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A REAL TIME SIGNAL PROCESSING USING WINDOWING TECHNIQUE IN LabVIEW

N. Jayaprakash[1]
[1]PG Student, Dept. of E&I, Bharathiar University, Coimbatore, Tamil Nadu, India

Dr. J. Vijayakumar[2]
[2]Associate Professor and Head, Dept. of E&I, Bharathiar University, Coimbatore, Tamil Nadu, India

Dr. R. Maheswaran[3]
[3]Assistant Technical officer, Dept. of E&I, Bharathiar University, Coimbatore, Tamil Nadu, India

ABSTRACT
In the field of Signal Processing, window technique is mostly used to the design of filters. It is used to reduce unwanted ripples in the signal. In this paper, we have to analyse the accuracy of windowing technique by Hanning window, Hamming window, Flattop window, Blackman window and Exact Blackman window. Here, different audio signals are used for window function through which we can examine the accuracy of the windows by using National Instruments Signal Processing Engineering Educational Device for Youth (NI SPEEDY 33) kit. This kit used for real time audio signal processing and its output is shown by the simulation in LabVIEW.
KEYWORDS: *Window functions, NI SPEEDY 33 kit, LabVIEW software.*

INTRODUCTION

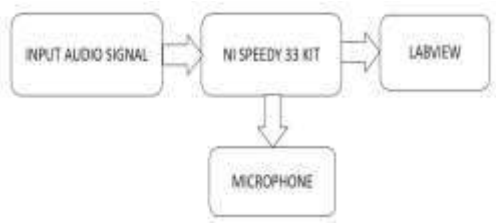
We know that audio is more important in our life. Let's think without sound that's unimaginable. In nature, sound creates feelings and emotional bounding. Everyday audio plays an important role in telecommunication, multimedia field and tele-conference and so on. In this paper, the analysis of windowing methods and its performance are calculated by its accuracy. Finally, these methods will be explained for different types audio signals and compared its efficiency.

REVIEW AND PERFORMANCE ANALYSIS

Noise reduction is an important step in the audio signal system. For the reduction of noise in speech signal, Hanning window technique is used to recover the original signal. In window sequence, compare to Blackman window specifies more accuracy than Hamming window and Hanning window. Reducing side lobes will increase the efficiency and also Blackman window increases the main lobe when compared to Hanning and Hamming window [1,2]. The window technique of white noise removal Blackman window gives less distortion than welch window function. So that it will reduce the noise in the signal and gives better results [3]. The window will reduce the leakage and it will not reduce the leakage or noise entirely [4]. The Kaiser-Bessel window is slightly equal to the Blackman-Harris window and its side lobes in time-bandwidth function is simple to generate and it declared that the good performer [5]. The window is applied over the impulse response of low pass filter, there is large amount of ripple is reduced using Hamming window to get the normal frequency [6]. In the window function large side lobes cause low width transition and Blackman window provided minimum attenuation in stop band [7]. In Hanning window, the side lobes are low but in Hamming window side lobes are slightly high. The major lobe height in Hanning window is nearly equal to the major lobe of Hamming window [8]. The Extremely Flattop window has high attenuation in the side lobe and it is suitable for accurate measure of short and long range signal leakage [9].

METHODOLOGY

1.Block diagram



Block diagram shows the connection of hardware to the implementation of audio signal for window technique

The process of real time signal processing is simply explained in above figure.
The audio signal is taken as input signal which is given to the AUDIO IN pin of NI SPEEDY 33 kit. Then, it will process the audio signal which uses the platform as LabVIEW software tool. The audio signals which are used that are Train horn sound and Baby chicks sound. The window functions are described as follows:

1.Hanning window:

It has the Owning Palette of Windows VIs. The input signal X is given to the Hanning window which is to determine the polymorphic instance and the output sequence represent as Y.

Y=0.5X[1-cos(w)]

$W=\frac{2\pi i}{n}$

For i = 0, 1, 2…. n-1
Where n is the frame size which is used as elements in X.

2.Hamming window:

It has the Owning Palette of Windows VIs. The input signal X is given to the Hamming window which is to determine the polymorphic instance and the output sequence represent as Y.

Y=X[0.54-0.46cos(w)]

$W=\frac{2\pi i}{n}$

For i = 0, 1, 2…. n-1
Where n is the frame size which is used as elements in X.

3.Flattop window:

It also has the Owning Palette of Windows VIs. The input signal X is given to the Flattop window which is to determine the polymorphic instance and the output sequence r Y obtain from:

Y=X[0.21557895-0.41663158cos(w)
+0.277263158cos(w)–
0.083578947cos(3w)+0.006947368(4w)]

$W=\frac{2\pi i}{n}$

For i = 0, 1, 2…. n-1
Where n is the frame size which is used as elements in X.

4.Blackman window:

It has the Owning Palette of Windows VIs. The input signal X is given to the Blackman window which is to determine the polymorphic instance and the output sequence obtain from elements Y using the formula:

Y=X[0.42-0.50cos(w)+0.08cos(2w)]

$W=\frac{2\pi i}{n}$

For i = 0, 1, 2…. n-1
Where n is the frame size which is used as elements in X.

6.Exact Blackman window:

It has the Owning Palette of Windows VIs. The input signal X is given to the Exact Blackman window which is to determine the polymorphic instance and the output sequence represent as Y.

Y=X[a_0-$a_1$cos(w)+$a_2$cos(2w)]

$W=\frac{2\pi i}{n}$

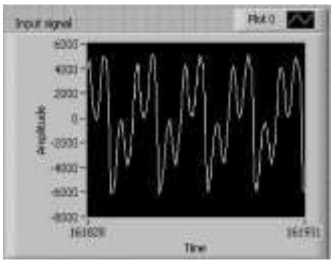
For i = 0, 1, 2…. n-1
Where n is the frame size which is used as elements in X.

$a_0 = \frac{7938}{18608}$,
$a_1 = \frac{9240}{18608}$,
$a_2 = \frac{1430}{18608}$.

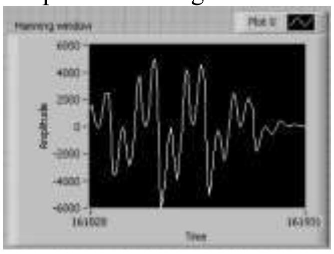
RESULTS AND DISCUSSION

In this research paper, two types of audio sounds are used. They are Train horn sound and Baby chicks sound which are used as input audio signals. Here, LabVIEW version 8.6 software is used as the system design platform. The original audio signal and the output windowing signal are plotted in following figures.

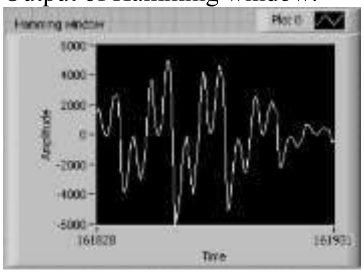
1.1 Original input audio signal of Train horn sound:



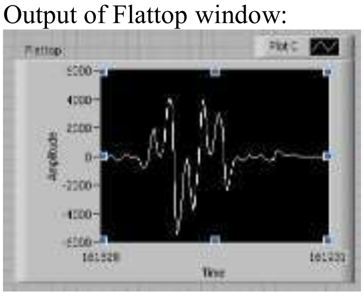
1.2 Output of Hanning window:



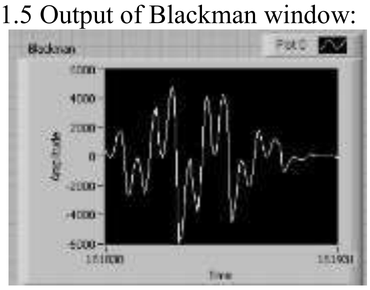
1.3 Output of Hamming window:



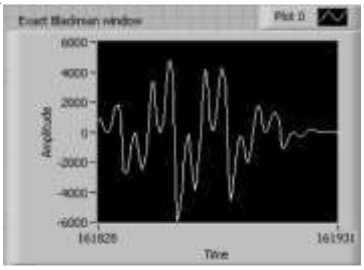
1.4 Output of Flattop window:



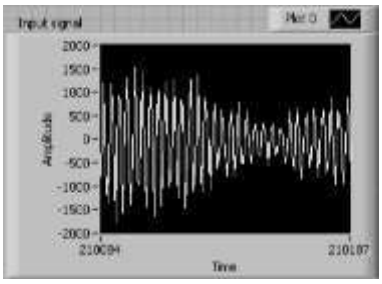
1.5 Output of Blackman window:



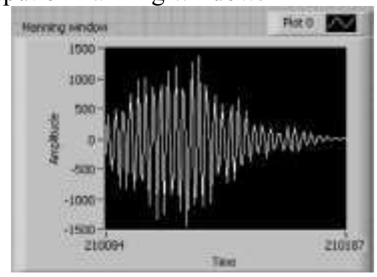
1.6 Output of Exact Blackman window:



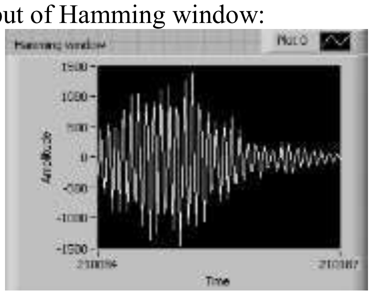
2.1 Original input audio signal of Baby chicks sound:



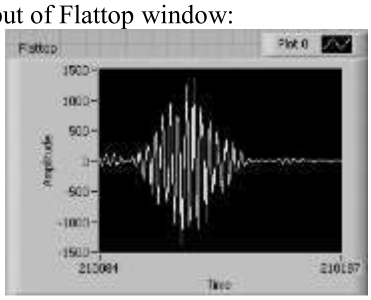
2.2 Output of Hanning window:



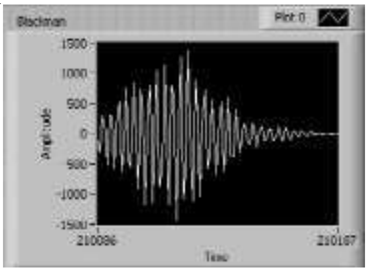
2.3 Output of Hamming window:



2.4 Output of Flattop window:



2.5 Output of Blackman window:



2.6 Output of Exact Blackman window:

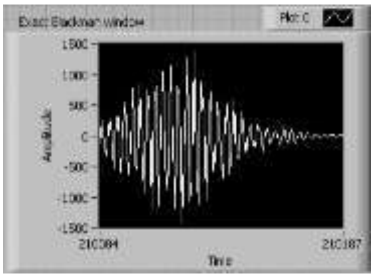


Table: Analysis of the proposed window techniques

Table 1: Shows the Train horn sound

Window function	Frame number(n) n=1,2..128	X is the input signal	Y is the Output sequence of windowed X
Hanning window	5	523	5.02
	9	4950	188.40
Hamming window	5	523	46.46
	8	2388	255.25
Flattop window	3	4604	-3.10
	7	436	-1.28
Blackman window	4	2647	5.21
	10	4907	92.04
Exact Blackman window	5	523	5.52827
	7	436	6.67478

Table 2: Shows the Baby chicks sound

Window function	Frame number(n) n=1,2..128	X is the input signal	Y is the Output sequence of windowed X
Hanning window	5	-933	-8.96
	9	-207	-7.88
Hamming window	5	-933	-82.89
	8	-686	-73.33
Flattop window	3	636	-0.43
	7	693	-2.04
Blackman window	4	361	0.71
	10	1105	20.73
Exact Blackman window	5	-933	-9.86210
	7	693	10.60923

In the figure 1.1 to 1.6 and 2.1 to 2.6 show the input and output audio signals which are plotted for train horn sound and baby chicks sound respectively. Here, the number of samples taken as 8000 and contains the frame size of 128 frames. For the performance of window function analysis of audio signal which are selected randomly. Its framed signals are plotted in the table 1 and 2. This method gives quick response for the functions.

CONCLUSION

The mathematical comparison of these window techniques which is concluded that Hanning window's side lobe is slightly equal to the Hamming window's side lobe that is clearly seen in above figure. Compared to Hanning window, Flattop window is the best amplitude accuracy with end of zero value in the side lobes. For the calculation prefers that the Blackman window shows the good performance and the Exact Blackman shows the accuracy in calculations and gives superior performance among these window techniques.

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