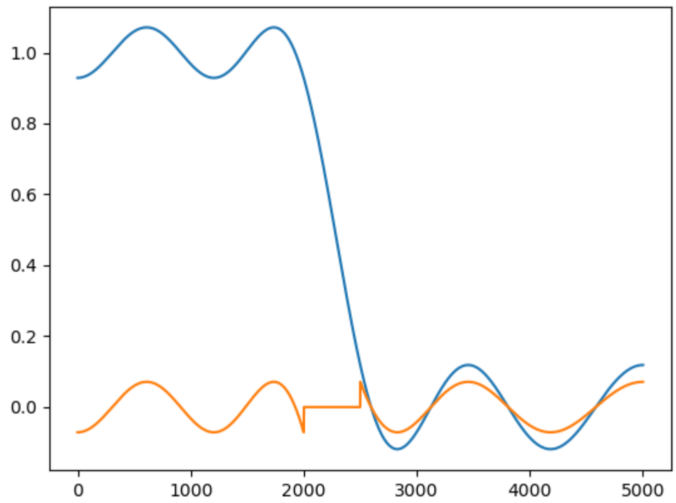
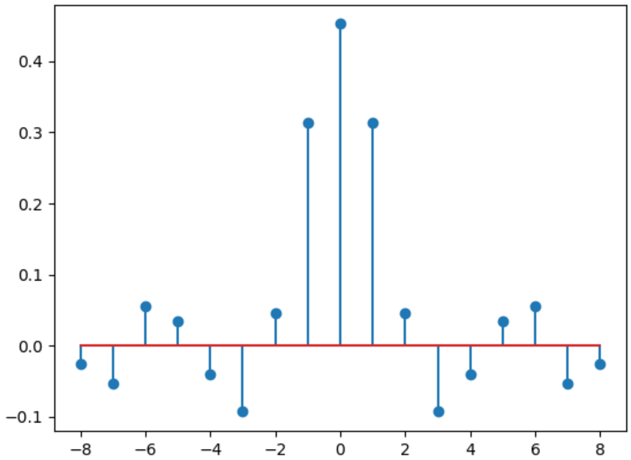
ADSP HW1 P10942A05 鄭閔軒

1.



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iter 1 times error 0.2160911472952194
iter 2 times error 0.14844152355516937
iter 3 times error 0.22000301878843057
iter 4 times error 0.10850288977885426
iter 5 times error 0.07591523695551773
iter 6 times error 0.07125815635500315
iter 7 times error 0.07120728523467923
```

2、 convolution

(a) $y(t) = x(t) * h(t) \overset{F.T.}{\Rightarrow} Y(f)H(f)$

$Y(f)H(f)$ 取 log　$\log(Y(f)) + \log(H(f))$

(b) DFT disadvantage

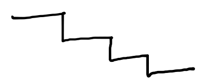
1、訊號需具週期性

2、取樣頻率需為訊號本身最高頻率的兩倍或以上 (Nyquist Sampling theorem)

3、IIR $y[n] = x[n] * (0.8^n u[n] - 0.6^n u[n])$　$u[n]$ is unit step fuction

$$h[n] = (0.8^n u[n] - 0.6^n u[n])$$

$$= (0.8^n - 0.6^n)\, u[n]$$



$$H(z) = \sum_{n=0}^{\infty} 0.8^n - 0.6^n z^{-n}$$

$$= \sum_{n=0}^{\infty} 0.8^n z^{-n} - \sum_{n=0}^{\infty} 0.6^n z^{-n}$$

$$= \frac{1}{1-0.8z^{-1}} - \frac{1}{1-0.6z^{-1}}$$

$$Y(z) = X(z)H(z)$$

$$= X(z)\left(\frac{1}{1-0.8z^{-1}} - \frac{1}{1-0.6z^{-1}}\right)$$

$$(1-0.8z^{-1})(1-0.6z^{-1})Y(z) = (1-0.6z^{-1})X(z) - (1-0.8z^{-1})X(z)$$

$$Y(z) = 0.2z^{-1}X(z) + 1.4z^{-1}Y(z) - 0.48z^{-2}Y(z)$$

$$\underline{y[n] = 0.2x[n-1] + 1.4y(n-1) - 0.48y(n-2)}$$

#

4.

(a) step invariance

aliasing effect 發生於高頻

利用 step invariance 先做積分然後取樣之後做差分

使得高頻能量下降可有效減少 aliasing effect

但無法完全避免

(b) Bilinear Transform 可完全解決 $f_s < 2B$ 時的 aliasing effect，利用將類比的濾波器 mapping 於數位濾波

$f_{analog} \in (-\infty, \infty)$

器之上，其頻率範圍從 $f_{digital} \in (-\frac{f_s}{2}, \frac{f_s}{2})$

且 $B \leq \frac{f_s}{2}$

5、

$x[n] = y(0.002n)$ length $(x[n]) = 2000$

$X[n]$ is FFT of $x[n]$

$f_s = \frac{1}{\Delta t} = \frac{1}{0.002} = 500$ Hz and $N = 2000$

又 $f = m\frac{f_s}{N}$

(a) $f = 300\frac{500}{2000} = 75$ Hz

(b) $f = [1800 - (500 \times 3)]\frac{500}{2000} = 75$ Hz

6.

Design 25-point lowpass filter $F < 0.25$ passband

Has the least error in passband $W(F)$ weight Function

To get best performance in passband we select slow change item (b) and (c)

Next we select (c) for its proper weighted

Higher weighted in passband to get better performance

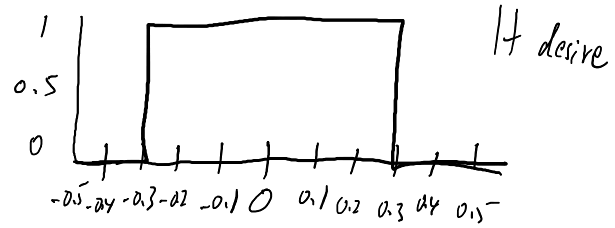
answer is (c)

7. MSE method design 5-point FIR filter

Approximates low pass filter of $H_d(F)=1$ for $|F|<0.3$

and $H_d(F)=0$ for $0.3<|F|<0.5$

desire output



$$R(F)=\sum_{n=0}^{k} s[n]\cos(2\pi nF)$$

$$s[0]=\int_{-\frac{1}{2}}^{\frac{1}{2}} H_d(F)\,dF = 0.6$$

$$s[n]=2\int_{-\frac{1}{2}}^{\frac{1}{2}} \cos(2\pi nF)\,H_d(F)\,dF$$

$$=2\int_{-0.3}^{0.3}\cos(2\pi nF)\cdot 1\,dF+\cancel{2\int_{0.3}^{0.5}\cos(10\pi F)\cdot 0+2\int_{-0.5}^{-0.3}\cos(10\pi F)0}$$

$$=2\cdot\frac{1}{2\pi n}\sin(2\pi nF)\Big|_{-0.3}^{0.3}$$

$$=\frac{1}{\pi n}\left(\sin(0.6\pi n)-\sin(-0.6\pi n)\right)$$

$$h[k]=s[0]$$

$$h[k+n]=\frac{s[n]}{2}\qquad h[k-n]=\frac{s[n]}{2}$$

for $n=1,2,3\ldots k$

$h[n]=0$ for $n<0$ and $n\geq N$

學號 0,5

Fourier Transform two advantages.

(1) Spectrum Analysis

(2) For L.T.I. systems, $y(t) = x(t) * h(t)$

$$\overset{F.T.}{\Rightarrow} Y(f) = X(f)H(f)$$

可將 convolution 變為乘法運算