

# DSP\_HW7

msh

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## Exercise 1

已知两个最小相位系统的幅频响应分别如下式所示，试求出它们的转移函数。

(1)

$$|H_1(\omega)|^2 = \frac{\frac{13}{9} - \frac{4}{3} \cos \omega}{\frac{10}{9} - \frac{2}{3} \cos \omega} \quad (1)$$

(2)

$$|H_2(\omega)|^2 = \frac{4(1 - \alpha^2)}{(1 + \alpha^2) - 2\alpha \cos \omega}, |\alpha| < 1 \quad (2)$$

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$$\begin{aligned} \text{hw7.1 (1)} \quad |H(\omega)|^2 &= \frac{\frac{13}{9} - \frac{4}{3} \cos \omega}{\frac{10}{9} - \frac{2}{3} \cos \omega} = \frac{\frac{13}{9} - \frac{2}{3} (e^{j\omega} + e^{-j\omega})}{\frac{10}{9} - \frac{1}{3} (e^{j\omega} + e^{-j\omega})} \\ \therefore |H(z)|^2 &= \frac{\frac{13}{9} - \frac{2}{3} (z^{-1} + z)}{\frac{10}{9} - \frac{1}{3} (z^{-1} + z)} = \frac{(1 - \frac{2}{3} z^{-1})(1 - \frac{2}{3} z)}{(1 - \frac{1}{3} z^{-1})(1 - \frac{1}{3} z)} = |H(z)| \cdot |H(z^{-1})| \end{aligned}$$

由于  $H(z)$  零极点均在单位圆内。

$$\therefore H(z) = \frac{1 - \frac{2}{3} z^{-1}}{1 - \frac{1}{3} z^{-1}}$$

$$(2) \quad |H(\omega)|^2 = \frac{4(1 - \alpha^2)}{(1 + \alpha^2) - \alpha(e^{j\omega} + e^{-j\omega})}, |\alpha| < 1, \quad \therefore |H(z)|^2 = \frac{4(1 - \alpha^2)}{(1 - \alpha z^{-1})(1 - \alpha z)}$$

$$\text{由于 } H(z) \text{ 零极点均在单位圆内且 } |\alpha| < 1, \quad \therefore H(z) = \frac{2(1 - \alpha^2)}{1 - \alpha z^{-1}}$$

## Exercise 2

令

$$H_1(z) = 1 - 0.6z^{-1} - 1.44z^{-2} + 0.864z^{-3}$$

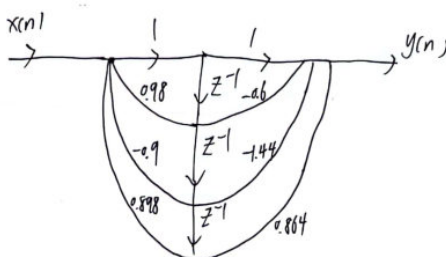
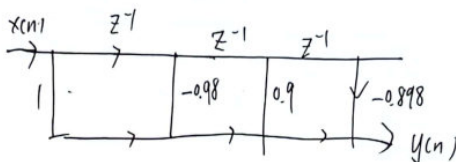
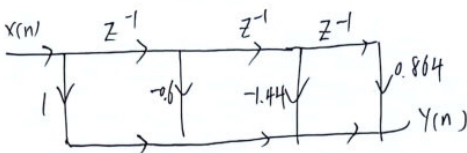
$$H_2(z) = 1 - 0.98z^{-1} + 0.9z^{-2} - 0.898z^{-3}$$

$$H_3(z) = H_1(z)/H_2(z)$$

(1) 分别画出  $H_1(z)$ ,  $H_2(z)$ ,  $H_3(z)$  直接实现的信号流图

(2) 分别将  $H_1(z)$ ,  $H_2(z)$ ,  $H_3(z)$  转换成对应的 Lattice 结构, 计算滤波器系数并画出 Lattice 结构的信号流图

HW 7.2 c1)



$$(Z) H_1(z) = 1 - 0.6z^{-1} - 1.44z^{-2} + 0.864z^{-3}$$

$$b_3^{(1)} = -0.6, b_3^{(2)} = -1.44, b_3^{(3)} = 0.864, k_1 = -b_3^{(1)} = 0.864$$

$$b_2^{(1)} = (b_3^{(1)} + k_1 b_3^{(2)}) / (1 - k_1^2) = 2.5410$$

$$b_2^{(2)} = (b_3^{(2)} + k_1 b_3^{(3)}) / (1 - k_1^2) = -3.6354$$

$$k_2 = -b_2^{(2)} = 3.6354$$

$$b_1^{(1)} = (b_2^{(2)} + k_2 b_2^{(3)}) / (1 - k_2^2) = -0.9642$$

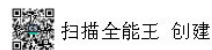
$$k_1 = -b_1^{(1)} = 0.9642$$

$\therefore H_1(z)$  Lattice 结构为  $k_1 = 0.9642, k_2 = 3.6354, k_3 = -0.8640$ .

$$(Z) H_2(z) = 1 - 0.98z^{-1} + 0.9z^{-2} - 0.898z^{-3}$$

$$b_3^{(1)} = -0.98, b_3^{(2)} = 0.9, b_3^{(3)} = -0.898, k_1 = -b_3^{(1)} = 0.898$$

$$b_2^{(1)} = (b_3^{(1)} + k_1 b_3^{(2)}) / (1 - k_1^2) = 0.0071$$



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1.1 W7.2 (2) ③ 续上.

$$b_2^{(1)} = (b_1^{(1)} + k_1 b_1^{(1)}) / (1 - k_3^2) = 0.1031$$

$$k_2 = -b_2^{(1)} = -0.1031$$

$$b_1^{(1)} = (b_2^{(1)} + k_2 b_2^{(1)}) / (1 - k_2^2) = -0.8045$$

$$k_1 = -b_1^{(1)} = 0.8045$$

$$\therefore k_1 = 0.8045, k_2 = -0.1031, k_3 = 0.898$$

$$\textcircled{3} H_3(z) = H_1(z) / H_2(z)$$

$$k_1 = 0.8045, k_2 = -0.1031, k_3 = 0.898$$

$$a_2^{(1)} = -0.8814, a_2^{(2)} = 0.1031, a_1^{(1)} = -0.898$$

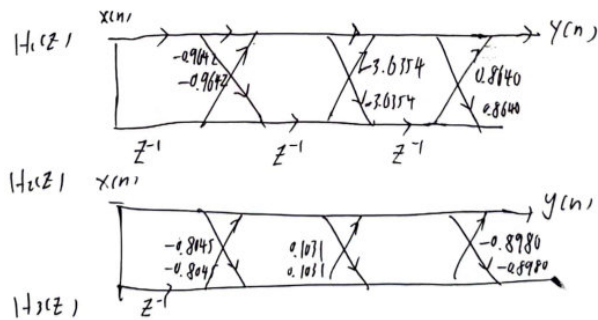
$$a_3^{(1)} = -0.98, a_3^{(2)} = 0.9, a_3^{(3)} = -0.898$$

$$c_3 = b_3 = 0.864$$

$$c_2 = b_2 - c_3 a_3^{(1)} = -0.5933$$

$$c_1 = b_1 - c_2 a_2^{(1)} - c_3 a_3^{(2)} = -1.9041$$

$$c_0 = b_0 - c_1 a_1^{(1)} - c_2 a_2^{(2)} - c_3 a_3^{(3)} = 0.3053$$



解.



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