Report

■ HW1:

– A sinusoidal signal has a frequency of 1MHz. It is sampled with a frequency of 4MHz. Find the discrete frequency of the sampled signal.

設f=1MHz/fs=4MHz

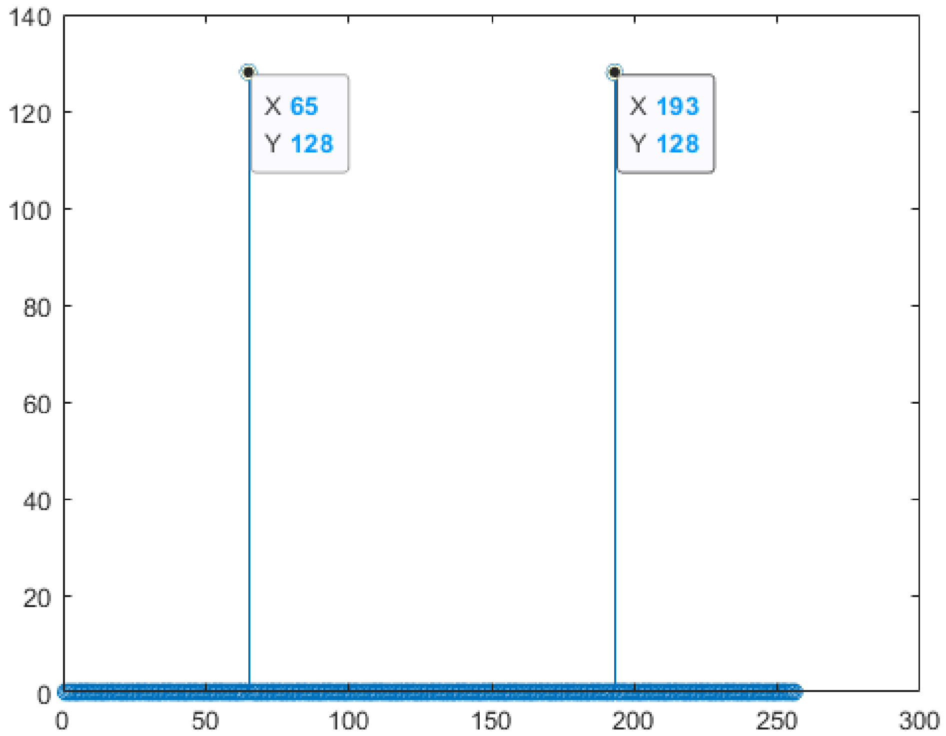
f=1MHz/fs=1.5MHz

產生 `x=cos(2*pi*f/fs*[0:256-1]);`

接著畫出頻譜做對照比較

256*1M/4M=64 /256-64=192 如下圖所示(誤差 1 是因為頻域 0 點在 1 的位置上)

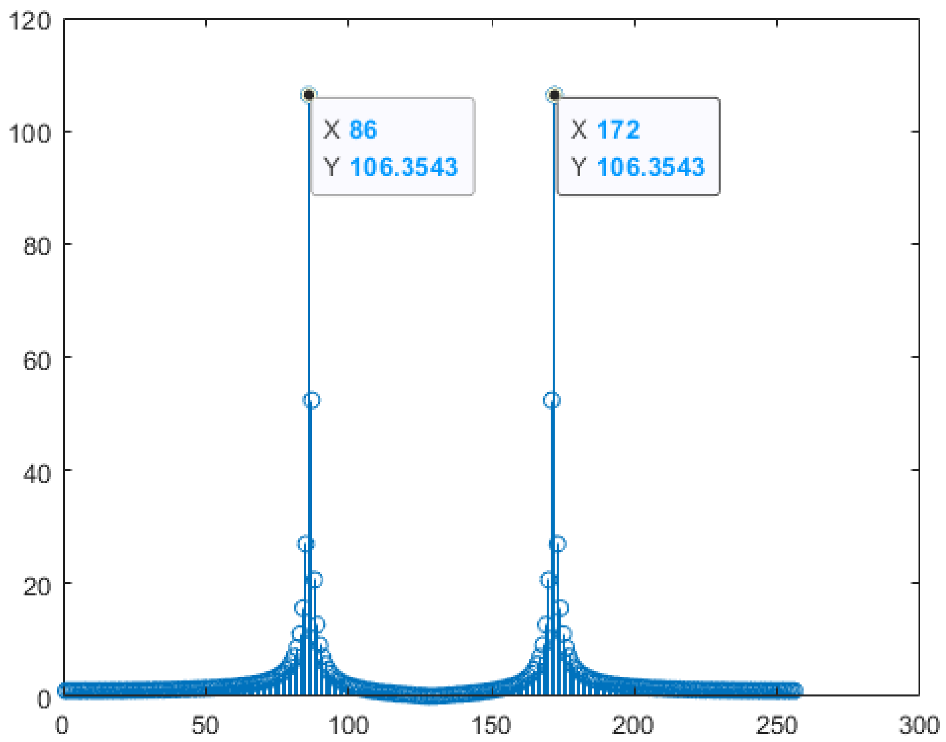
– Plot its spectrum with a DFT of size 256.



– If the signal is sampled with 1.5MHz, find the frequency of the sampled signal.

– Plot its spectrum with a DFT of size 256

下圖是取樣頻率太小造成的情況，出現了許多其他頻率的分量疊合，會影響還原訊號



HW2

– Generate a triangular signal (with length smaller than 128) and add Gaussian noise to yield an average SNR of 15dB.

用方波對自己摺積來產生三角波，利用給定的 signal power 帶入公式

來求 15dB 的 noise power

```
Noise_power=mean(y.^2)*10^(-1.5);
```

並且產生雜訊

```
v = sqrt(np)*randn(1,n*2-1);
```

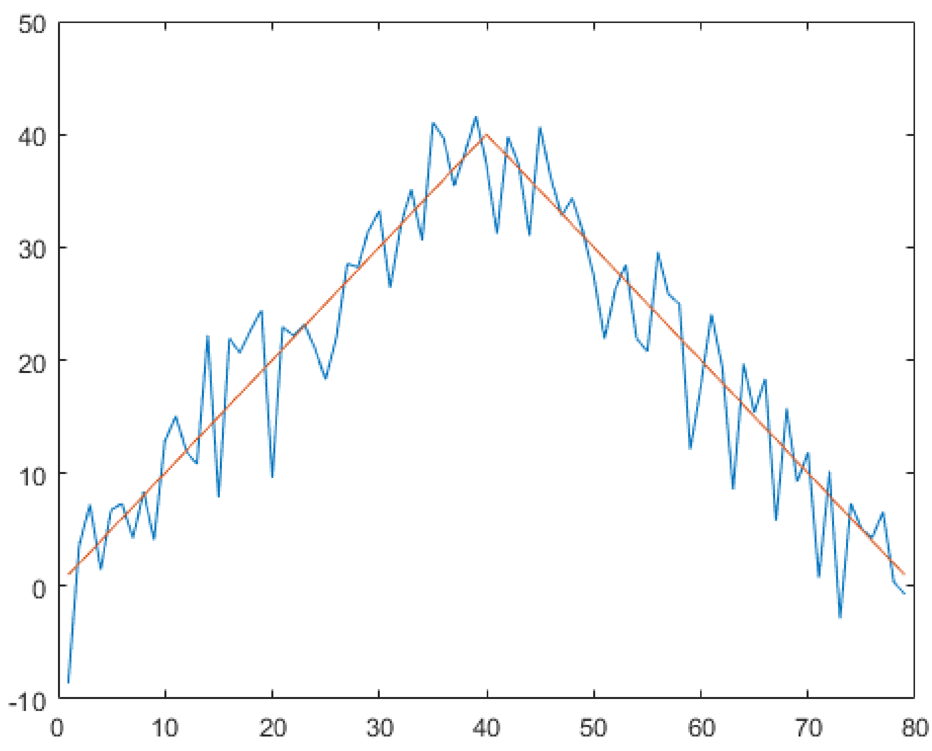
– Using the frequency windowing technique to conduct a filtering operation (conducting 128-point DFT).

```
s = 三角波 + 雜訊;
sf = fft(s);
傅立葉轉換後根據window做zero-padding
sfw = zeros(1,2*n-1);
sfw(1:w)=sf(1:w);
sfw(2*n+1-w:2*n-1)=sf(2*n+1-w:2*n-1);

還原訊號
r = ifft(sfw);
```

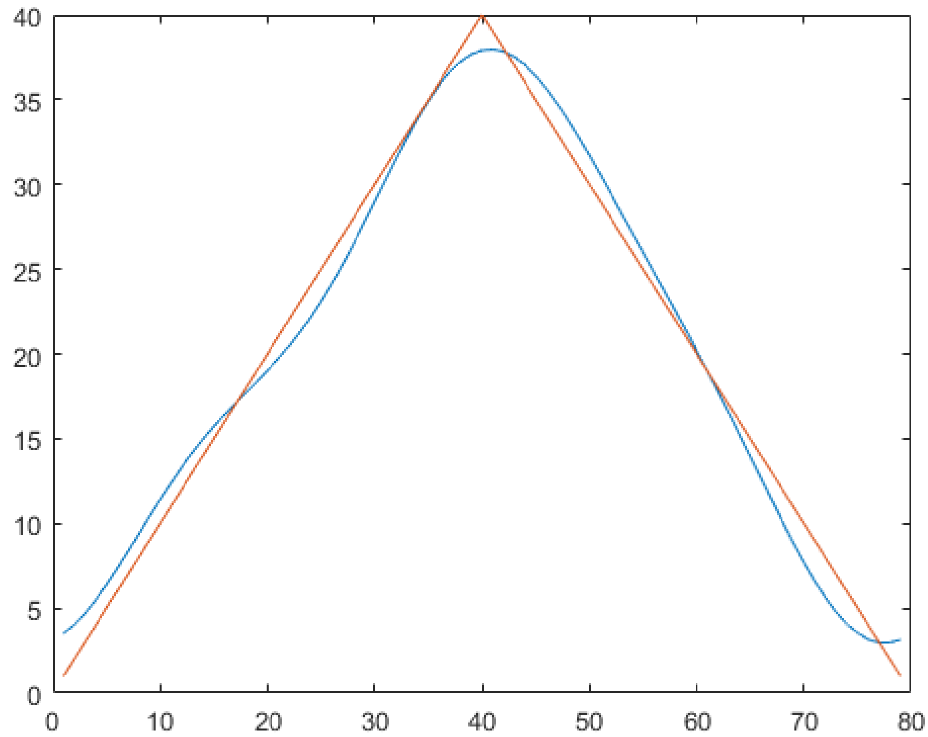
– Find an optimum windowing function such that the meansquare-error of the filtered signal is minimized.

```
Loop 不超過原訊號長度的window size
並計算MSE的結果存起來
MSE(w) = mean((r-y).^2)
最後找出最小的MSE是多少window size
[M,I]=min(MSE);
下圖是三角波和受雜訊影響後還原的訊號(window size=signal size=40)
```



下圖是三角波和受雜訊影響後還原的訊號

`(window size= optimal(by comparing MSE) = 4)`



Conclusion

可以理解到對於訊號的還原上只要能抓到主要的特徵，在有雜訊的情況下，分量少的特徵受雜訊影響的相對程度更大，所以適當的抓取 Window size 會有更好的還原效果