HW1 442

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② $h(n) = (0.9)^{|n|}$

$$H(e^{jw}) = \sum_{n=-\infty}^{\infty} h[n] e^{-jwn} = \sum_{n=0}^{\infty} (0.9)^n e^{-jwn} + \sum_{-\infty}^{0} (0.9)^{-n} e^{-jwn} \quad \left[\text{geometric sum}\right]$$

See phase and mag plot

$$H(e^{jw}) = \frac{1}{1-0.9e^{-jw}} + \frac{0.9e^{jw}}{1-0.9e^{jw}}$$

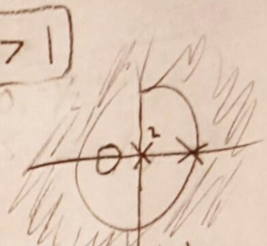
③ $x(n) = 2\delta(n-2) + 3u(n-3) \rightarrow X(n) = 2z^{-2} + \frac{3z^{-3}}{1-z^{-1}} = \frac{2z^{-2}(1-z^{-3}) + 3z^{-3}}{1-z^{-3}}$

$$= \frac{2z^{-2} - z^{-5} + 3z^{-3}}{1-z^{-3}} = \frac{2z^{-2} + z^{-3}}{1-z^{-1}}$$

$\boxed{\text{ROC } |z| > 1}$ (right sided)

$$= \frac{2z+1}{z^3 - z^2} \quad \boxed{\begin{array}{l}\text{zeros} = -0.5 \\ \text{poles} = 0 \text{ and } 1\end{array}}$$

See Matlab function and printout



① r_{xx} is symmetrical with a peak in the center, meaning high correlation. r_{yx} seems to be more correlated at lower values (optimal ≈ 5). Since r_{xx} is autocorrelation, it should be highly correlated

④ $H(z) = \frac{z}{z-0.5} + \frac{1}{z-0.5}$ $\quad H(z) = \frac{z+1}{z-0.5}$ (causal) $= \frac{1}{1-0.5z^{-1}} + \frac{z^{-1}}{1-0.5z^{-1}}$

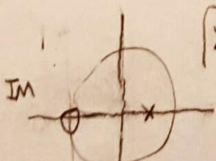
(i) $H(z) = \frac{z+1}{z-0.5} = \boxed{0.5^n u(n-1) + 0.5^{(n-1)} u(n-1) = h(n)}$

(ii) $H(z) = \frac{1+z^{-1}}{1-0.5z^{-1}} = \frac{Y(z)}{X(z)} \rightarrow Y(z)(1-0.5z^{-1}) = X(z)(1+z^{-1})$

$Y(z) = X(z) + z^{-1}X(z) + 0.5z^{-1}Y(z)$

$\boxed{y(n) = x(n) + x(n-1) + 0.5\,y(n-1)}$

(iii) $\boxed{\begin{array}{l}\text{Zeros: } -1 \\ \text{Poles: } 0.5\end{array}}$



$x(n) = 3\cos(\pi n/3)u(n)$

(iv) $X(z) = \frac{1 - z^{-1}\cos\frac{\pi}{3}}{1 - 2z^{-1}\cos\frac{\pi}{3} + z^{-2}} = \frac{1 - z^{-1}\left(\frac{1}{2}\right)}{1 - z^{-1} + z^{-2}}$ $\quad X(z) * H(z) = \boxed{\frac{z^{-1}+1}{z^{-2} - z^{-1} + 1} = Y(z)}$

$Y(z) = \frac{z + z^2}{1 - z + z^2} \rightarrow \frac{1}{z-1} + \frac{1}{z+1} \rightarrow \boxed{y(n) = u(n-1) + (-1)^{n-1} u(n-1)}$