

Lab6

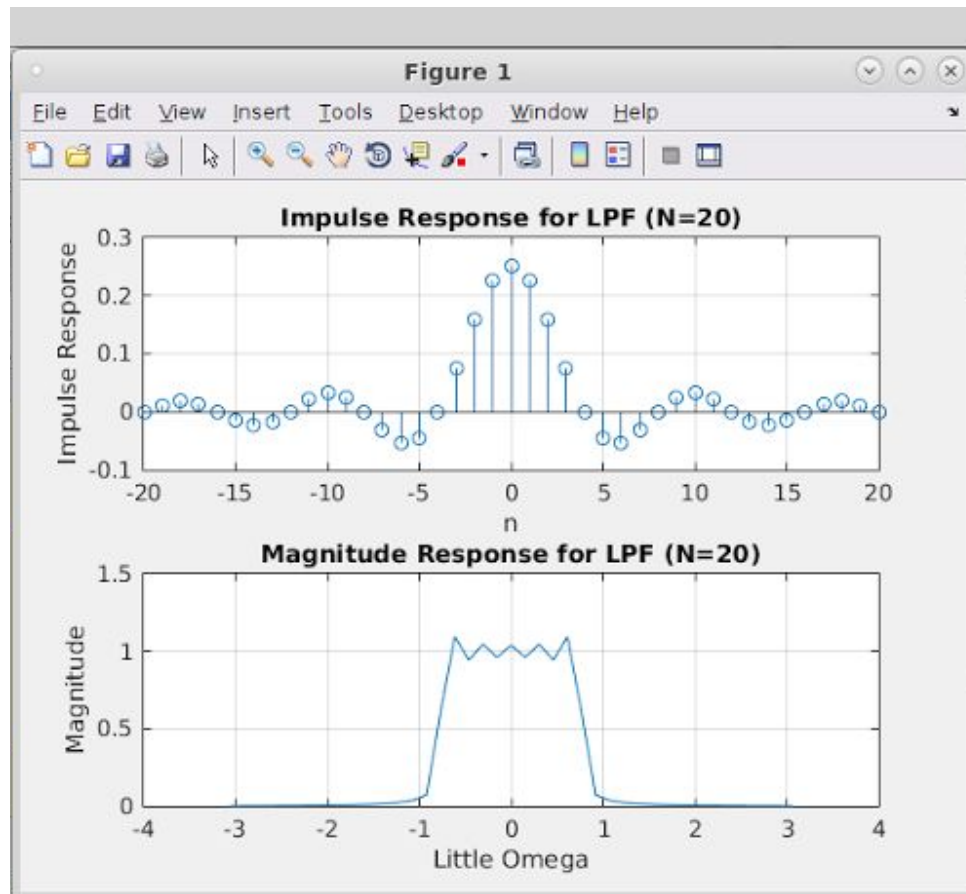
Name: Zhijie Jin

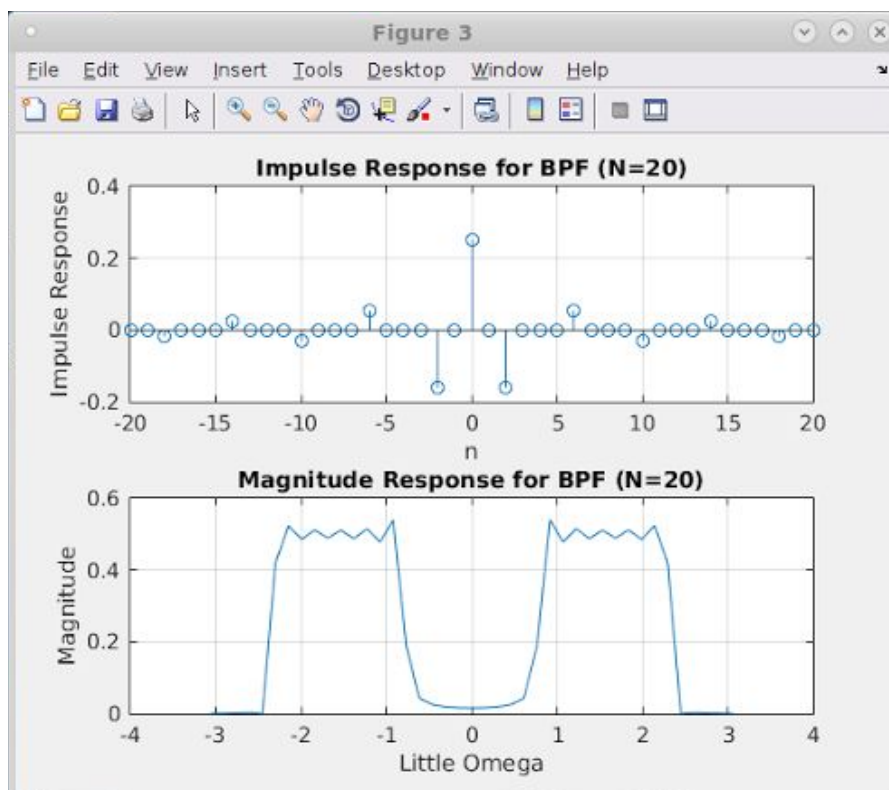
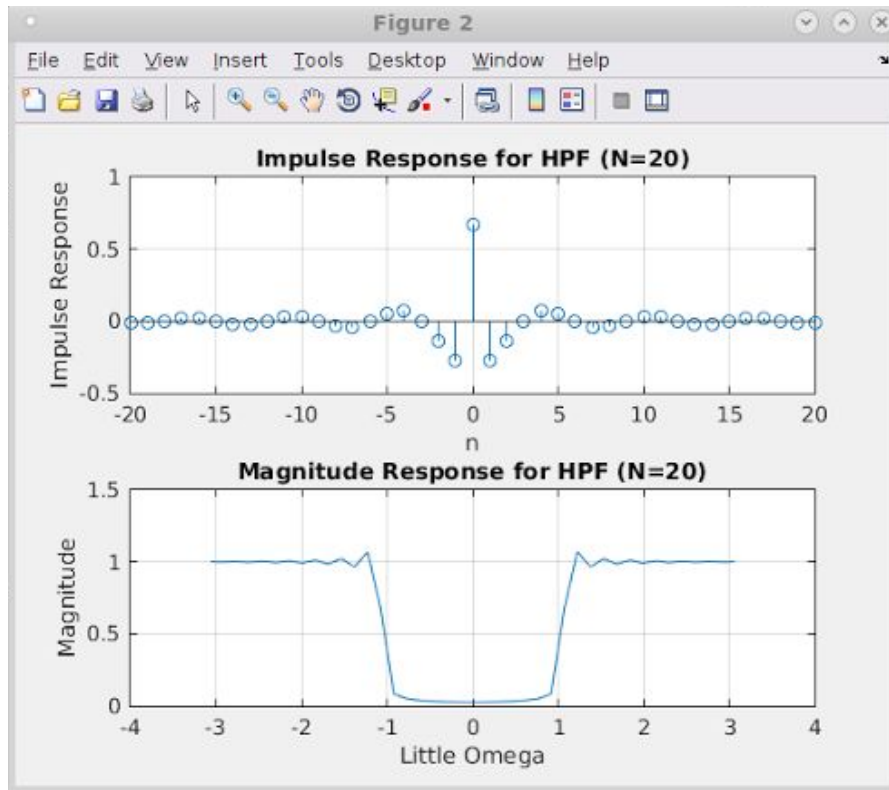
NetID: zhijiej2

Section: A

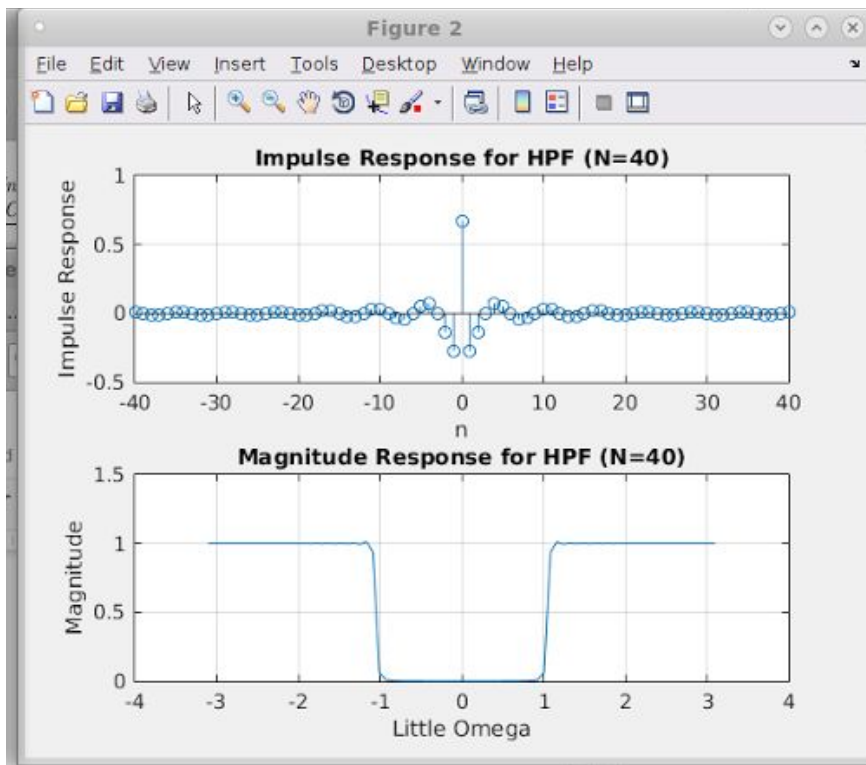
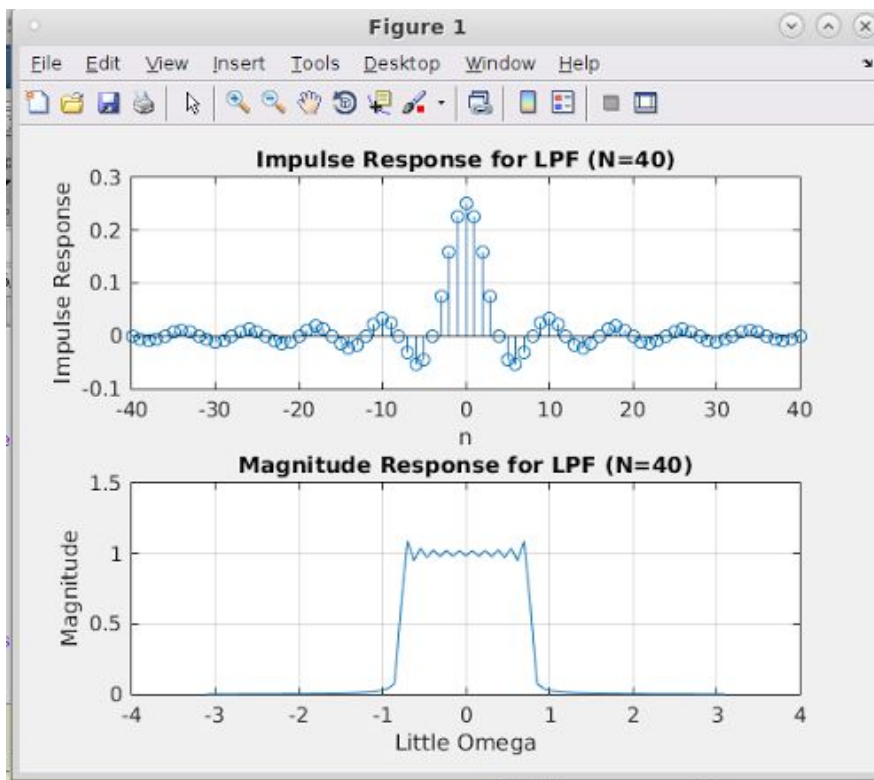
Report Item 1:

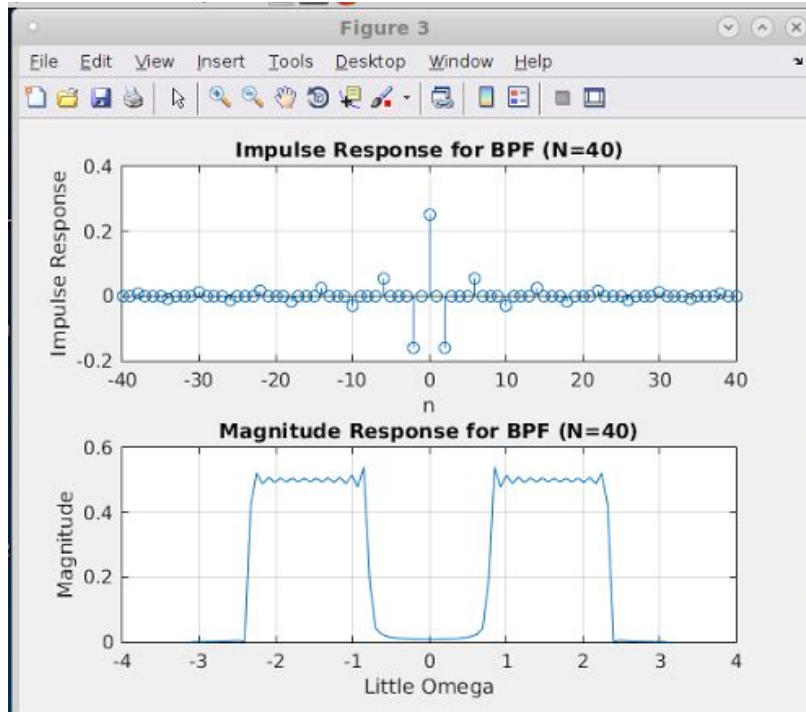
N = 20:





N = 40:

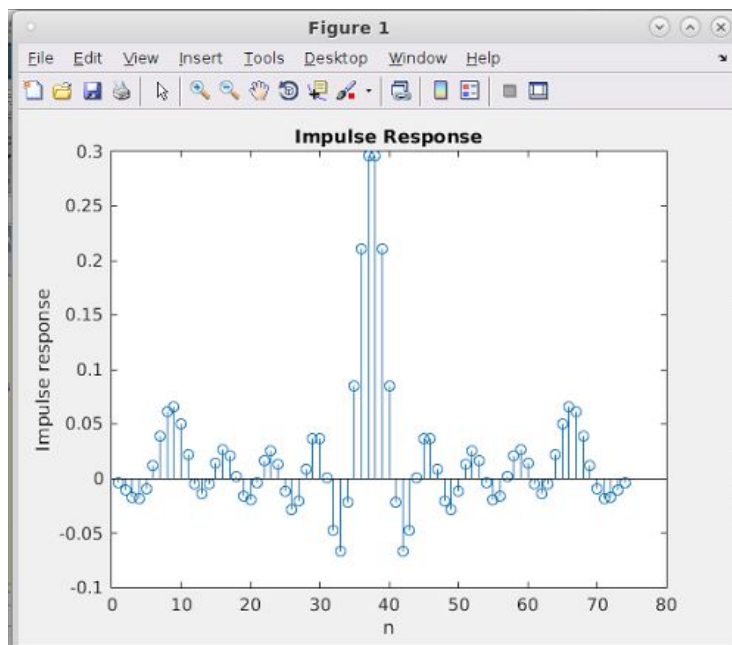




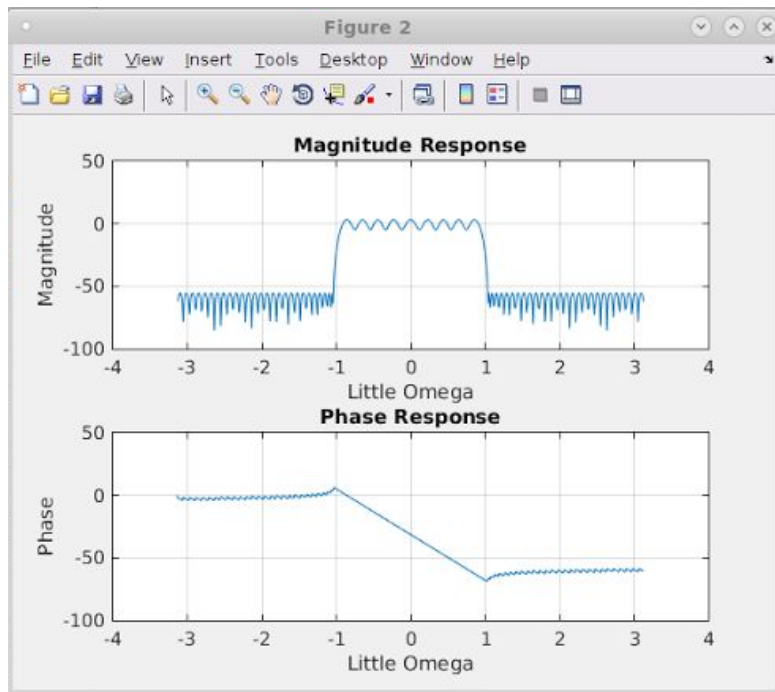
The magnitude response of these plots don't overlap the ideal filters perfectly. There are some ripples on the passband. Also, whenever the magnitudes do not equal to zero when the frequency equals w_c or $w_0 \pm w_c$. However, the larger N we use, the better approximation we got from the models.

Report Item 2:

Impulse Response



Magnitude and phase response:

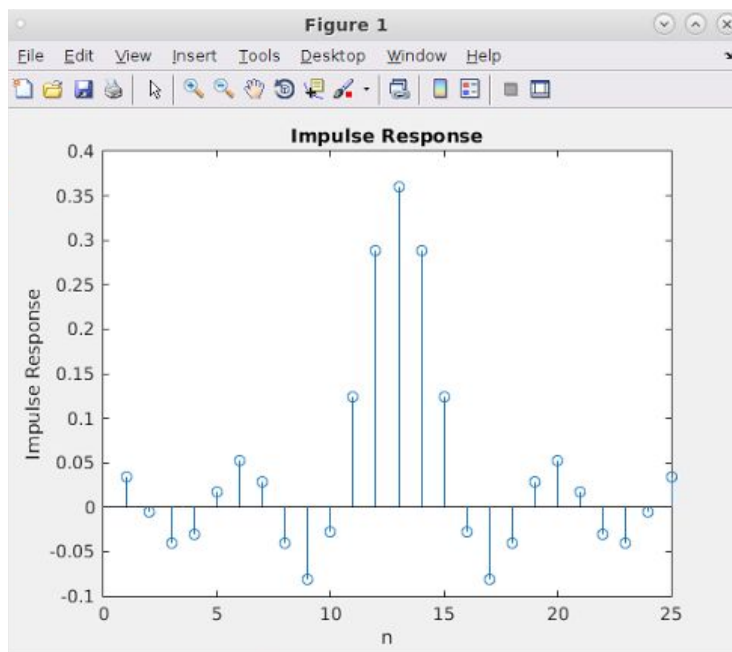


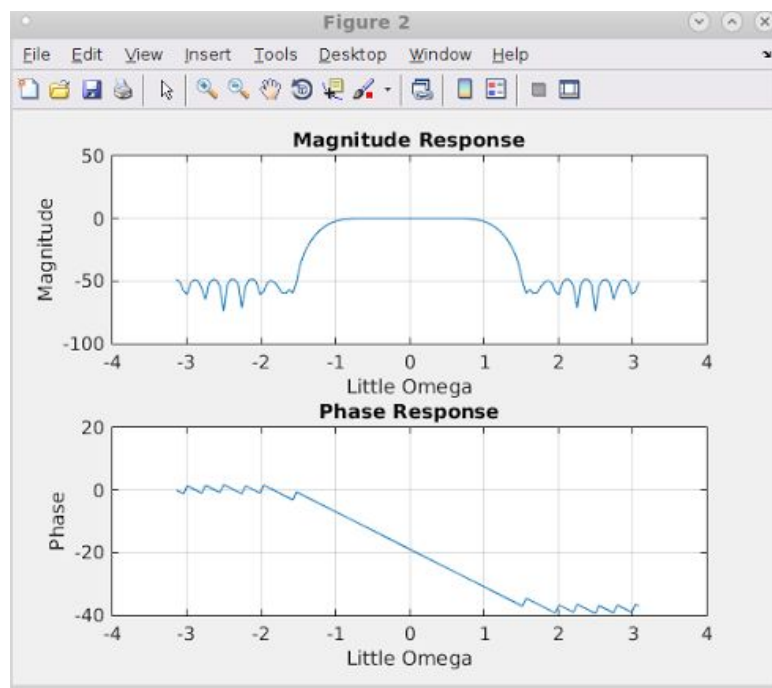
Passband ripple: 7 dB

Stopband ripple: 30 dB

Transition bandwidth: 0.2

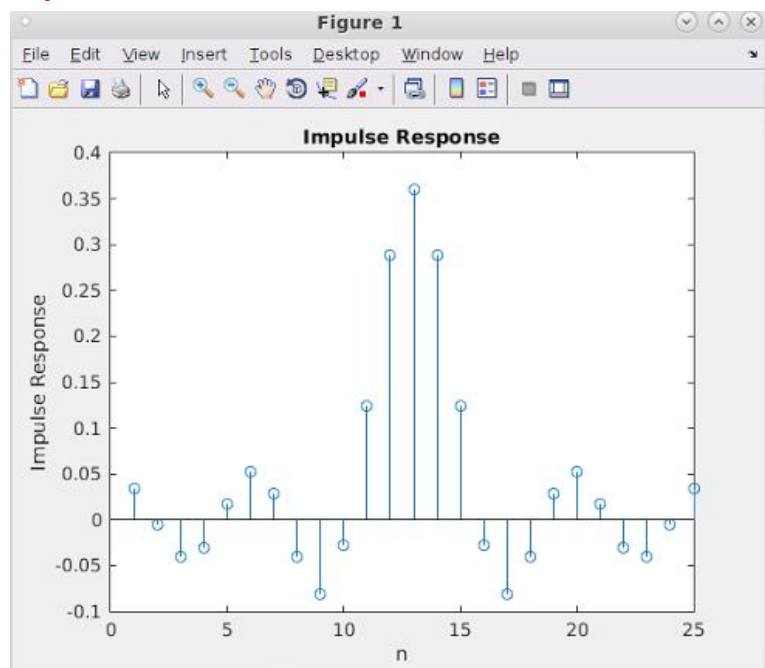
Report Item 3:

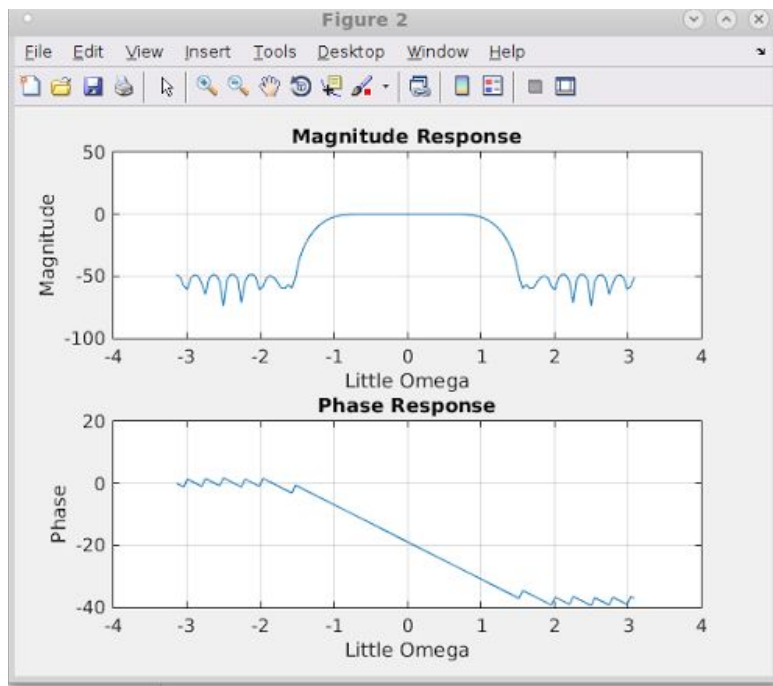




Passband Ripple: 0.3 dB
 Stopband Attenuation: -50 dB
 Passband Edge Frequency: 0.9
 Stopband Edge Frequency: 1.5

Report Item 4:

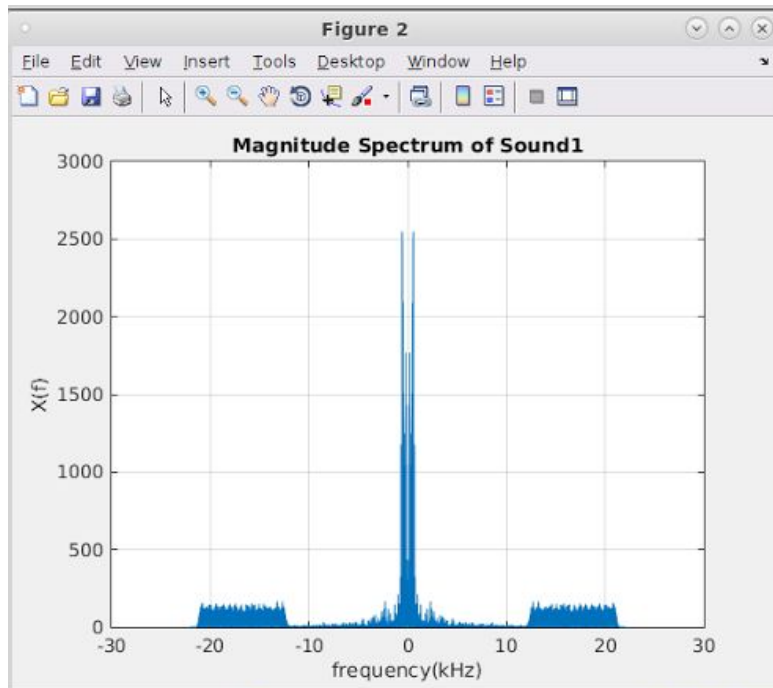




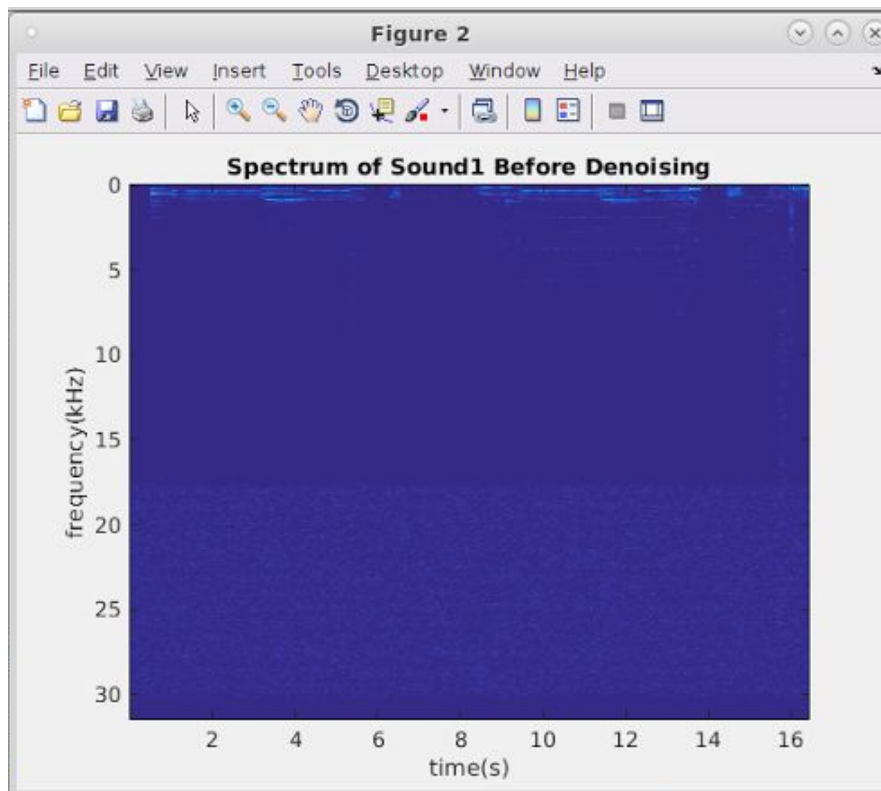
Report Item 5:

The signal in sound1 lasts 14.739229 seconds.

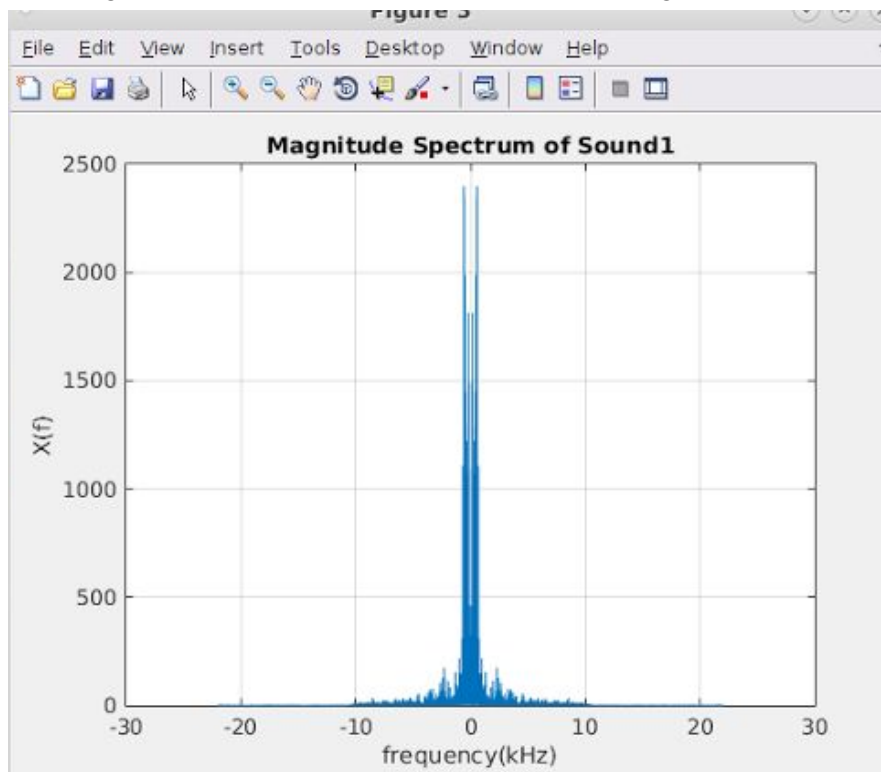
The Magnitude Spectrum of Sound1:



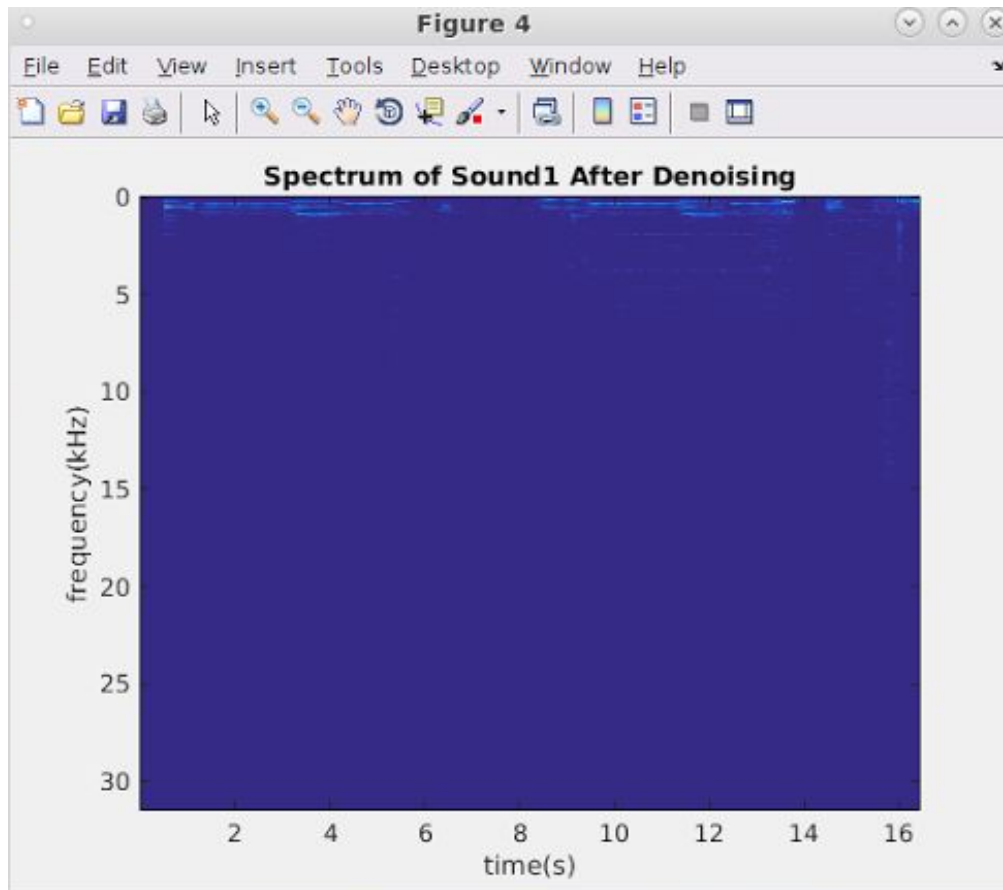
The Spectrum of Sound1:



The Magnitude Spectrum of Sound1 after denoising:



The Spectrum of Sound1 after denoising:

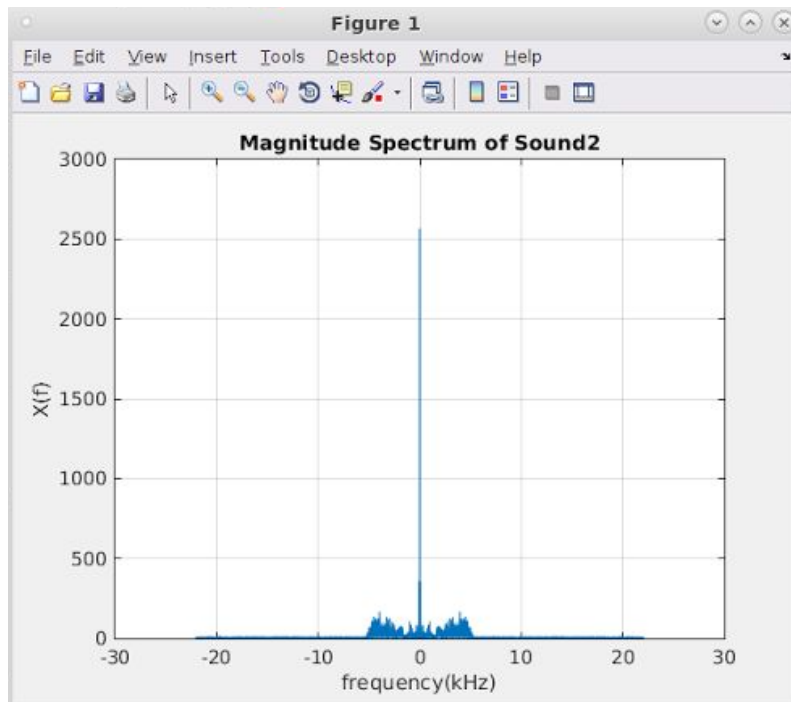


Observation:

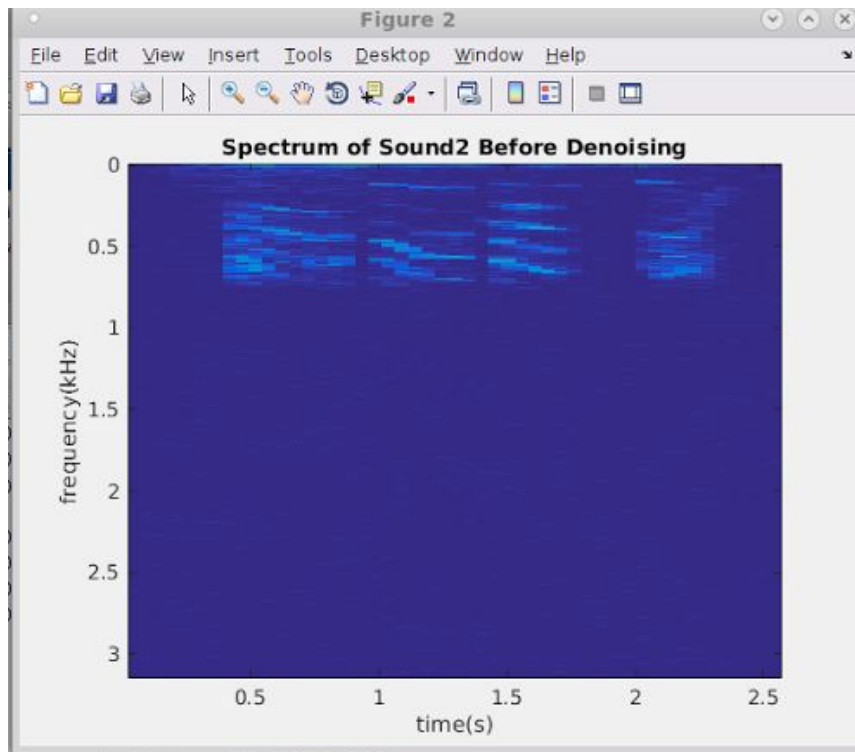
1. Duration of the sound: 14.739229 seconds
2. Listening to the sound: The sound after denoising is a very beautiful melody and much pleasant than the sound before.
3. Effectiveness of the filter: White Noise is almost gone. The sound is much more pleasant after denoising.

Report Item 6:

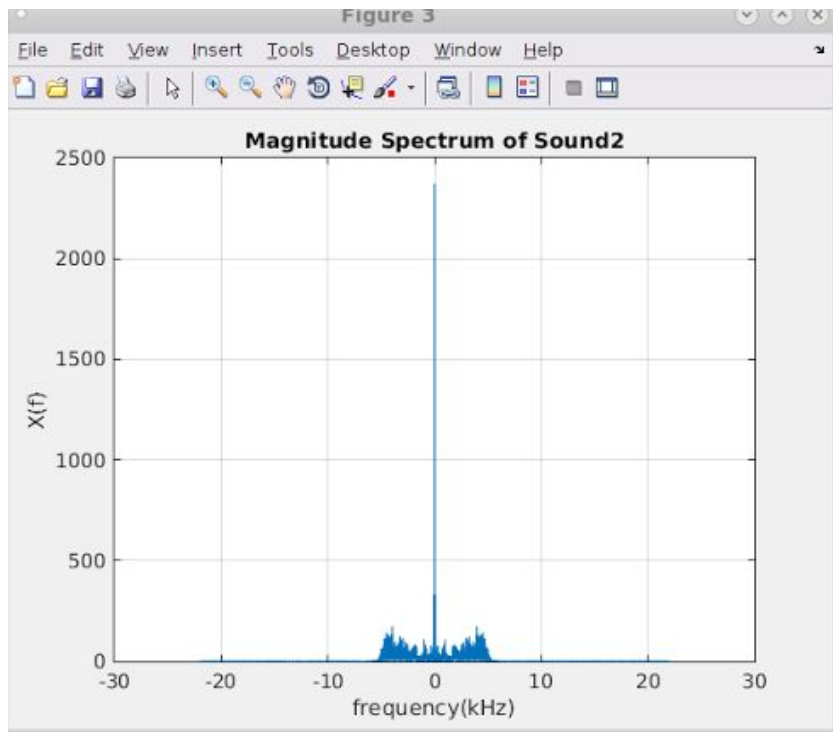
The Magnitude Spectrum of Sound2:



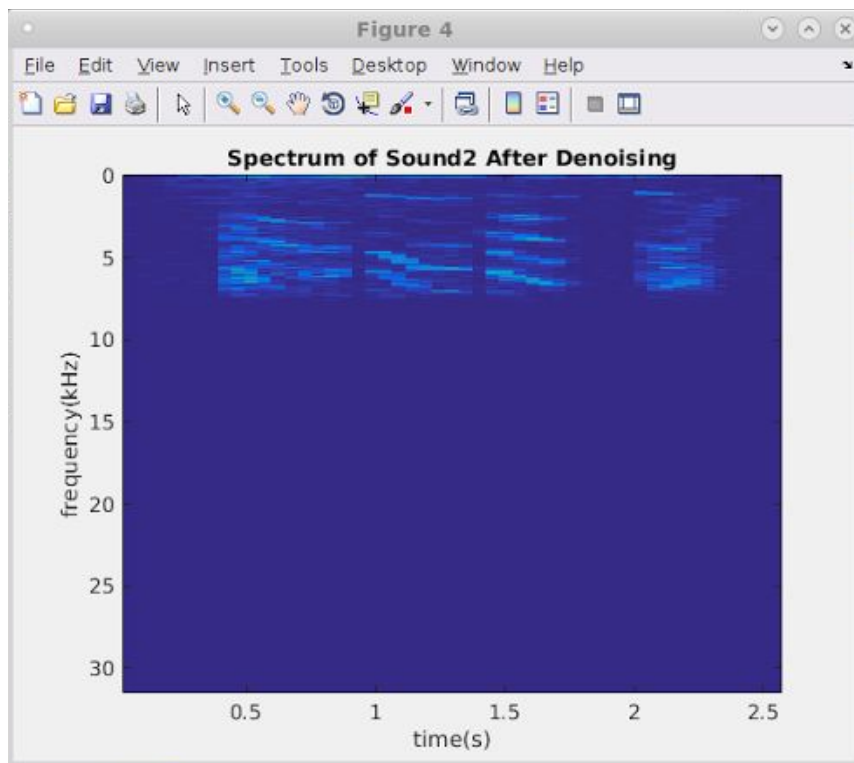
The Spectrum of Sound2:



The Magnitude Spectrum of Sound2 after denoising:



The Spectrum of Sound2 after denoising:



Observation:

1. Duration of the signal: 2.324898 second
2. Parameters chosen for spectrogram: Hamming window, noverlap = 2048, w = 4098
3. White Noise appears in the entire spectrum
4. The magnitude spectrum fails to capture the white noise because the noise is hidden behind the desired signal. Because the spectrogram can show how frequency varies at different time slot, it can capture the white noise.
5. Effectiveness of the filter: The denoising filter removes most of the noises. However, there are still some noises under 7kHz.
6. Sound: The sound after denoising has less noises, but I still could not hear clearly what the sound says.

Report Item 7:

```
(N=50)
Using FFT
Elapsed time is 0.000059 seconds.
Using matrix C
Elapsed time is 0.000045 seconds.

(N=100)
Using FFT
Elapsed time is 0.000039 seconds.
Using matrix C
Elapsed time is 0.000076 seconds.

(N=500)
Using FFT
Elapsed time is 0.000113 seconds.
Using matrix C
Elapsed time is 0.000125 seconds.

(N=1000)
Using FFT
Elapsed time is 0.000144 seconds.
Using matrix C
Elapsed time is 0.000869 seconds.

(N=10000)
Using FFT
Elapsed time is 0.001778 seconds.
Using matrix C
Elapsed time is 0.054361 seconds.

>>
```

When N is small, using FFT method to calculate y is a little bit slower than the matrix method. However, as we increase N, the FFT method become more and more efficient.

The results got by performing FFT and the results got by performing matrix C are the same for all cases above.