

HW #1 (120%) Due: 03/20

[MATLAB WARM-UP]

1. (15%) Given $x[n]=[3 \ -2 \ 6 \ 8 \ -1]$; $h[n]=[2 \ 5 \ 0 \ -5 \ 2 \ -3 \ 1]$;

Please find $y[n]=x[n]*h[n]$ by the following three methods:

- (1) Find $y[n]$ by the direct convolution of $x[n]$ and $h[n]$;
- (2) Decompose $x[n]$ into impulses with different delays, then produce $y[n]$ by doing the linear combination of the impulse-wise convolution with $h[n]$.
- (3) Do the vector-wise convolution $\mathbf{y}=\mathbf{H}\mathbf{x}$, where \mathbf{x} , \mathbf{y} represent the input, output vector respectively, where \mathbf{H} represents the matrix formed by components of $h[n]$.

(Plot $y[n]$ and compare whether the results in these methods are the same.)

(Hint: MATLAB commands: plot、conv、在執行vector加法時，各vector的長度需相等，若有長度不等之處，請直接補零至相同長度)

2. (15%) As defined in Q1, $x[n]$ is now the system input and $h[n]$ represents the impulse response of the system. Therefore, $y[n]=x[n]*h[n]$ is the system output.

- (1) Plot the 64-point magnitude response of $y[n]$ (Hint: fft).
- (2) Also plot the 64-point magnitude response of $x[n]$ and $h[n]$.
- (3) Please verify the relation of those magnitude responses (of $y[n]$, $x[n]$ and $h[n]$) in frequency domain.

(Hint: MATLAB commands: (.*)表示矩陣(向量)元素相乘、fft(x , numbers of point)、在執行元素乘法時，各vector的長度需相等)

[TEXTBOOK PROBLEMS]

3. (20%) 2.30
4. (10%) 2.41
5. (10%) 2.42 (a), (b)
6. (20%) 2.44 (a), (b), (d), (e)
7. (20%) 2.56
8. (10%) 2.66 (a), (b) (Ref. MATLAB command: filtfilt)