

Design And Implementation Of Digital Fir Filter & Its Performance Assessment Using Matlab Simulink

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Abstract

A digital filter plays an important role in today's world of communication and computations. The most common purpose for filtering is to remove the noise from desired signal. FIR filter are widely used over IIR because of its stability, linear phase characteristics. FIR filters from the basis of wireless system in many applications. The main objective of this paper is to design the minimum order FIR filter for the required specifications using different windowing techniques and to implement the 1-D and 2-D FIR filters using Simulink tool of MATLAB. The results of 1-D FIR is compared with the 2-D FIR to assess the performance of the filters.

Tools required:-MATLAB software with FDA TOOL & SIMULINK TOOL.

Keywords:-FIR filters, 1-D & 2-D filters.

Introduction:

In DSP the lot of techniques for designing of the digital filters for receiver process according to the filter specifications. Basically filter is a device to extract the information from the noisy signal. Digital filters are placed an important role in ds, compared with analog filters and it is also used in every electronic device such as mobilephone, speakers, setupboxes. Digital filters are classified into a two type's

finite duration unit pulse response(FIR), &infinite duration unit pulse response (IIR) filters. By using FIR digital filters, the impulse response is finite, so it can be used for fast Fourier transform (FFT) algorithm to achieve the filtered signal. To use FIR filters in communication & video systems high performance in speed, area& power consumption is required.

The response of the FIR filter depends only on the present and past input Samples. The FIR filters circuit must be able to operate at high samples rates. It can be designed by impulse response truncation, windowing design method and by optimal filter designing technique. Practical FIR designs typically consist of filters that meet certain design specifications i. e., transition width and maximumpassband/stopbandripples. The main advantages of the FIR filters fir filters with exactly linear phase characteristics. It can be realized in both recursive and non-recursive structures. The fir filters are free of limit cycle oscillations, when implemented on a finite word length digital system. The disadvantage of fir filters is that they often require a much higher order filter than IIR filter to achieve a desired performance. The application of fir filters preconditioning, band selection, and low passes filtering.

In digital system there is the requirement of multirate digital signal processing when more than one sample rat is required. Decimation and interpolation are the two basic operations in multirate digital signal processing. Decimation is used for reducing the sampling rate. It is process of down sampling followed by a mitigate aliasing filter. Interpolation is increases the original sampling rate of sequences to a higher rate i. e., inserting zero valued samples between original samples. It is the process of up sampling followed by anantialiasing filters.

Table 1 FIR Filter Parameters Specifications

Filters parameters	Value
Structure	Direct FIR filter
Response	Low pass filter
Filter order	32
Design method	(kaiser window, $\beta=0.5$)
Frequency specification	(0-1) Normalised
Wc	0.5

Implementation Of Fir Filter:

The Fig. 1 shows the realization of the FIR Filter using MATLAB. The FDA tool has been used for obtaining the desired filter length and the windowing technique has been used as the designing method. Thefigures 2 to 6 shows the different the responses of the FIR filter.

Fig: 8& 9 shows the realization of the 2-D & 2-I fir filer using mat lab Simulink. The decimation and interpolationFactors are changed and the responses are observed.

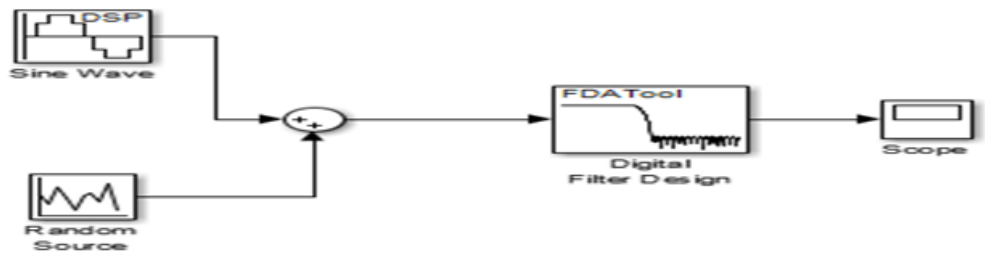


Figure 1 Implementation of 1-D FIR Filter

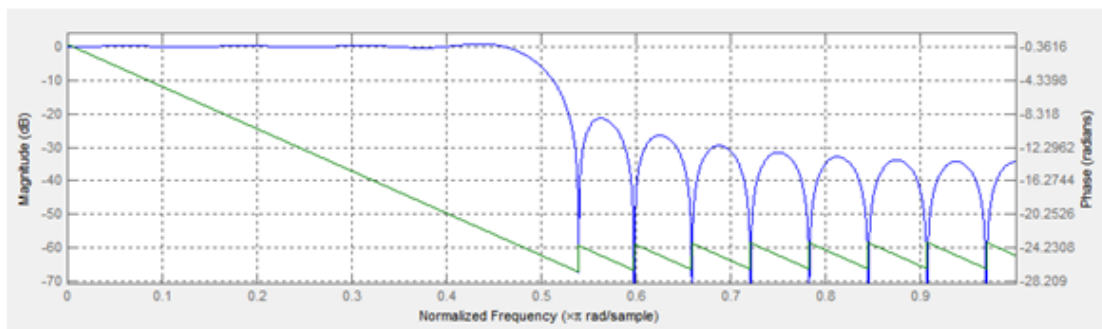


Figure 2 Magnitude And Phase Response

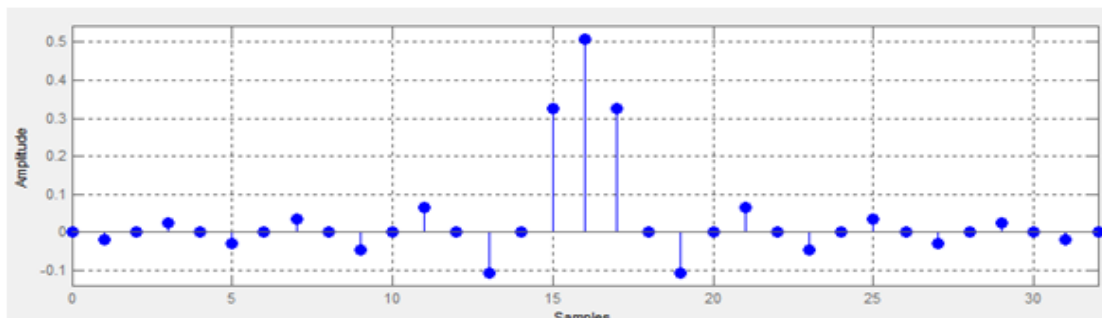


Figure 3 Impulse Responses

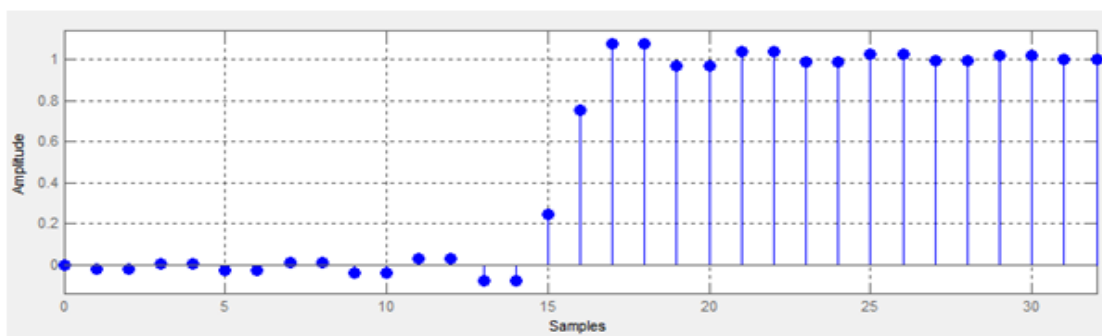


Figure 4 Step Responses

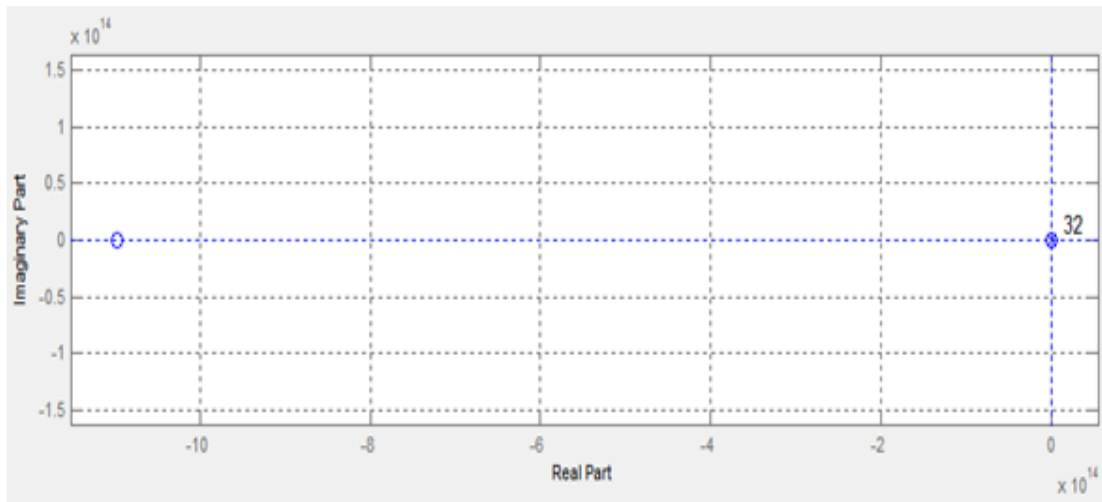


Figure 5 Pole Zero Plots

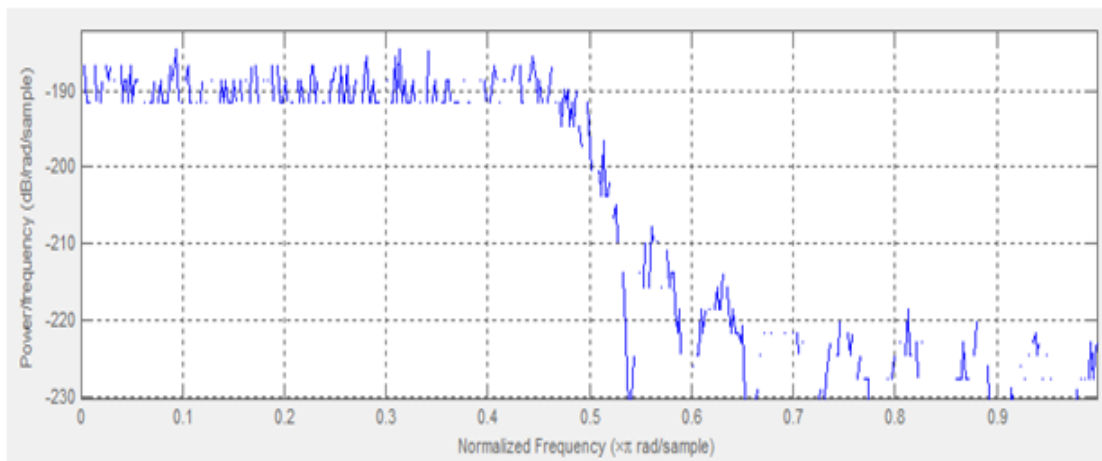


Figure 6 Round-off Noise Power Spectrum

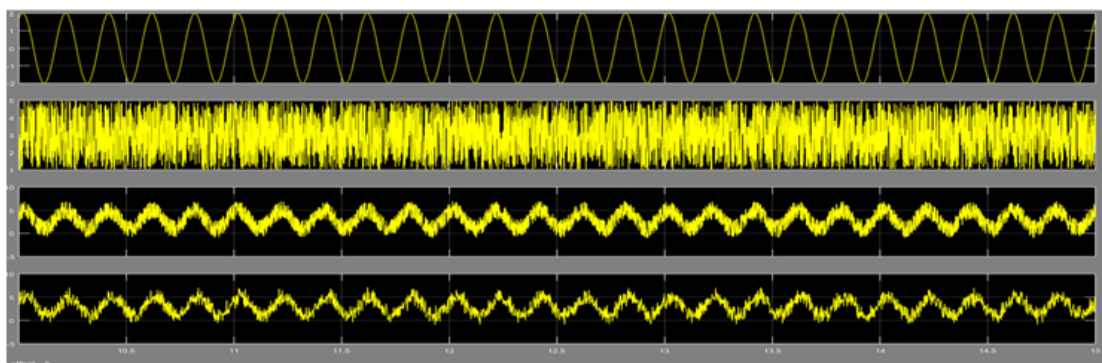


Figure 7 filtered output using Kaiser Windowing

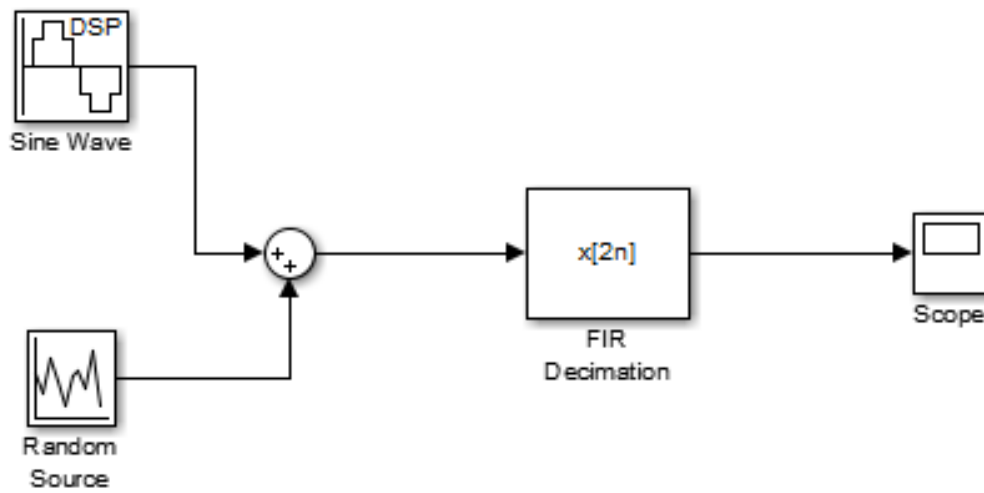


Figure 8. Implementation of 2D FIR filter

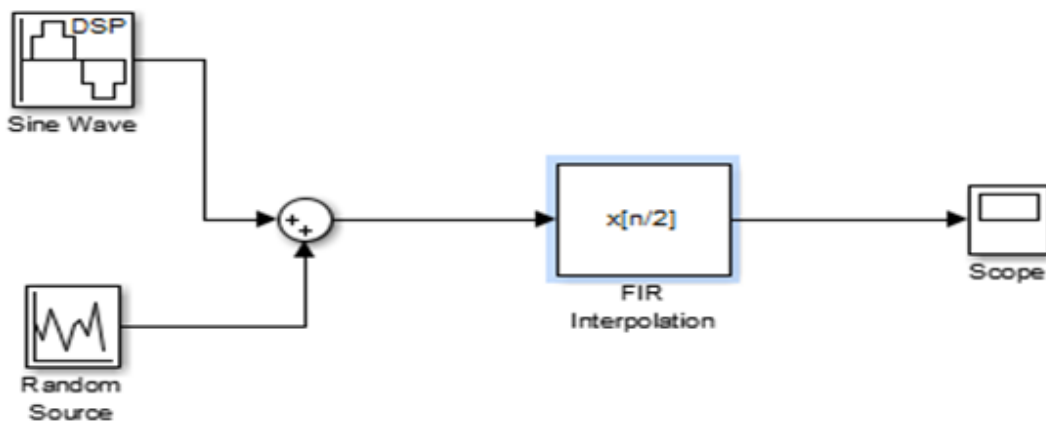


Figure 9. Implementation of 2I FIR filter

Comparison of multirate signals:

factor	1-D	2-D	2-I
Filter length	33	33	16
Number of multipliers	33	33	16
Number of adders	32	32	14
Number of states	32	32	7
Mult per input sample	33	16.5	16
Add per input sample	32	16	14

Conclusion:

The realization of Direct-type fir filters are carried out in Simulink of MATLAB. 33 multipliers, 32 adders are required to realize the 32 order filter. The implementation and simulation of 1-D, 2-D & 2-I fir filters are done, and their response are studied and compared. After comparing these waveforms we conclude that 2-D filter has increased computation speed as compared to 1-D, and it is more efficient in reducing the noise presented in the signal.

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