IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 3 Issue 8, August 2016
ISSN (Online) 2348 – 7968 | Impact Factor (2015) - 4.332
www.ijiset.com

Designing a Low- Pass FIR Digital Filter by using Rectangular Window and Hanning Window Technique

Gauri nandan Prasad Tripathi[1], Ghanshyam Shriwas[2], Kamal Kant Chandra[3], Pranay kumar Rahi[4]

[1,2,3] BE Scholars,[4] Assistant Professor
[1,2,3,4] Department of Electrical & Electronics Engineering, Institute of Technology, Korba, Chhattisgarh ,India

ABSTRACT

Digital Signal Processing is a special microprocessor designed for processing of digital signals, usually in the real time.DSP which refers to manipulating analog signals such sound or photograph that has to be converted into digital form. It is characterized by the use of digital signals as discrete time or frequency or other discrete domain signal in the form of a sequence of number or symbol to permit the digital processing of these signals. DSP applications include sonar and radar signal processing, sensor array processing, spectrum emmition, signal processing control of signals biomedical signal etc. In this paper we are concentrating on Low Pass FIR filter design by using Rectangular and Hanning window techniques. By the comparative analysis of both the window technique we conclude that, Hanning Window Technique has better response than Rectangular Window Technique.

KEYWORDS: *DSP, Digital filter, FIR filter, Low pass Rectangular Window and Hanning.*

1. INTRODUCTION

A digital filter is a system which passes some desired signals more than others to reduce or enhance certain aspects of that signal. It can be used to pass the signals according to the specified frequency pass-band and reject the other frequency than the pass-band specification [1].

to provide spectra shaping or to perform signal detection or analysis [5].

1.1 RECTANGULAR WINDOW FUNCTION

The weighting function for the rectangular window is given by

$$W_R(n) = \begin{cases} 1 \; for |n| \le \frac{M-1}{2} \\ 0 \; , otherwise \end{cases} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

In the FIR system, the impulse response is of finite duration, this means that it has a finite number of nonzero terms. On the other hand, The IIR system has an infinite number of nonzero terms. This means its impulse response is of infinite duration. While implementation, FIR filter needs no feedback. FIR filter is not a recursive filter. Because of this reason, the structure of FIR filter is much more simpler than compared to the IIR filter .

Digital Signal Processing (DSP) is an important (imp) field of study that has come about due to advances in communication theory, digital computer technology, and consumer devices. There is always a driving need to make thing better and DSP provides many techniques for doing this [2].

The Design process with the filter specification, which may include constraints on the magnitude and/or phase of the frequency response constraints on the unit sample response or step response of the filter specification on the type of filter (*e.g.* FIR or IIR) and the filter order [3].

In FIR filter design using window method, the common window functions that are commonly used are Rectangular window, Triangular window, Bartlett window, Hamming window, Hanning window [4].

In addition the characteristics of a digital filter can be easily changed under software control. Many digital systems use signal filtering to remove unwanted noise

1.2 HANNING WINDOW FUNCTION

The window function of a causal hanning window is given by

$$W_{Hann(n)} = \{ \quad 0.5 - 0.5cos\frac{2\pi}{M-1}, \; 0 \le n \le M\text{-}1 \; \ldots\ldots\ldots\ldots (2)$$

IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 3 Issue 8, August 2016
ISSN (Online) 2348 – 7968 | Impact Factor (2015) - 4.332
www.ijiset.com

3 SIMULATION AND RESULT

Table 1: Parameter Specification

PARAMETER	VALUES
Sampling Frequency(F_s)	2100
Cut off Frequency(F_c)	500
Order(N)	10

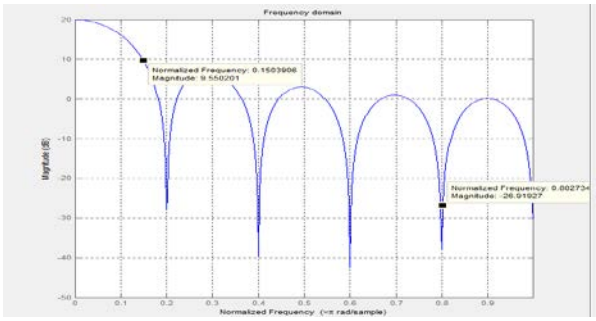

Fig 1: Magnitude response of Rectangular Window Technique

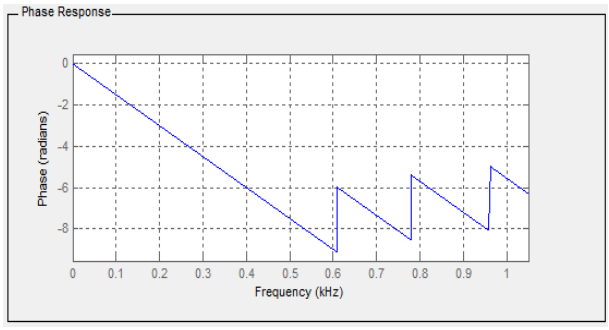

Fig2: Phase response of Rectangular Window Technique

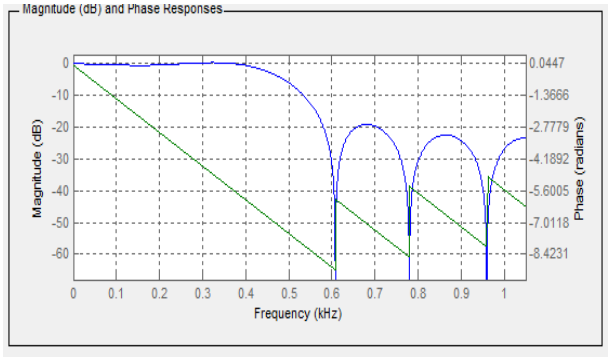

Fig 3: Magnitude and Phase Response of rectangular window technique

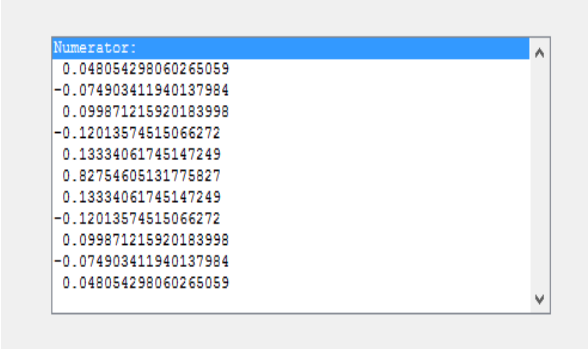

Fig 4: Filter coefficient of Rectangular Window Technique

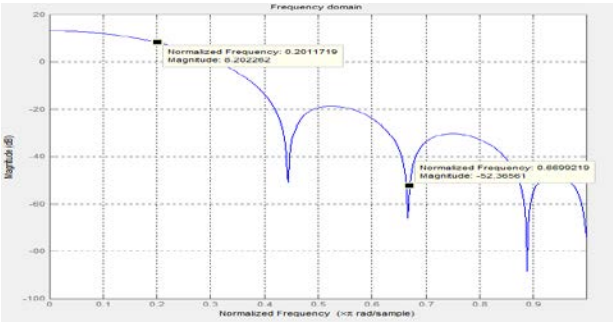

Fig 5: Magnitude Response of Hanning Window technique

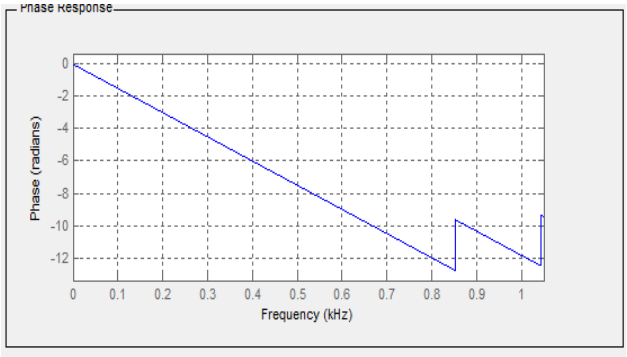

Fig6: Phase Response of Hanning Window Technique

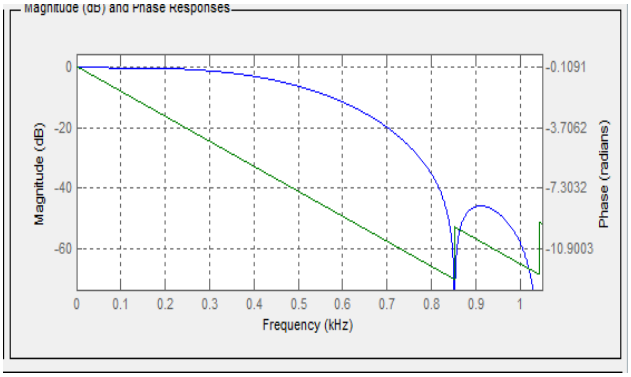

Fig7: Magnitude and phase Response of Hanning window Technique

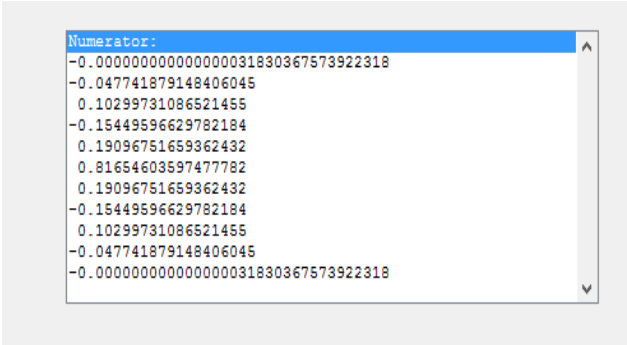

Fig8: Filter coefficient of Hanning Window Technique

Table 2 Magnitude and Phase response

Frequency	Window technique	
	Rectangular	Hanning
0.1	9.550201	11.87954
0.2	7.033825	7.998638
0.3	-27.55703	0.5503054
0.4	2.999042	-14.81719
0.5	-26.81717	-19.33331
0.6	-30.37668	-26.02294

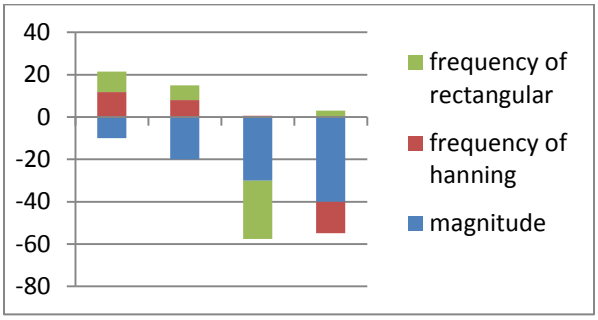

Fig9: Magnitude and Frequency plot of Rectangular and Hanning Window Technique.

4. FILTER SPECIFICATION

Before a filter can be design, a set of filter specification must be define, For *e.g.* suppose that we would like to design a low pass filter with a cut of frequency w_c.The frequency response of an ideal low pass filter with linear phase and a cut of frequency w_c is

$$H_d(e^{jw}) = \begin{cases} e^{-jw} & |w| \le wc \\ 0 & wc \le |w| \le \pi \end{cases}$$

Which has a unit sample response

$$h_d(n) = \frac{sin\ (n-a)wc}{\pi(n-a)}$$

Because this filter is unrealizable (non causal and unstable) it is necessary to relax the ideal constraints on the frequency response and allow some deviation from the ideal response. The specification for a low pass filter will typically have the form.

5. CONCLUSIONS

By analysis we conclude that Hanning Window Technique has better response than Rectangular Window Technique.

REFERENCES

1.Sandeep Kaur, Sangeet Pal Kaur, "Design of FIR filter using hanning window, hamming window and modified hamming window", Vol 4 Issue 5, May 2015.

2. S Salivahanan, C Gnanapriya, A Vallavaraj "Digital signal processing "McGraw-Hill Education, 2nd Edition.

3. Ankan Bhattacharya, "A modified window function for FIR filter design with an improved frequency response and its comparison with the Hamming window" International Journal of Science, Engineering and Technology Research (IJSETR) Vol 2, Issue 5, May 2013.

4. Manjinder Kaur, Sangeet Pal Kaur, " FIR Low Pass Filter Designing Using Different Window Functions and their Comparison using MATLAB" (An ISO 3297: 2007 Certified Organization) Vol 4 Issue 5, May 2015.

5. Sanjit K. Mitra "Digital signal processing "a computer based approach second edition McGraw Hill.

6. Pranay Kumar Rahi &Rajesh Mehera "Analysis of Power Spectrum Emition using WELCH method for various window techniques".IJETE 30th-31th August 2014 ISSN: 2348-8050.

AUTHORS

Gauri Nandan Prasad Tripathi perusing Bachelor of Engineering in Electrical and Electronics Engineering in 5th semester from Institute of Technology Korba ,Chhattisgarh Swami Vivekanand Technical University Chhattisgarh, India

Kamal Kant Chandra perusing Bachelor of Engineering in Electrical and Electronics Engineering in 5th semester from Institute of Technology Korba,Chhattisgarh Swami Vivekanand Technical University Chhattisgarh, India

Ghanshyam Shriwas Perusing Bachelor of Engineering in Electrical and Electronics Engineering in 5th semester from Institute of Technology Korba ,Chhattisgarh Swami Vivekanand Technical University Chhattisgarh, India

Pranay Kumar Rahi received the Bachelors of Engineering degree in Electronics and Telecommunication Engineering from Government Engineering College, Guru Ghasidas University, Bilaspur, Chhattisgarh, India in 2004, and pursuing Masters of Engineering in Electronics and Communication Engineering from National Institute of Technical Teacher's Training & Research, Punjab University, Chandigarh, India. Working as a Assistant professor in Electrical & Electronic Engineering Department of Institute of Technology, Korba since 2008. He has authored 14 research publications and published a number of Journal papers and research paper in the leading International & National Journal. His primary research interest includes Digital Signal Processing, VLSI Design, Control System and Digital Electronics and logic design.