ADSP HW2 溫皆循 R10945006

2)

a) Stable and causal.

b) 當 signal 和 noise 有 overlap 時，白能降低 noise

c) i. 可藉由倒頻譜濾除雜訊，減少其他路徑的干擾，不需測量延遲時間

ii. Equalizer 會有發散問題導致不穩定

3)

a)

$$\to H(z)=\frac{(z+2)(2z^2+1)}{\left(z-\frac{-1+\sqrt{7}i}{4}\right)\left(z-\frac{-1-\sqrt{7}i}{4}\right)}=\frac{(z+2)\left(z-\frac{\sqrt{2}}{2}i\right)\left(z+\frac{\sqrt{2}}{2}i\right)}{\left(z-\frac{-1+\sqrt{7}i}{4}\right)\left(z-\frac{-1-\sqrt{7}i}{4}\right)}$$

$$=\frac{2z^2(1+0.5z)\left(1+\frac{\sqrt{2}}{2}iz^{-1}\right)\left(1-\frac{\sqrt{2}}{2}iz^{-1}\right)}{z^2\left(1-\frac{-1+\sqrt{7}i}{4}z^{-1}\right)\left(1-\frac{-1-\sqrt{7}i}{4}z^{-1}\right)}$$

$\Rightarrow \hat{h}[n]=$

$$\begin{cases}\log(2), & n=0\\ -\frac{1}{n}\left(\frac{\sqrt{2}}{2}i\right)^n-\frac{1}{n}\left(-\frac{\sqrt{2}}{2}i\right)^n+\frac{1}{n}\left(\frac{-1+\sqrt{7}i}{4}\right)^n+\frac{1}{n}\left(\frac{-1-\sqrt{7}i}{4}\right)^n, & n\ge 1\\ \frac{(-0.5)^n}{n}, & n\le -1\end{cases}$$

b)

$n<0$ 的部分為 0（單位圓內）

$$H(z)=-2\times\frac{\left(z+\frac{1}{2}\right)(2z^2+1)}{2z^2+z+1}$$

4)

a) even: i, ii, vi

b) odd: iii, v,

5)

$$\to p[n]=\alpha_1\delta[n]+\alpha_2\delta[n-30]+\alpha_3\delta[n-40]+\alpha_4\delta[n-50]$$

$$\to P(z)=\alpha_1+\alpha_2z^{-30}+\alpha_3z^{-40}+\alpha_4z^{-50}$$

$$=\alpha_1\left(1+\frac{\alpha_2}{\alpha_1}z^{-30}+\frac{\alpha_3}{\alpha_1}z^{-40}+\frac{\alpha_4}{\alpha_1}z^{-50}\right)$$

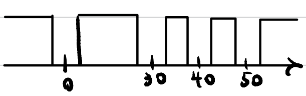
$$\to \hat{P}(z)=\log\alpha_1+\log\left(1+\frac{\alpha_2}{\alpha_1}z^{-30}+\frac{\alpha_3}{\alpha_1}z^{-40}+\frac{\alpha_4}{\alpha_1}z^{-50}\right)$$

$$=\log\alpha_1+\sum_{k=1}^{\infty}(-1)^{k-1}\left(\frac{\alpha_2}{\alpha_1}z^{-30}+\frac{\alpha_3}{\alpha_1}z^{-40}+\frac{\alpha_4}{\alpha_1}z^{-50}\right)^k$$

$\to \hat{p}[n]=$

$$\log\alpha_1\delta[n]+\sum_{k=1}^{\infty}\frac{(-1)^{k-1}}{k}\left(\left(\frac{\alpha_2}{\alpha_1}\right)^k\delta[n-30]+\left(\frac{\alpha_3}{\alpha_1}\right)^k\delta[n-40]+\left(\frac{\alpha_4}{\alpha_1}\right)^k\delta[n-50]\right)$$

$\to$ lifter $(l(n))$: $l(n)=0,\ n=kN_p$



6)

i. 計算量較少

ii. $B_m[k]$ 為等比級數，接近人耳的區別性

iii. $\Sigma|X[k]|^2B_m[k]$ 較小，無 phase ambiguity

7)

點數增加，計算量大

8)

$$\begin{cases}\text{i, } \cos(200\pi t): 100\,Hz\\ \text{ii, } \sin(600\pi t): 300\,Hz\\ \text{iii, } \cos(1800\pi t): 900\,Hz\end{cases}$$

a)

人耳對於 3000Hz 的聲音最敏感，向兩側遞減，因 $\cos(1800\pi t)$ 的頻率最接近 3000Hz，故聲音最大

b)

頻率越低，波長越長，故繞射能力較強，因 $\cos(200\pi t)$ 的頻率最低，故能傳得更遠.

Extra：學號尾數 0, 6

DTFT is a special case of z-transform, where

$$\begin{cases} z=e^{j2\pi f\Delta t}\\ |z|=1\end{cases}$$

$$Z(g[n])=G(z)=\sum_{n=-\infty}^{\infty}g[n]z^{-n}$$

$$DTFT(g[n])=G(f)=\sum_{n=-\infty}^{\infty}g[n]e^{-j2\pi fn\Delta t}$$