Solution of microstrip low pass filters system parameters by MATLAB

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***Abstract*— In recent years, due to the magnificent development of Filter designs take attention in research area. RF/microwave Filters are used to separate or combine different frequencies. We are going to improve performance in microwave low pass filters. Low pass filters are vital in modern electronics, their design and verification can be tedious and time consuming job. The design problem of Infinite Impulse Response (IIR) digital filters are usually expressed as the minimization problem of the complex magnitude error that includes both the magnitude and phase information The filters are expected to have a cutoff frequency at 219 Hz with 2670 sampling frequency, pass band ripple is 1.5dB, Stop band attenuation is 47.5dB Pass band corner frequency is 0.16045 and stop band corner frequency is 0.2884 . This paper approach toward the aim of different testing and analysing on low pass filters in magnitude response, phase response pole and zero diagrams and finally comparison between four filters (Butterworth ,Chebyshev Type I, Chebyshev Type II and Elliptic.) by written program in MATLAB.**

***Keywords*- Low pass, Butterworth ,Chebyshev Type I, Chebyshev Type II and Elliptic., MATLAB**

I. INTRODUCTION

Filters play a very important role in the field of Frequency separation. A microwave filter is a two port network used to control the frequency response at a certain point in a microwave system by providing transmission at frequencies within the pass band of the filter and attenuation in the stop band of the filter [1]. Filters are classified as analog and digital. Filter is a frequency selective circuit that allows a certain band of frequency to pass while attenuating the others frequencies. fIR filters have not much better frequency response than IIR filters with the same order [2].]. RF/microwave signals are selected or confine by the filter within the assigned spectral limits. RF/microwave filters challenge with ever more stringent requirements- higher performance, smaller size, lighter weight, and lower cost, Depending on the requirements and specifications [3].. The design of IIR filters proceeds through a vastly different set of steps than those followed by FIR filter design algorithms. The design of IIR filters is closely related to the design of analog filters, which is a widely studied topic. An analog filter is usually designed and a transformation is carried out into the digital domain. The responses of four IIR filters using MATLAB are compared with the same specifications. The main goal of this paper is to obtain an optimized filter response.

2. DIGITAL IIR FILTERS

The function of the filter is used to remove unwanted parts of the signal, such as random noise, or to extract useful parts of the signal in signal processing.

There are some considerable advantages of digital over analog filters which make digital filters unavoidable [4]. Some of these are as follows:

1. A digital filter is programmable, i.e. its operation is determined by a program stored in the processor's memory. This means the digital filter can easily be changed without affecting the circuitry (hardware).
2. Digital filters are easily designed,tested and implemented on ageneral purpose computer or workstation.
3. Unlike their analog counterparts, digital filters can handle low frequency signals accurately. As the speed of DSP technology continues to increase, digital filters are being applied to high frequency signals in the RF (radio frequency) domain, which in the past was the exclusive preserve of analog technology.

2.1 BUTTERWORTH FILTER

Some characteristics are shown by the Butterworth filter

1. It provides smooth response at all frequencies.
2. Monotonic decrease from the specified cut-off frequencies
3. Flatness is maximal with the ideal response of unity in the pass band and zero in the stop band.

The transfer function for Butterworth filter is given by-

$$B(\omega) = \frac{1}{[1 + \left(\frac{\omega}{\omega_0}\right)^{2n}]^{1/2}}$$

Where n is the order of filter [5].

2.2 CHEBYSHEV FILTERS

Some characteristics are shown by the Chebyshev filters

- Peak error minimized in the pass band.
- It provides Equiripple magnitude response in the pass band.
- It provides monotonically decreasing magnitude response in the stop band.
- Sharper roll off than Butterworth filters.

The frequency response of the filter is given by-

$$|H(\Omega)|^2 = \left(1 + \varepsilon^2 T_N^2 \left(\frac{\Omega}{\Omega_p}\right)\right)^{-1}$$

Where ε a parameter of the filter is related to ripple present in the pass band and T (x) N is the Nth- order Chebyshev polynomial defined as

$$T_N = \cos(N \cos^{-1} x) \qquad |x| \leq 1$$
$$\cos(N \cosh^{-1} x) \qquad |x| \geq 1$$

2.3 ELLIPTIC FILTERS

Some characteristics are shown by the Elliptic filters.

- It provides Minimization of peak error in the pass band and the stop band.
- It provides Equiripples in the pass band and the stop band.
- The transfer function is given by

$$|H(\Omega)|^2 = \left(1 + \varepsilon^2 U_N \left(\frac{\Omega}{\Omega_c}\right)\right)^{-1}$$

Where U (x) N the Jacobian is elliptic function of order N and ε is a constant related to pass band ripple. They provide a realization with the lowest order for a particular set of conditions.

FDATOOL

The Filter Design and Analysis Tool (FDATool) is a powerful user interface for designing and analyzingfilters quickly. FDATool enables you to design digital FIR or IIR filters by setting filter specifications, byimporting filters from your MATLAB workspace, or by adding, moving ordeleting poles and zeros. FDATool also provides tools for analyzing filters, such as magnitude and phase response and pole-zero plots. FDA tool is an inbuilt standard tool in MATLAB

3. DESIGN OF DIGITAL IIR FILTER WITH MATLAB

MATLAB empowers to build own solutions for scientific and engineering systems. It gives the flexibility to design and manipulates the predefined systems. We can simulates all the filters and also create different types of filters [6]. In this paper we use four digital IIR filters to simulate on some system specifications. we are comparing the magnitude responses of all the filter by help of MATLAB also display the phase response and comparison between all filters and one by one Pole-zero diagram of all the filters with help of FDA tool in MATLAB.

System specification

Cut-off frequency	-	219 Hz
sampling frequency	-	2670
Pass band ripple	-	0.33
Stop band ripple	-	75
pass band ripple	-	1.5dB
Stop band attenuation	-	47.5dB
Pass band corner frequency	-	0.16045
stop band corner frequency	-	0.2884

4 .SIMULATION AND RESULT

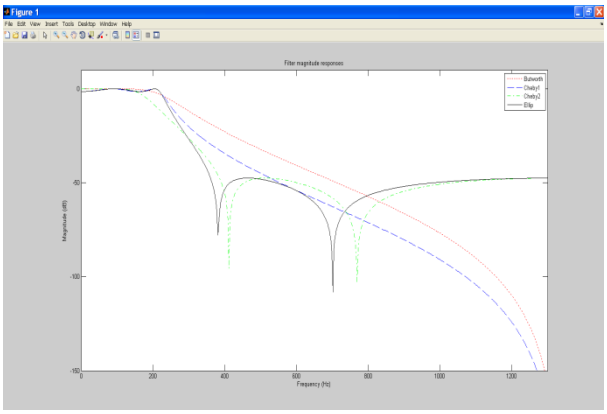


Fig. 1 Magnitude response of filters

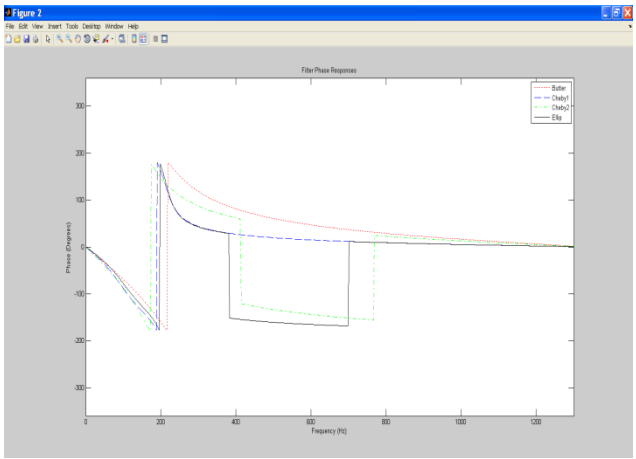


Fig. 2 Phase response of filters

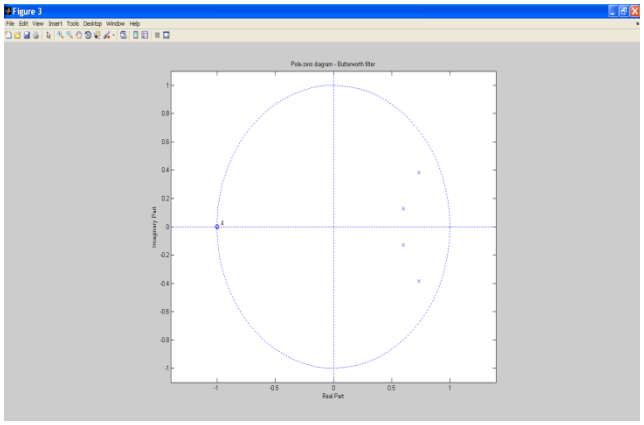


Fig. 3 Pole-zero diagram Butterworth filter

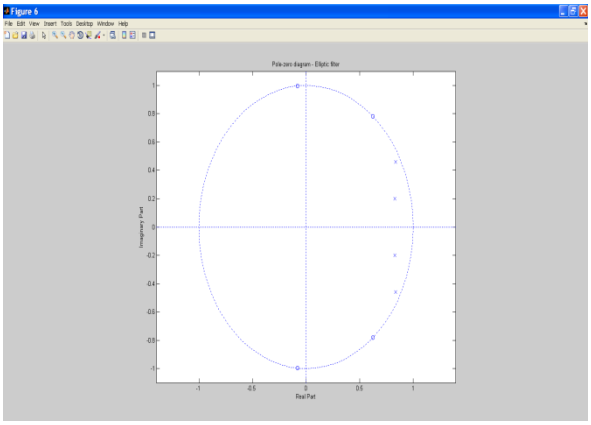


Fig 6 Pole-zero diagram Elliptic filter

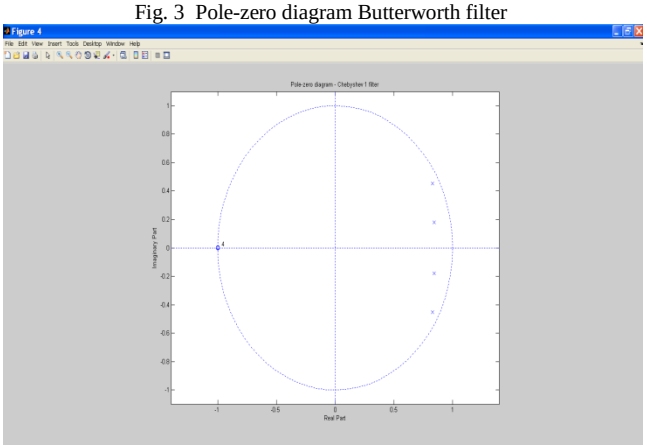


Fig 4 Pole-zero diagram Chebyshev Type I filter

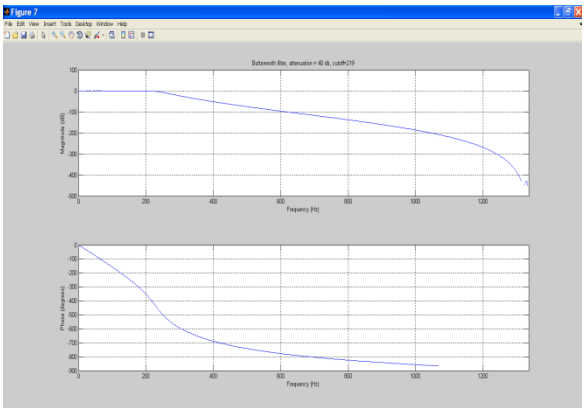


Fig 7 Comparative study between Magnitude response and phase response of butterworth filter

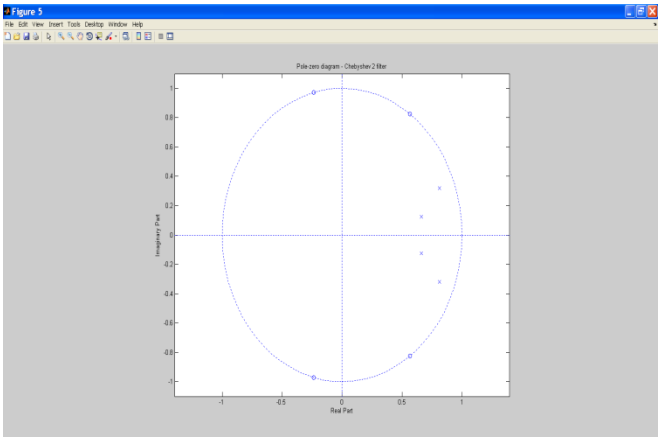


Fig 5 Pole-zero diagram Chebyshev Type II filter

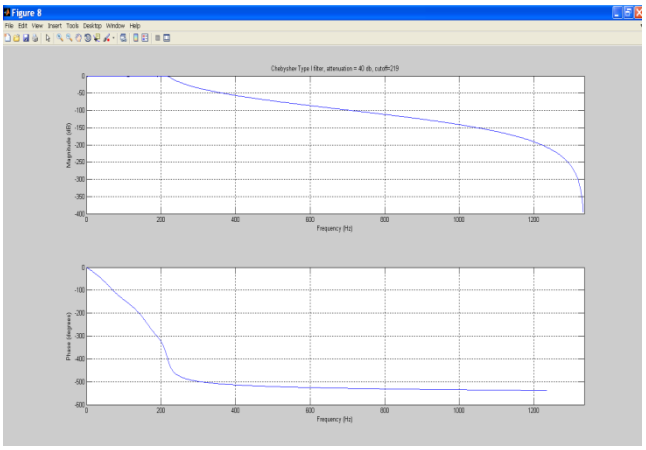


Fig 8 Comparative study between Magnitude response and phase response Chebyshev Type I filter

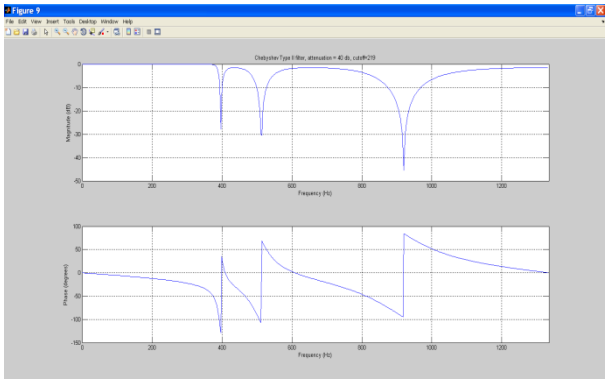


Fig 9 Comparative study between Magnitude response and phase response Chebyshev Type II filter

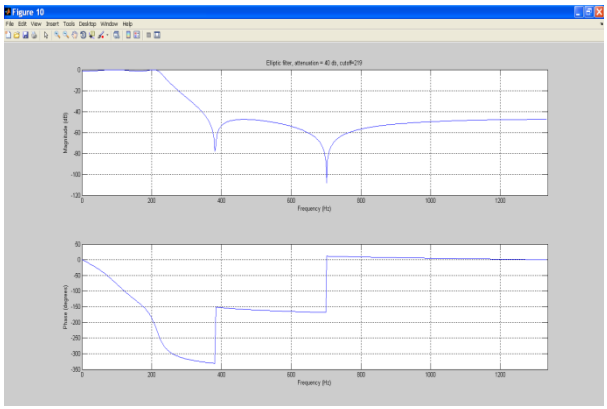
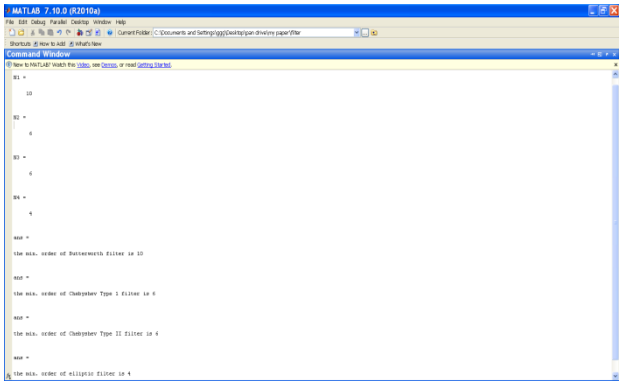


Fig 10 Comparative study between Magnitude response and phase response elliptic filter



CONCLUSION

The of this paper has been to outline some of the issues involved in the choice of IIR filters .and also we have propose the improved method to design the stable IIr filter. In our proposed method,the approximation problems of magnitude and phase response Several well known ouputs have been presented in a unified foem by the help of FDA tool in MATLAB. We were placed in providing a simple and general fram work that enales easy understanding of result and convergence properties of the filters used in the programming in MATLAB. Simulation were included to illustrate some of the result placed.Finally, the designs are demonstrated to illustrate the effectiveness of the proposed method.

References

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