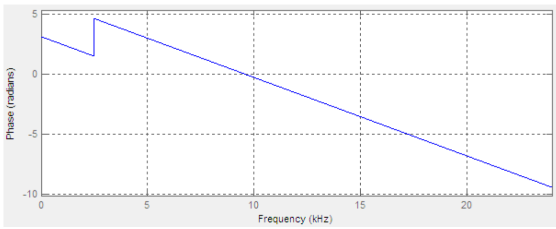

Figure 2: Phase Response of Hamming Window Technique

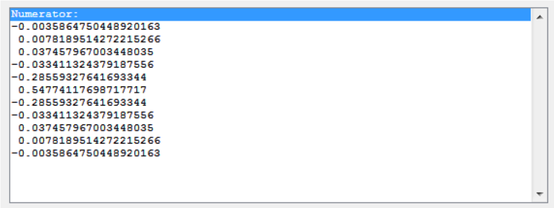

Figure 3: Filter Coefficient of Hamming Window Technique

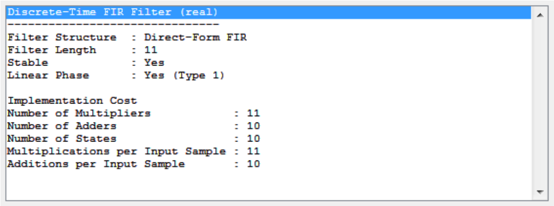

Figure 4: Filter Information of Hamming Window Technique

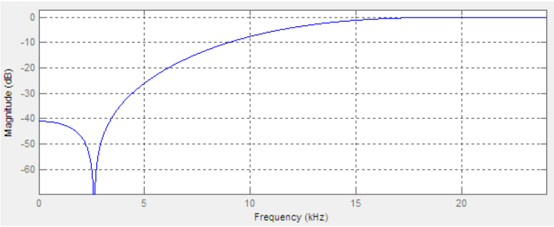

Figure 5: Magnitude Response of Hanning Window Technique

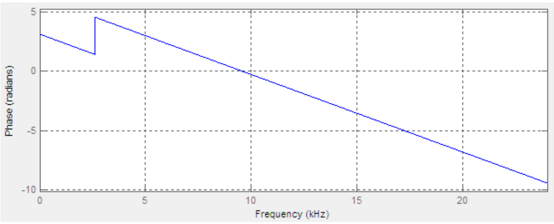

Figure 6: phase response of Hanning window technique

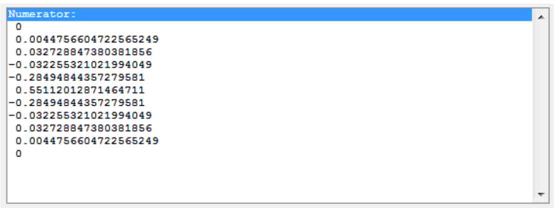

Figure 7: Filter Coefficient of Hanning Window Technique

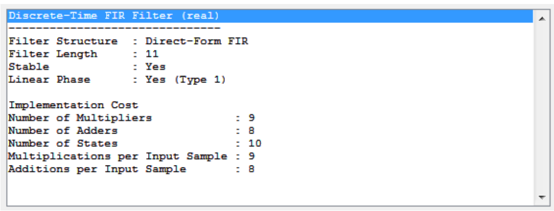

Figure 8: Filter Information of Hanning Window Technique

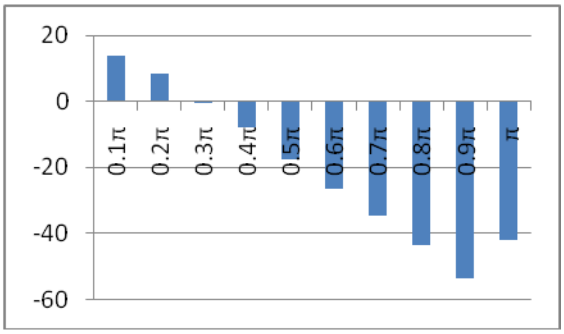

Figure 9: Magnitude and Frequency Plot of Hamming Window Technique.

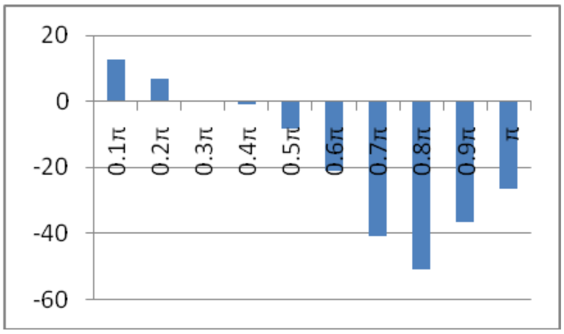

Figure 10: Magnitude and Frequency Plot of Hanning Window Technique.

5. CONCLUSION

From the above simulation result the conclusion can be summarized as follows: if can be seen that the height if the side-lobes are the lowest using the Hanning but highest using the Hamming window. The width of the major lobe is highest in case Hanning and almost equal in the case of hamming window. The availability of well defined equation for calculating window coefficient has made this method preferable. But if offers very little design flexibility hamming window offer very low order to given specification. The best digital filter design results comes for using the hamming window from the window design technique.

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AUTHORS

Jyoti Kharsan, pursuing Bachelor of Engineering in Electrical and Electronics Engineering in 5th semester from Institute of Technology Korba, Chhattisgarh Swami Vivekananda Technical University, Chhattisgarh, India.

Pramod Yadav, pursuing Bachelor of Engineering in Electrical and Electronics Engineering in 5th semester from Institute of Technology Korba, Chhattisgarh Swami Vivekananda Technical University, Chhattisgarh, India.

Shivani Yadav, pursuing Bachelor of Engineering in Electrical and Electronics Engineering in 5th semester from Institute of Technology Korba, Chhattisgarh Swami Vivekananda Technical University, Chhattisgarh, India.

Pranay Kumar Rahi, received the Bachelor of Technology degree in Electronics and Telecommunication Engineering Collage, Guru Ghasidas University, Bilaspur Chhattisgarh, India in 2004, and pursuing Master of Engineering in Electronics and Communication Engineering from National Institute of Technical Teacher's Training & Research, Punjab University, Chandigarh, India. Presently Working as Assistant Professor in Department of Electrical and Electronics Engineering, Institute of Technology, Korba, Chhattisgarh since 2008. He has authored more than 14 research publications and published Journal paper and Research papers in the leading International and National Journal. His primary research interest includes Digital Signal, Processing VLSI Design, Control Systems and Digital Electronics and Logic Design.

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