



COMPARISON OF IIR FILTER AND FIR FILTER AND THEIR TYPES

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ABSTRACT

Within the field of DSP, filter plays a very important role of extracting meaningful knowledge from the signal and thence before planning, it's vital to understand the sort of response required. The operator of filters is to eliminate the chosen vary of signal corresponding to noise or to extract meaningful knowledge from the signal. A filter may be a device that is meant to pass frequencies inside a particular vary whereas rejecting all different unwanted frequencies that fall outside this vary. This paper describes the comparison between Infinite impulse Response (IIR) and Finite Impulse Response (FIR). This paper conjointly describes the comparison between Butterworth methodology of IIR Filter and Window methodology of FIR Filter for low pass, high pass band pass and band reject, we've used few parameters corresponding to magnitude response, section response, zero-pole response, cluster delay & section delay.

Keywords: *IIR, FIR, Butterworth, Window, section delay, band reject.*

I. INTRODUCTION

The procedure of changing associate degree analog signal into digital signal is performed victimization sampling with a finite frequency f_s . This frequency is thought as oftenest. If a filter contains $f_s/2$ frequency part, it'll cause a distortion or noise within the original signal spectrum. Thus it's necessary to use a coffee pass filter within the input to scale back the impact of noise. Filters are often classified into completely different teams supported the necessity. In the main Finite impulse response (FIR) and Infinite impulse response (IIR) filters square measure used. Each kinds of filters have their own benefits and drawbacks that play a significant role whereas planning filter. FIR filters offer linear section, forever stable and may be used for additional advanced circuits. On the opposite hand, the IIR filter provides nonlinear section characteristics, unstable and that they square measure used for fewer complexness.

II. FIR FILTER

FIR filters square measure filter having a transfer operate of a polynomial in s and is all zero filter within the sense that the zeroes within the s plane confirm the frequency response magnitude characteristics. FIR Filter square measure significantly helpful for applications wherever precise linear section response is needed. The FIR filter is mostly enforced in an exceedingly non algorithmic approach that guarantees a stable filter. FIR Filter are particularly useful for applications where exact linear phase response is required. The FIR filter is generally implemented in a non-recursive way which guarantees a stable filter.

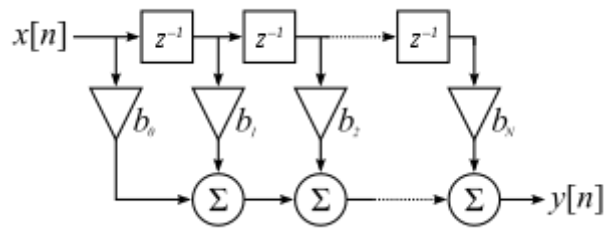


Fig.1.A Direct Form Discrete-Time FIR Filter of Order N.

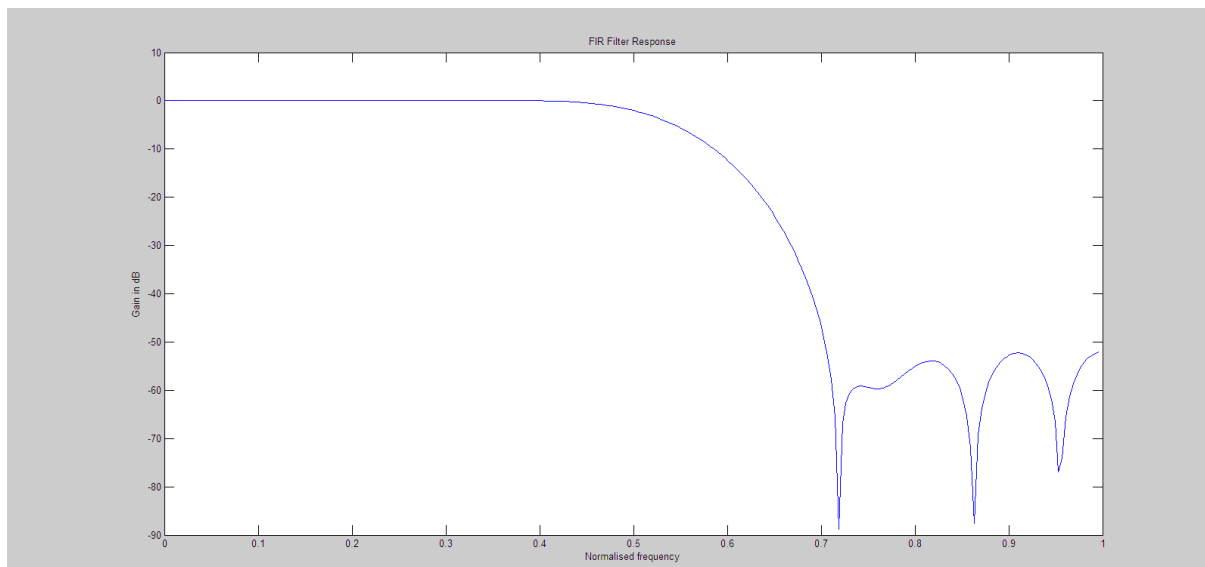


Fig.2.FIR Filter Response

Output

Enter the passband ripple : 0.04

Enter the stopband ripple : 0.03

Enter the passband freq : 1610

Enter the stopband freq : 2200

Enter the sampling freq : 6500

III. IIR FILTER

The digital filter that has Associate in Nursing impulse response of infinite period (infinite variety of non-zero terms) is called infinite impulse response filter. IIR filters also are called algorithmic filters. There is continuously feedback required. Wherever part distortion is tolerated, IIR are typically favored. As a result of here parameters demand is lesser to realize sharp cutoff filters, and thus less complexness. Solely issues occur throughout implementation arstability and troublesome style.

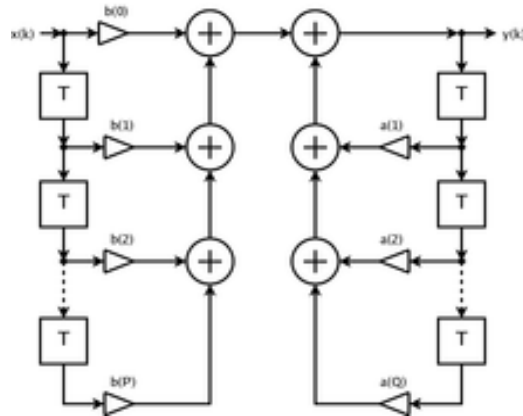


Fig.3. Form of IIR Filter of order N

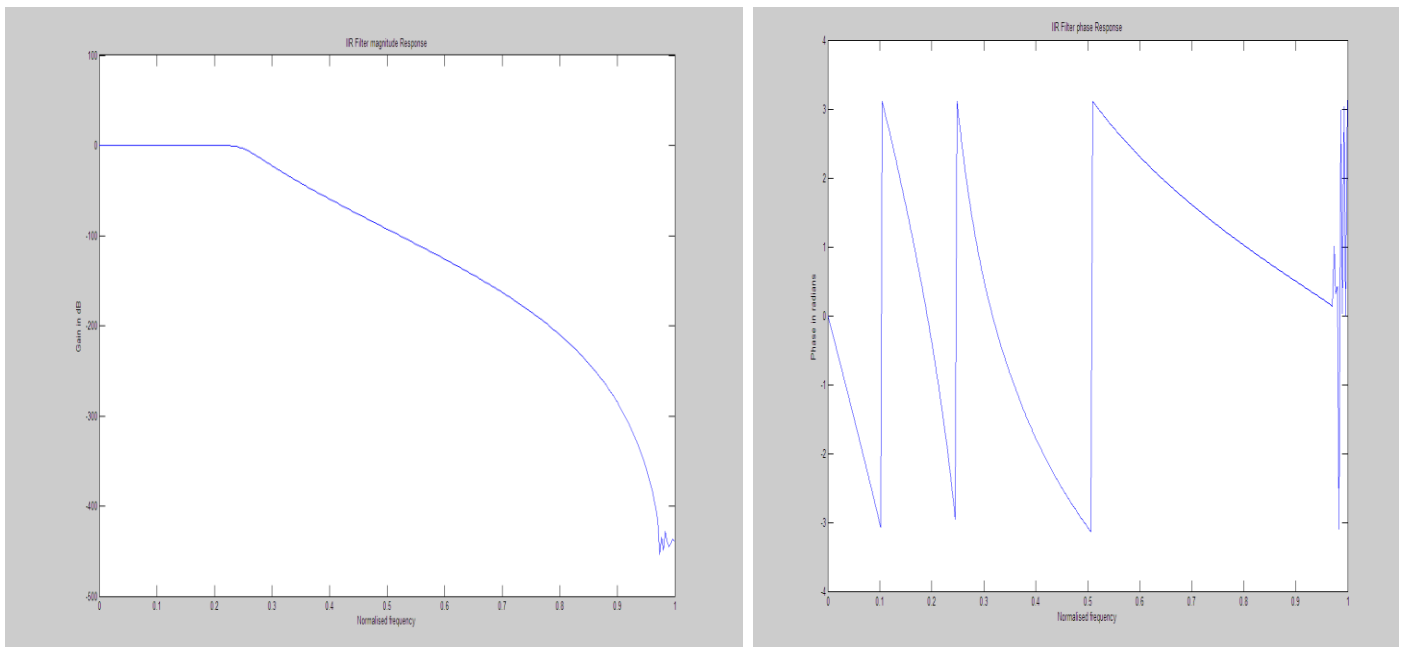


Fig.4.Magnitude and Phase Response of IIR Filter

OUTPUT

Enter the passband ripple : 0.7

Enter the stopband ripple :70

Enter the passband freq : 1500

Enter the stopband freq : 3000

Enter the sampling freq : 15000

IV. ADVANTAGES OF FIR FILTER OVER IIR FILTER

- They merely be designed to be "linear phase" (and generally are). Put simply, linear-phase filters delay the sign, but don't distort its section.



They're straightforward to implement. On most DSP microprocessors, the FIR calculation could also be done by method one instruction.

They're suited to multi-rate applications. By multi-rate, we have a tendency to tend to mean either "decimation" (reducing the sampling rate), "interpolation" (increasing the sampling rate), or both. Whether or not or not decimating or interpolating, the utilization of FIR filters permits variety of the calculations to be omitted, therefore providing an important procedure efficiency. In distinction, if IIR filters square measure used, each output ought to get on a personal basis calculated, the' it that output will discarded (so the feedback square measure incorporated into the filter

- They have fascinating numeric properties. In observe, all DSP filters ought to be implemented victimization "finite-precision" arithmetic, that is, a restricted vary of bits. the utilization of finite-precision arithmetic in IIR filters can cause important problems due to the utilization of feedback, but FIR filters have no feedback, in order that they'll generally be implemented victimization fewer bits, and so the designer has fewer wise problems to unravel with reference to non-ideal arithmetic.
- Totally constant cluster delay throughout the frequency spectrum complete stability the smallest amount bit frequencies in spite of the size of the filter could also implemented with fast convolution relatively insensitive to division

V. ADVANTAGES OF IIR FILTER OVER FIR FILTER

The main blessings of IIR filter have over FIR filter is their economical implementation, so as to fulfill system demand in terms of pass-band, stop-band, ripple, or/ and roll-off. Such a specification may be achieved with a lower order. This means a correspondingly lesser range of calculations for each step and also the procedure saving is usually an oversized concern.

1. IIR filters are able to do a desired filtering characteristic exploitation less memory parts and calculations than a FIR filter.
2. With high procedure potency and short delays IIR filters, typically build the IIR filter most well-liked as an alternate. Whereas FIR filters became too long in digital feedback systems that cause issues. FIR cannot implement analog filter responses, however IIR is employed to style that accurately.
3. IIR filters area unit additional at risk of noise.
4. Less mathematical operations area unit performed
5. Time delay is a smaller amount.
6. It Contain less range of aspect lobes within the stop-band

VI. BUTTERWORTH METHODOLOGY OF IIR FILTER

The classical methodology that's wont to style analog filters is Butterworth approximation. It's additionally referred as maximally flat filters. The calculations and different mathematical operations area unit less complicated than the opposite filters. It additionally has poor section characteristics. Higher the Butterworth filter order, higher the quantity of cascaded stages needed. Much Butterworth filter frequency response is unrealizable as a result of it produces excessive pass-band ripple. Primarily Butterworth is employed from RF to audio active filter. It's additional linear section response compared to others filters.

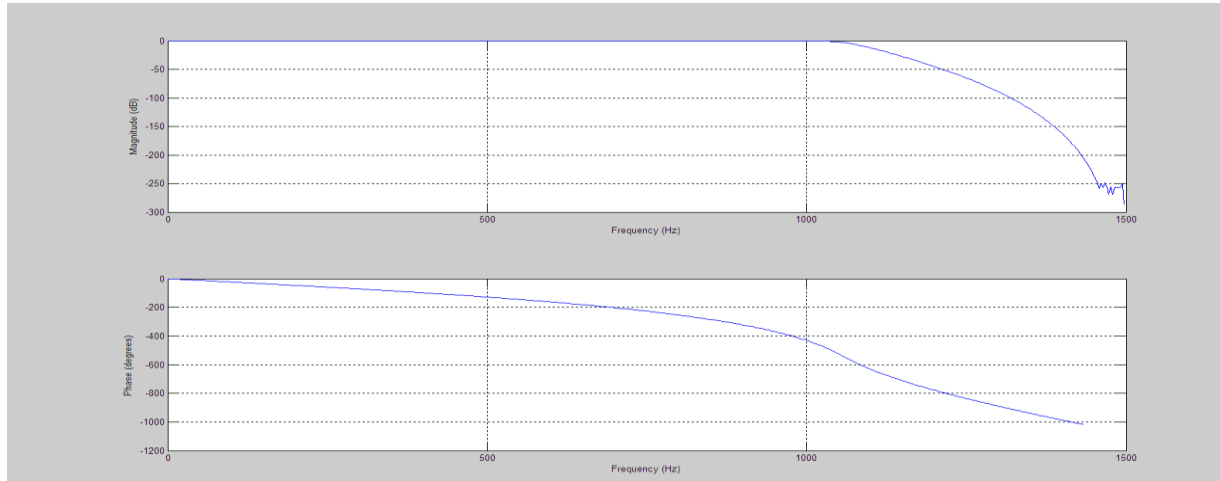


Fig.5.Magnitude and Phase Response of Butterworth Filter

OUTPUT

Enter the pass band frequency :1200

Enter the stop band frequency :1200

Enter the pass band attenuation :0.2

Enter the stop band attenuation :47

Enter the sampling frequency :3100

VII. WINDOW TECHNIQUE IN FIR FILTER

Windowing is that the method of taking little set of a bigger dataset, for process and analysis. A naive approach, the oblong window, involves merely truncating the dataset before and once the window, whereas not modifying the contents of the window the least bit. However, as we'll see, this is often a poor technique of windowing and causes power escape. The selection of the window depends on the noise characteristics, transition region and also.

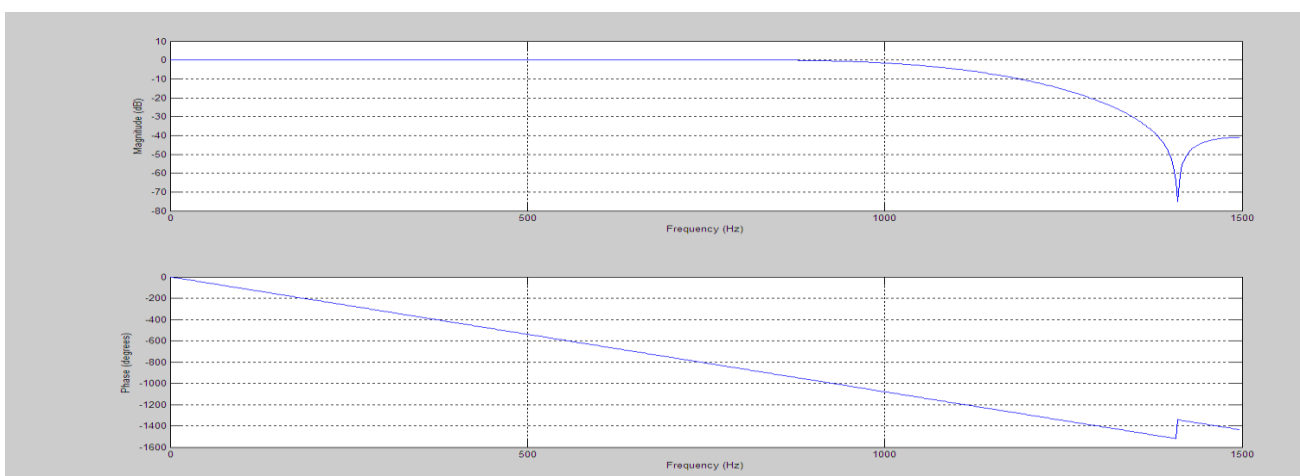


Fig.6.Magnitude and Phase Response of FIR filter using Window Method



OUTPUT

Enter the pass band frequency:1000

Enter the stop band frequency:1250

Enter the pass band attenuation:0.3

Enter the stop band attenuation:50

Enter the sampling frequency:3000

VIII. CONCLUSION

FIR filters are a lot more powerful than IIR filters, however additionally need a lot of process power and a lot of work to line up the filters. During this paper, we tend to represent concerning FIR and IIR Filter optimization completely different technique. During this Paper we tend to discuss a way to use style filter to get a spread of low pass FIR and IIR filters with completely different constraints and style ways. Style filter may be accustomed get high pass, band pass, band stop, and arbitrary-magnitude, individual, and Hilbert styles.

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