EE473 HW-5

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QUESTION-2

Part-a

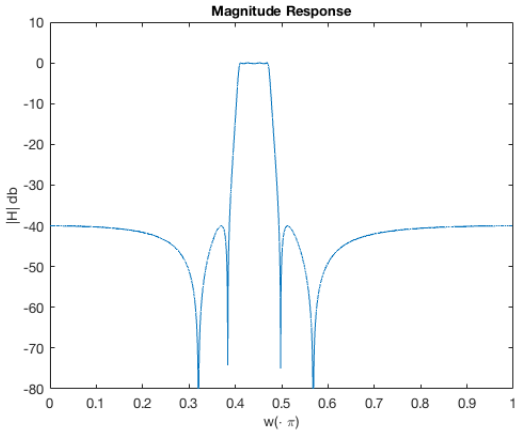


Fig. 1: Initial Positions

Part-b

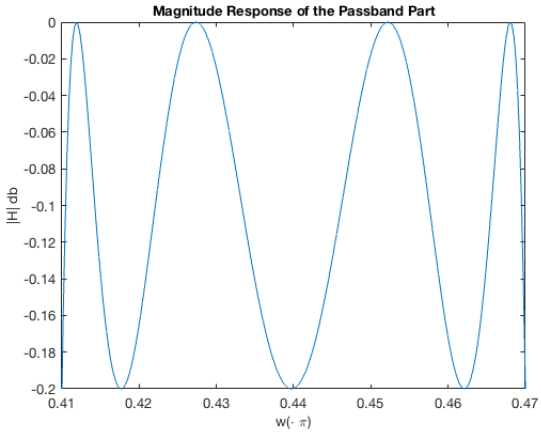


Fig. 2: Initial Positions

Magnitude response oscillatses about -0.1db, so we should shift its center to 0db. I changed the coefficients of x as $b = b * 10^{(0.005)}$. Yes, both δ_1 and Δ_1 is the same and represents 0.1db oscillation because we shifted the graph only. But it is for db graph. Shifting db graph means scaling in normal magnitude graph, so δ_1 and Δ_1 will be different.

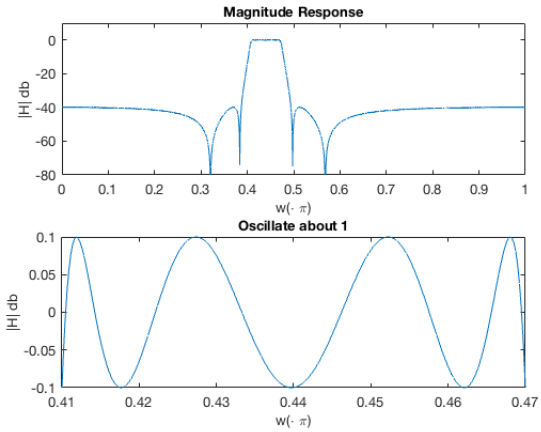


Fig. 3: Initial Positions

Part-c

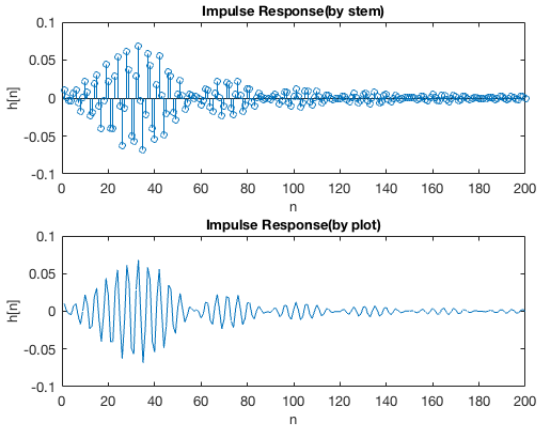


Fig. 4: Initial Positions

To see behaviour of the impulse response, using plot instead of stem is better, because there are many points. The frequency response of bandpass filter is zero except some frequency interval. So h[n] should

not contain too low frequency cosine component and also too high frequency cosine component. When we look the Figure 4, the first part of h[n] has high frequency and when we goes to the right, the frequency of the cosine component decreases. On the other hand the graph looks like the multiplication of sinc and cosine, and it is equivalent to convolution in frequency domain. Convolution of rect and dirac equals to bandpass filter.

QUESTION-3

Part-a

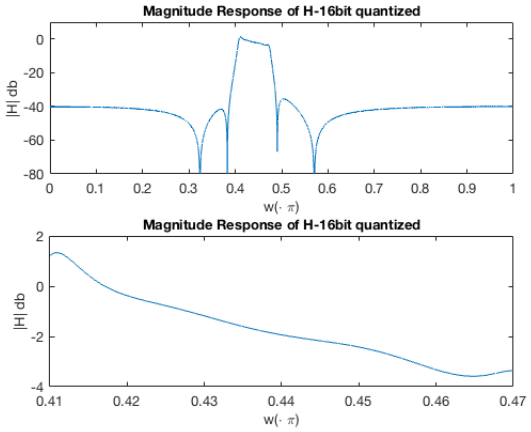


Fig. 5: Initial Positions

Maximum difference between normal and quantized level is 2.0133e-04.

Part-b

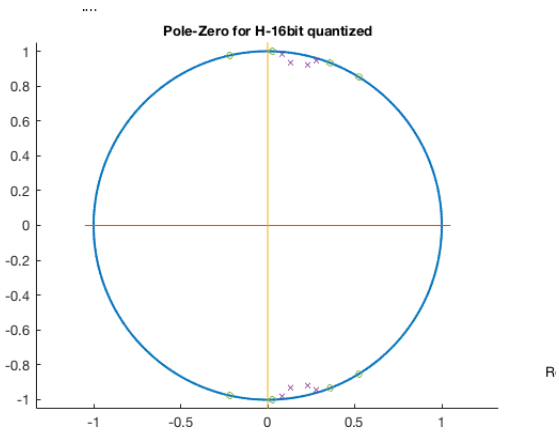


Fig. 6: Initial Positions

Part-c

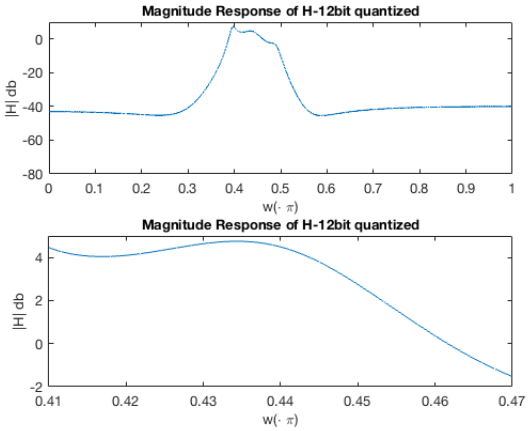


Fig. 7: Initial Positions

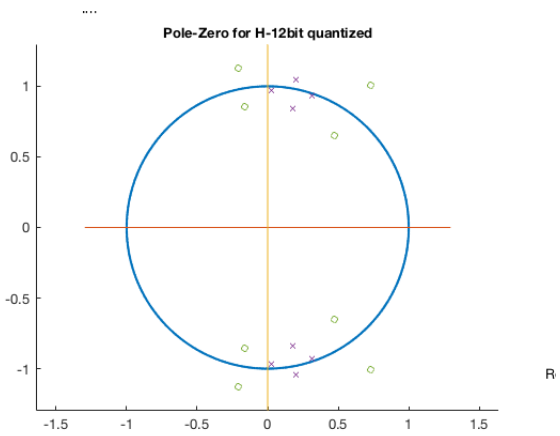


Fig. 8: Initial Positions

Part-d

For 16-bit quantized, because all poles are inside the unit circle, it can be both causal and stable when the R.O.C. is outward. However, for 12-bit quantized, it cannot be both causal and stable, because some poles are at the outside of the unit circle. When it is causal, R.O.C. should be outward and it doesnot contain unit circle.

Part-e

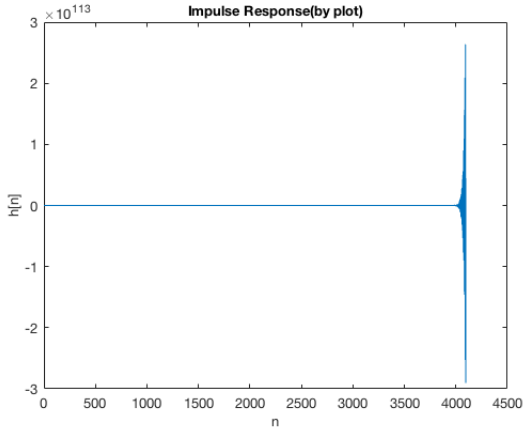


Fig. 9: Initial Positions

It is not stable. It can seen from the figure 9 that, h[n] reaches 10^{113} and it represents infinity for matlab. Also on previous section we have showed that it cannot be stable.

QUESTION-4

Part-b

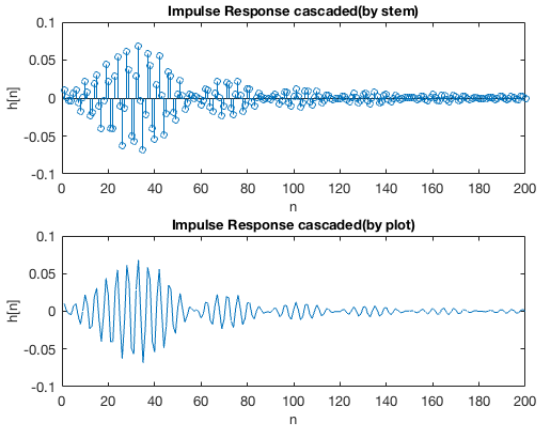


Fig. 10: Initial Positions

The maximum difference is 1.0365e-13.

Part-c

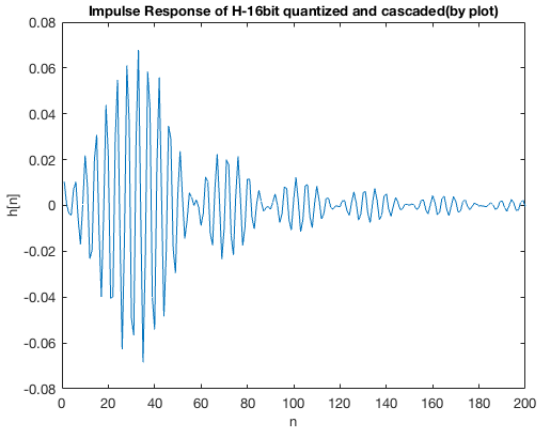


Fig. 11: Initial Positions

Part-d

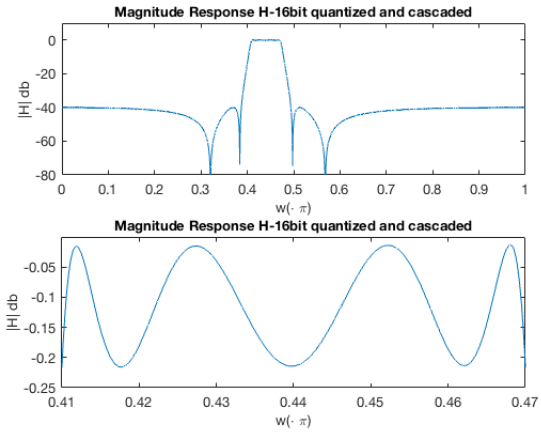
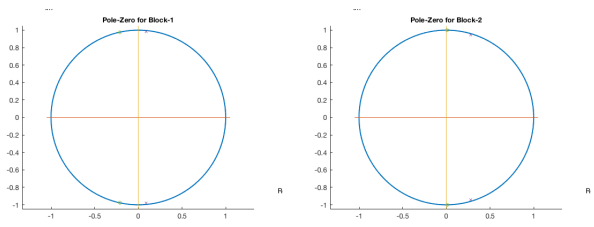
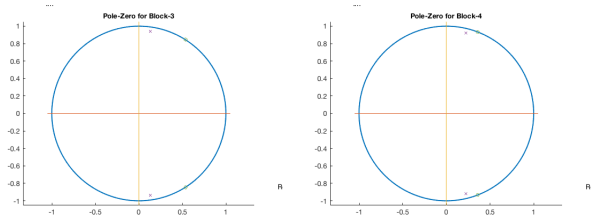
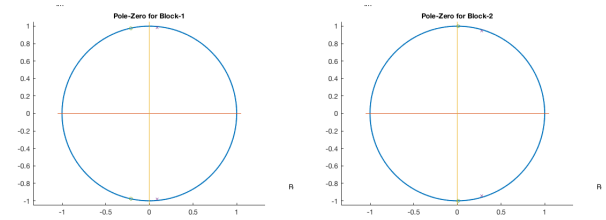


Fig. 12: Initial Positions

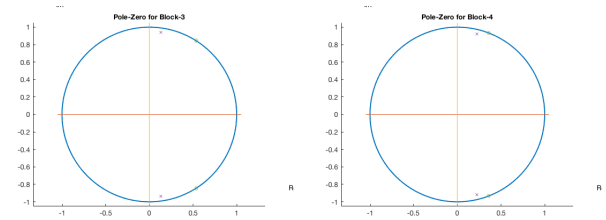






Each of the causal second-order subsections stable because poles are in the unit circle and causality implies stability for this case. Moreover, the union of the poles and zeros of the second-order subsections is equal to the poles and zeros of overall cascade system.

Part-e



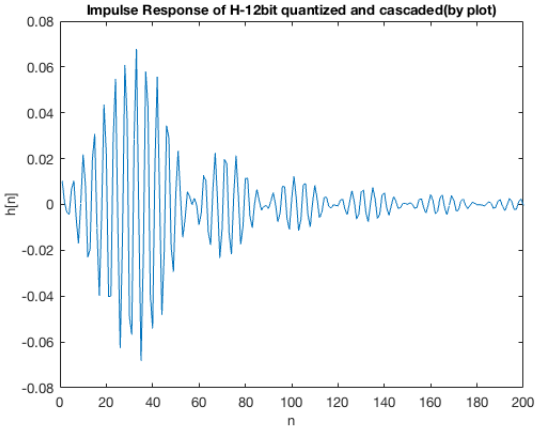


Fig. 13: Initial Positions

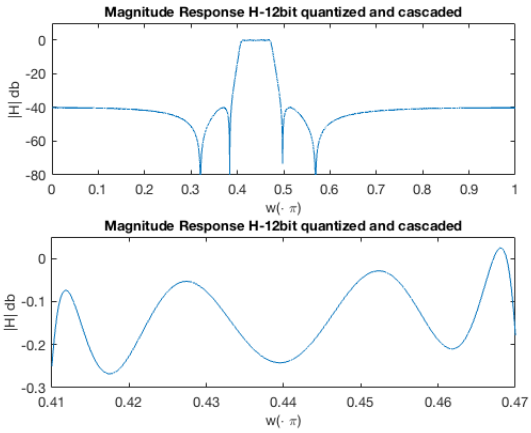


Fig. 14: Initial Positions

Each of the causal second-order subsections are stable, because all poles are inside the R.O.C. and causality implies stability for this case.
The union of poles and zeros of all subsystems equals to overall cascaded system.
The magnitude response of 12bit quantized and cascaded system is more similar to the our main system than direct form system.

QUESTION-5

Part-b

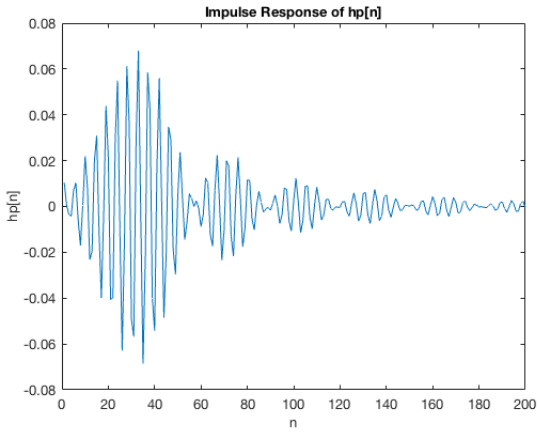


Fig. 15: Initial Positions

The impulse response of the parallel system is almost equal to the original form. The max distance is between these is 1.7335e-13.

Part-d

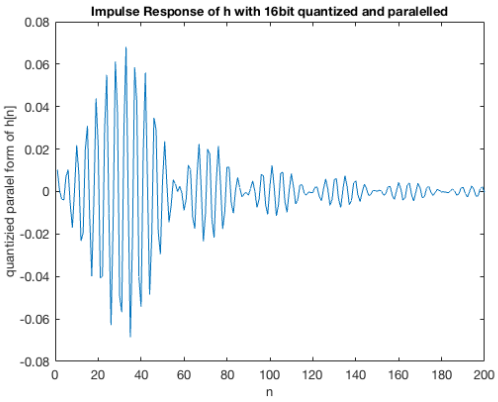


Fig. 16: Initial Positions

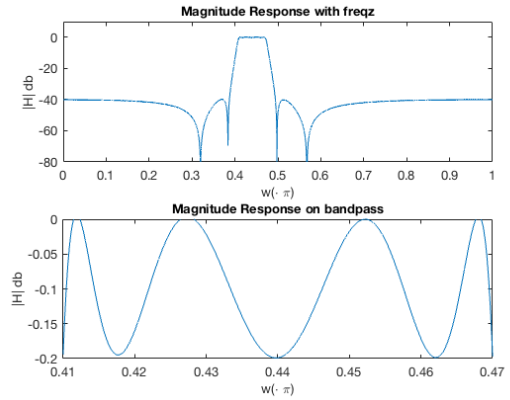


Fig. 17: Initial Positions

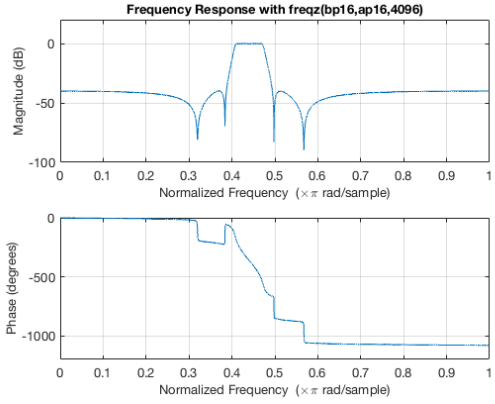


Fig. 18: Initial Positions

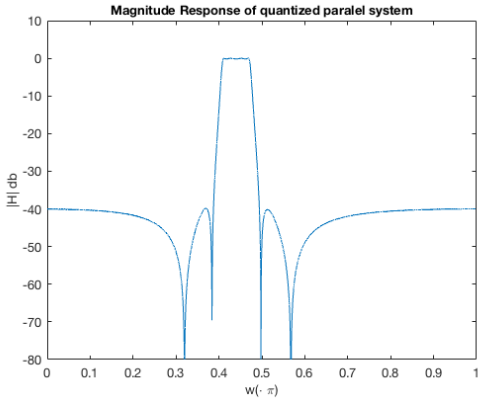


Fig. 19: Initial Positions

Quantized parallel form system and the system function described by bp16 and ap16 are the same.

Part-e

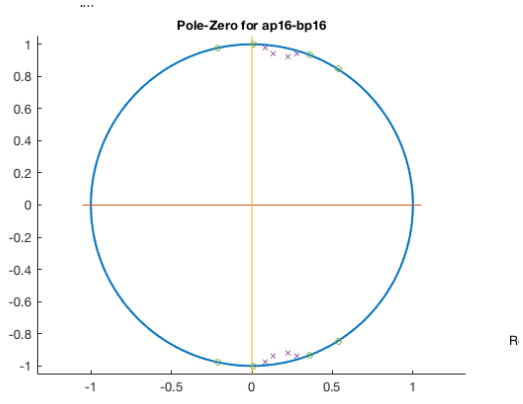


Fig. 20: Initial Positions

Because all poles are inside the unit circle, R.O.C. is outward and include unit circle, it implies the system is both stable and causal.

Part-f

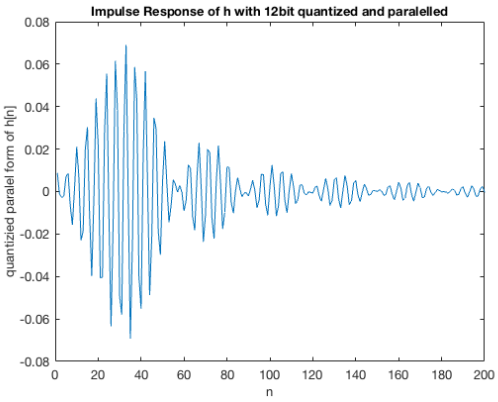


Fig. 21: Initial Positions

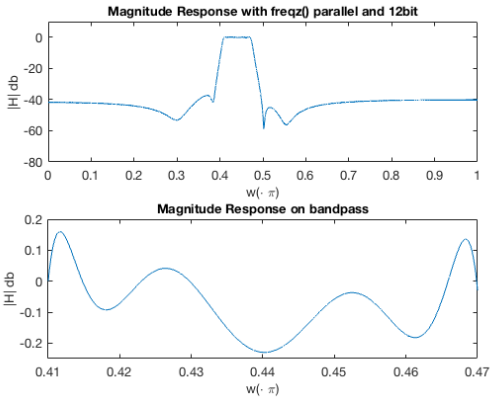


Fig. 22: Initial Positions

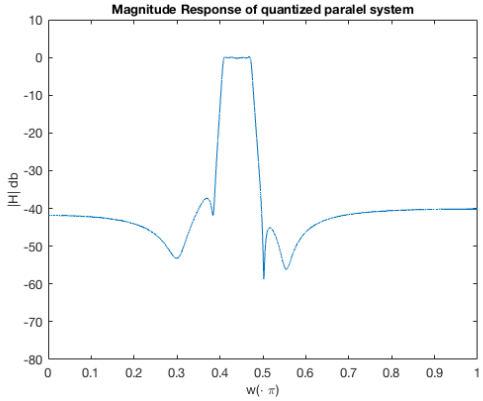


Fig. 23: Initial Positions

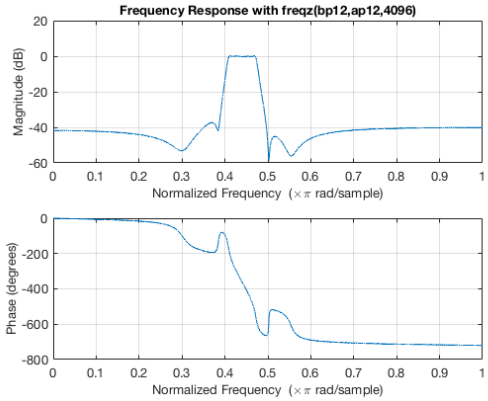


Fig. 24: Initial Positions

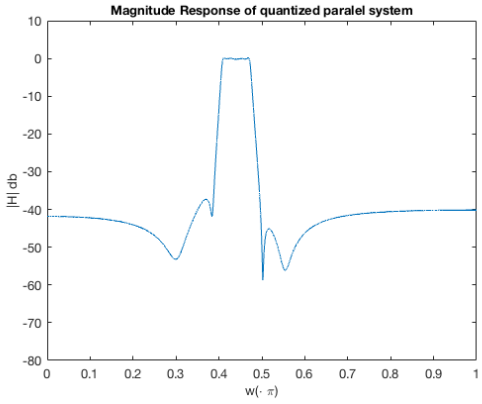


Fig. 25: Initial Positions

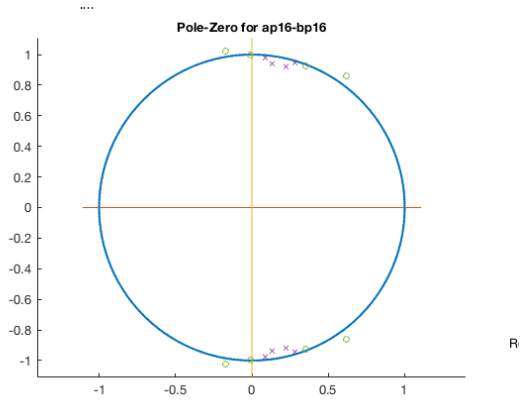


Fig. 26: Initial Positions

Because poles are inside the unit circle, the system is stable and causal.

The magnitude response of the parallel form is more closer to the response of unquantized form than the responses of quantized form of cascaded and direct form.
As a result, the parallel form gives us better result than direct and cascaded form for quantization. Moreover, cascaded systems are better than direct form.
On the other hand, 16bit quantized systems more close to the systemm that unquantized one. Because decreasing the quanted number of bit makes system worse.