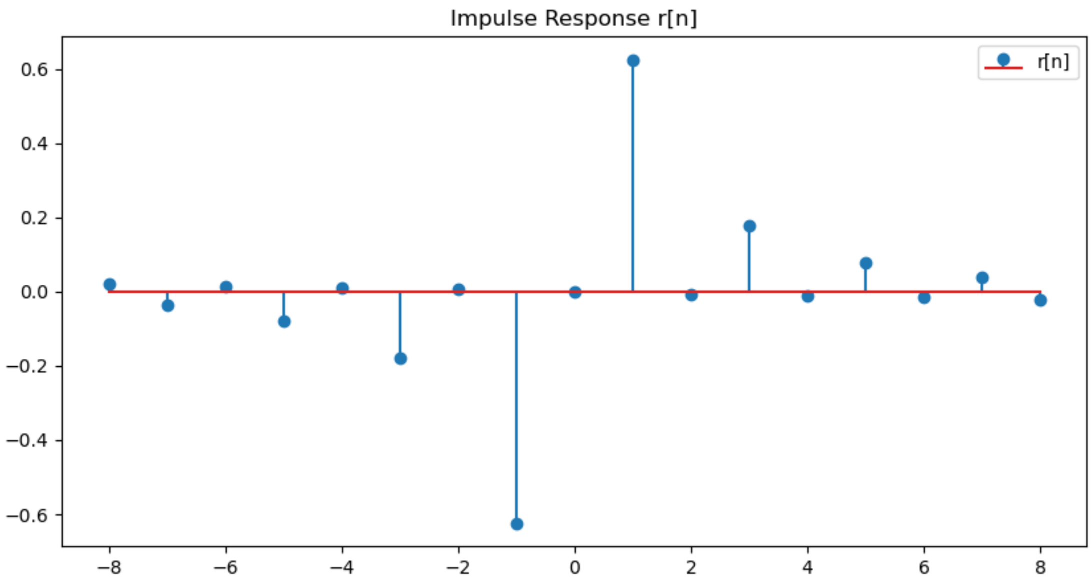
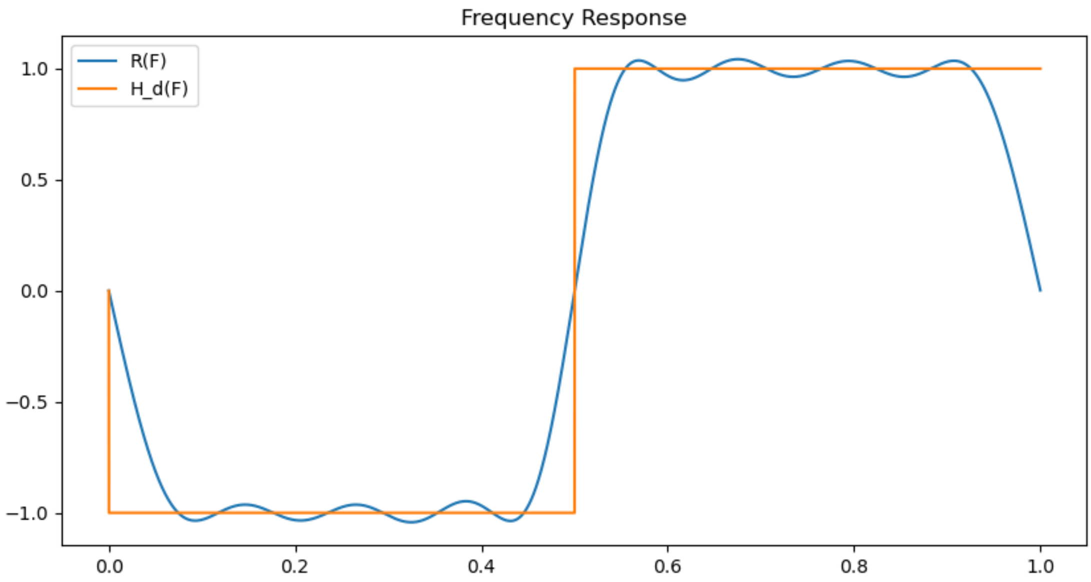
ADSP HW2 r12631055 林東甫

(1)

(i) the impulse response when k = 8



(ii) the frequency response when k = 8



2-3-Ex

2. $N \approx \dfrac{\frac{1}{\Delta t}}{2\pi\Delta f} \times A$ where $A = -20\log_{10}\sqrt{0.01\times0.01}$

$\Delta f = 6000-5000 = 1000$, $\Delta t = 0.00005$, $\dfrac{\frac{1}{0.00005}}{2\pi\cdot1000} \times 40 \doteqdot 127.32\ldots$

$\doteqdot \underline{128}$ #

3. 運算量太大，DFT的複雜度 $O(N\log N)$，理論上可做且方便，實務上幾十、百、千萬的DFT的計算量太大。

Ex (學號末碼為5)

when $f = -10{,}000$, $f_s = 40{,}000$, $N = 10$

代入 $f = m\dfrac{f_s}{N} - f_s$, $-10000 = m\dfrac{40{,}000}{10} - 40{,}000$

$m = \dfrac{30}{4} = \underline{7.5}$ #

4-5

4. ~ (nth term) and the (n+1)th term

$-2\sin(2\pi(n-\frac{1}{2})F)+\sin(2\pi(n+\frac{1}{2}F)$ ↙

$-\sin(\alpha-\beta)+\sin(\alpha+\beta) = 2\sin\beta\cos\alpha$

since $\beta=\pi F$, $\alpha=2\pi nF$

$= 2\sin(\pi F)\cos(2\pi nF)$

$R(F)= \sin(\pi F)\sum_{n=0}^{k_1} s_1[n]\cos(2\pi nF)$

$\therefore$

$= \frac{1}{2}\sum_{n=0}^{k_1} s_1[n]\sin(2\pi(n+\frac{1}{2})F) - \frac{1}{2}\sum_{n=0}^{k_1} s_1[n]\sin(2\pi(n-\frac{1}{2})F)$

$= \frac{1}{2}\sum_{n=0}^{k_1} s_1[n-1]\sin(2\pi(n-\frac{1}{2}F) - \frac{1}{2}\sum_{n=0}^{k_1} s_1[n]\sin(2\pi(n-\frac{1}{2})F)$

$= \frac{1}{2}s_1[k_1]\sin(2\pi(k_1+\frac{1}{2})F) + \frac{1}{2}\sum_{n=1}^{k_1} \cancel{s_1[n-1]\sin(2\pi(n-\frac{1}{2}}\, s_1[n-1]\sin(2\pi(n-\frac{1}{2})F)$

$- \frac{1}{2}s_1[0]\sin(-\pi F) - \frac{1}{2}\sum_{n=1}^{k_1} s_1[n]\sin(2\pi(n-\frac{1}{2})F)$

$= \frac{1}{2}s_1[0]\sin(\pi F) + \sum_{n=1}^{k_1}\frac{1}{2}(s_1[n-1]-s_1[n])\sin(2\pi(n-\frac{1}{2})F) + \frac{1}{2}s_1[k_1]\sin(2\pi(k_1+\frac{1}{2})F)$

Let $k_1+\frac{1}{2}=k$

$R(F) = (s_1[0]-\frac{1}{2}s_1[1])\sin(\pi F) + \sum_{n=2}^{k-\frac{1}{2}}\frac{1}{2}(s_1[n-1]-s_1[n])\sin(2\pi(n-\frac{1}{2}F)$

$+\frac{1}{2}s_1[k-\frac{1}{2}]\sin(2\pi kF)$

$err(F) = [Hd(F)-RF)wF$

$= [Hd(F) - \sin(\pi F)\sum_{n=0}^{k-\frac{1}{2}} s[n]\cos(2\pi nF)]w(F)$

$= [\csc(\pi F)Hd(F) - \sum_{n=0}^{k-\frac{1}{2}} s[n]\cos(2\pi nF)\sin(\pi F)w(F)$

5. (a) $x[n]=1+\sin(n)$

Hilbert transform $\hat{x}[n]=\cos(n)$

(b) $x_a[n] = (1+\sin(n)) - j\cdot\cos(n)$

$s[1] = s_1[0]-\frac{1}{2}s_1[1]$

$s[n] = \frac{1}{2}(s_1[n-1]-s_1[n])$

for $2\le n\le k-\frac{1}{2}$

$s[k+\frac{1}{2}] = \frac{1}{2}s_1[k-\frac{1}{2}]$

$k \longrightarrow k-\frac{1}{2} = \frac{N}{2}-1$

$Hd(F) \rightarrow \csc(\pi F)Hd(F)$

$W(F) \rightarrow \sin(\pi F)w(F)$

6-7-8

6. (a). (ii), (iii), (iv)

(b). (v), (vi), (vii)

7. (a) ① try to make the energy concentrating on the region near to $n=0$.

② try to make both the forward and inverse transforms stable.

~~(b) ① H(z) may be unstable~~

~~② H(z) is usually a dynamic response (very)~~

~~8. (a)~~ $\cancel{H(z) = \dfrac{1+z^{-1}-1.5z^{-2}+z^{-3}}{1-0.3z^{-1}-0.4z^{-2}} = \dfrac{}{(1+0.1z^{-1})(1-0.4z^{-1})}}$

7 (b) ① α, N_p are unnecessary to known.

② 可以用 cepstrum 將 multipath 的影響去除

8. (a)

$$H(z) = \frac{1+z^{-1}-1.5z^{-2}+z^{-3}}{1-0.3z^{-1}-0.4z^{-2}} = \frac{(1+2z^{-1})(1-(\frac{1}{2}+\frac{i}{2})z^{-1})(1-(\frac{1}{2}-\frac{i}{2})z^{-1})}{(1-0.4z^{-1})(1-0.1z^{-1})}$$

$(1+2z^{-1})$ $\cancel{(\ldots)(1+\tfrac{1}{2}z)}$

$= 2z^{-1}(1-(\frac{-1}{2}z))$

$$\hat{x}[n] = \begin{cases} \log(2), & n=0 \\ -\dfrac{(\frac{1}{2}+\frac{i}{2})^n}{n} + \dfrac{-(\frac{1}{2}-\frac{i}{2})^n}{n} + \dfrac{(0.1)^n}{n} + \dfrac{(0.4)^n}{n}, & n>0 \\ \dfrac{(\frac{-1}{2})^n}{n}, & n<0 \end{cases}$$

(b)

$$H(z) = \frac{(1+2z^{-1})(1-z^{-1}+0.5z^{-2})}{(1-0.4z^{-1})(1-0.1z^{-1})} = \frac{2z^{-1}(1+0.5z)(1-z^{-1}+0.5z^{-2})}{(1-0.4z^{-1})(1-0.1z^{-1})}$$

An. All-Pass Filter $H_{ap}(z) = \dfrac{1-z^{-1}+0.5z^{-2}}{z^{-2}-z^{-1}+0.5}$, $H(z) = H_{ap}(z) \cdot H_{mp}(z)$

$$H_{mp}(z) = \frac{(1+2z^{-1})(z^{-2}-z^{-1}+0.5)}{1-0.3z^{-1}-0.4z^{-2}}$$