EECE 491 Mini Project

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I. IIR Filter Design

A. Elliptic

- $\delta_{\text{iir}} = -G_{\text{pb\_min}} = 1$ dB
- $\xi_{\text{iir}} = -G_{\text{sb\_max}} = 40$ dB
- $k = 1$ since in IIR scaling is not needed
- The order of the filter is $n = 5$
- Size of denominator: 5(excluding 1)
- Size of numerator: 6

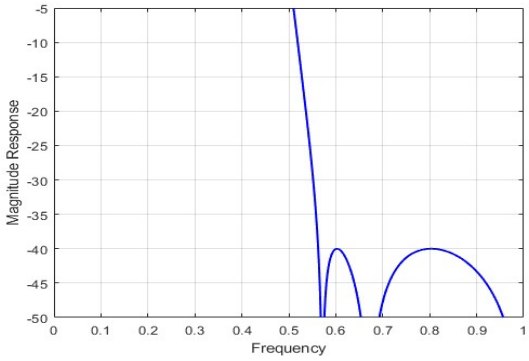

Fig. 1. Magnitude Response from -50db to -5db

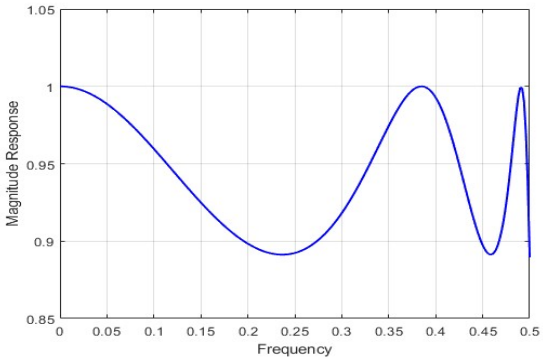

Fig. 2. Linear Magnitude Response from 0.85 to 1.05

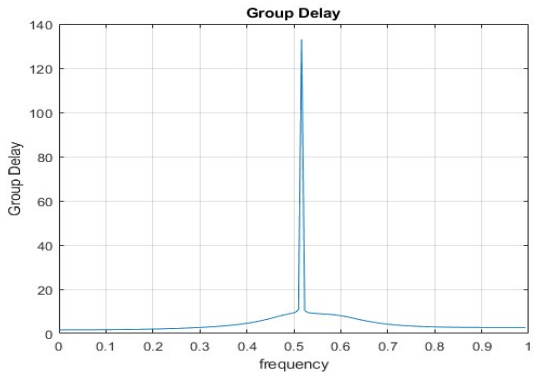

Fig. 3. Group Delay of Elliptic Filter

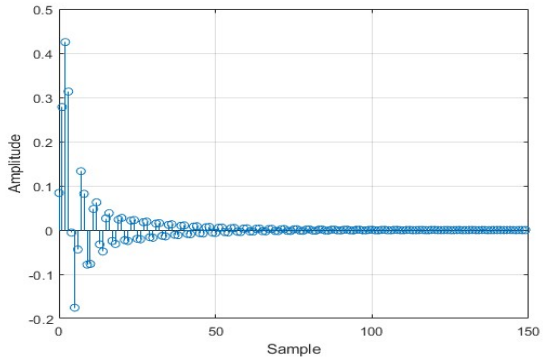

Fig. 4. Impulse Response of Elliptic Filter

B. Butterworth

- $\delta_{\text{iir}} = -G_{\text{pb\_min}} = 1$ dB
- $\xi_{\text{iir}} = -G_{\text{sb\_max}} = 40$ dB
- $k = 1$ since in IIR scaling is not needed
- The order of the filter is $n = 17$
- Size of denominator: 17(excluding 1)
- Size of numerator: 18

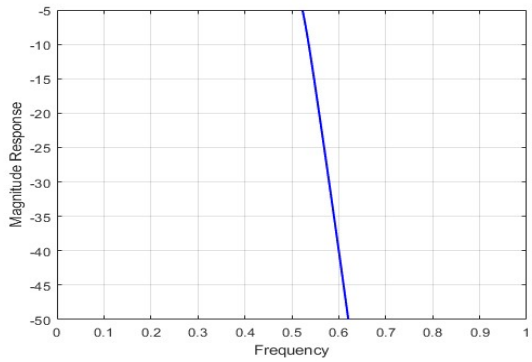

Fig. 5. Magnitude Response from -50db to -5db

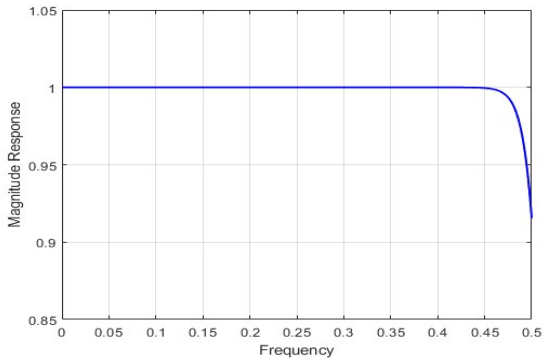

Fig. 6. Linear Magnitude Response from 0.85 to 1.05

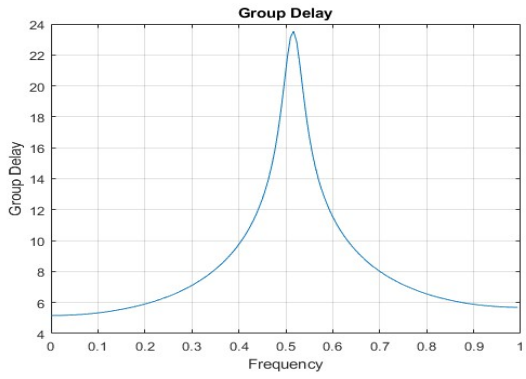

Fig. 7. Group Delay of Butterworth

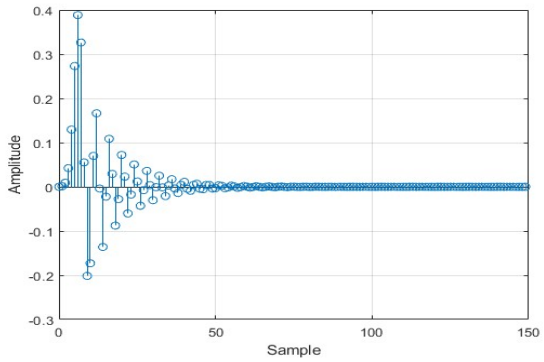

Fig. 8. Impulse Response of Butterworth

II. FIR Filter Design

- $k_{\text{FIR}} \times (1 + \delta_{\text{FIR}}) = 1$
- $k_{\text{FIR}} \times (1 - \delta_{\text{FIR}}) = 10^{-1 \div 20}$
- $\xi_{\text{FIR}} \times k_{\text{FIR}} = 10^{-2}$
- The order of the filter is n = 28.
- For n=28, symmetry in impulse response was noticed at n=14. This indicates that this is a type 1 FIR filter. Thus, to take advantage of this symmetry, we only need the first 15 coefficients(0 to 14)

Solving the above equations we get: $k_{\text{FIR}} = 0.945$, $\xi_{\text{FIR}} = 0.01$ and $\delta_{\text{FIR}} = 0.05$

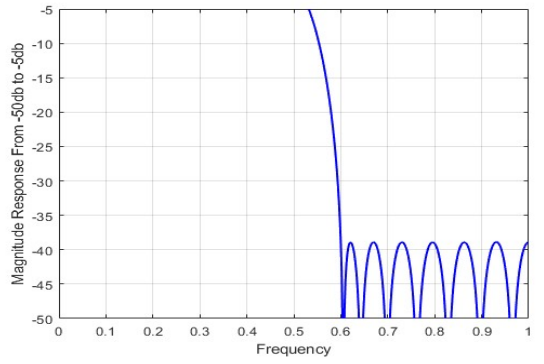

Fig. 9. Magnitude Response from -50db to -5db

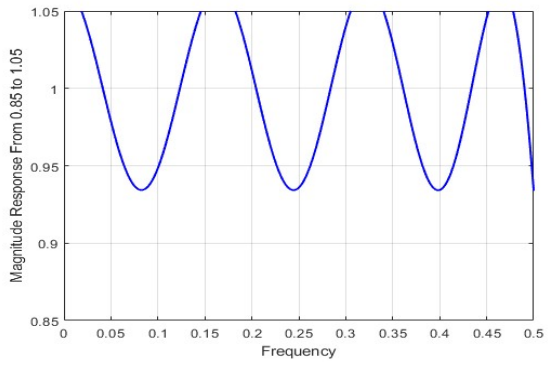

Fig. 10. Linear Magnitude Response from 0.85 to 1.05

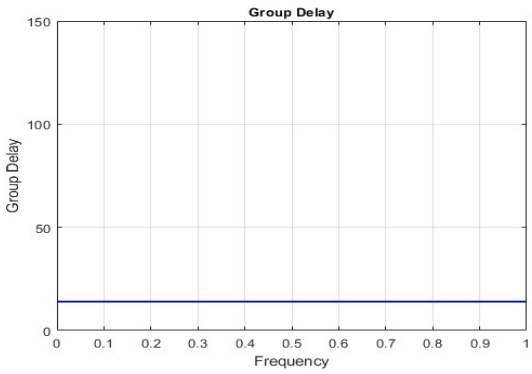

Fig. 11. Group Delay of FIR

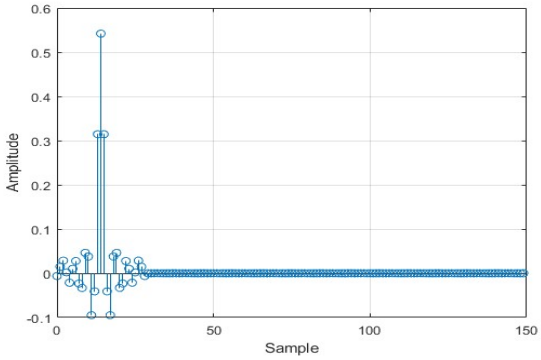

Fig. 12. Impulse Response of FIR