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ESC HW 10

(10) a) $H(z) = \frac{(z+1)^2}{z^2 - 1.75z + 0.8672} = \frac{z^2+2z+1}{z^2-1.75z+0.8672}$

b) $\frac{1+2z^{-1}+z^{-2}}{1-1.75z^{-1}+0.8672z^{-2}}$

$(1-1.75z^{-1}+0.8672z^{-2})Y(z) = (1+2z^{-1}+z^{-2})X(z)$

$Y(z) = X(z) + 2z^{-1}X(z) + z^{-2}X(z) + 1.75z^{-1}Y(z) - 0.8672z^{-2}Y(z)$

$y[k] = x[x] + 2x[k-1] + x[k-2] + 1.75y[k-1] - 0.8672y[k-2]$

c) see attached

d) ~~pole~~ coefficients 1, 2, -1.75 can all be represented in [16, -6] two's complement schemes. For 0.8672, the closest we can get is

$0.8672 \times 2^6 = 55.5008 = 56$

$\bar{B}_R = 0000\ 0000\ 0011\ 1000$

$56/2^6 = \boxed{0.875}$

This makes the denom. $= z^2 - 1.75z + 0.875$

with new poles at $\boxed{0.875 \pm i0.3307} = z$

zeros remain the same

$\bar{H}(z) = \frac{z^2+2z+1}{z^2-1.75z+0.875}$

e) see attached

The original signal has a peak magnitude at (0.3418, 85.46)

The approx. signal has a peak mag. at (0.3534, 87.67)

This new peak is slightly higher, and shifted right a bit, which makes sense because our new ~~pole~~ poles ~~are~~ cover a wider range.

f) $H - \bar{H} = \frac{2.008z^2 - 3.484z + 1.742}{s^4 - 3.5s^3 + 4.805s^2 - 3.049s + 0.7588}$

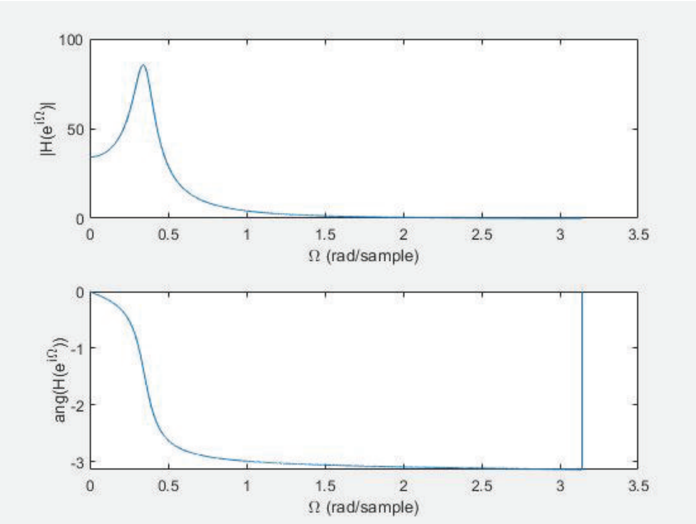
thanks matlab

1: $\|H-\bar{H}\|_{L_1[0,2\pi]} = \int_0^{2\pi} \uparrow = 17.6734$ 1

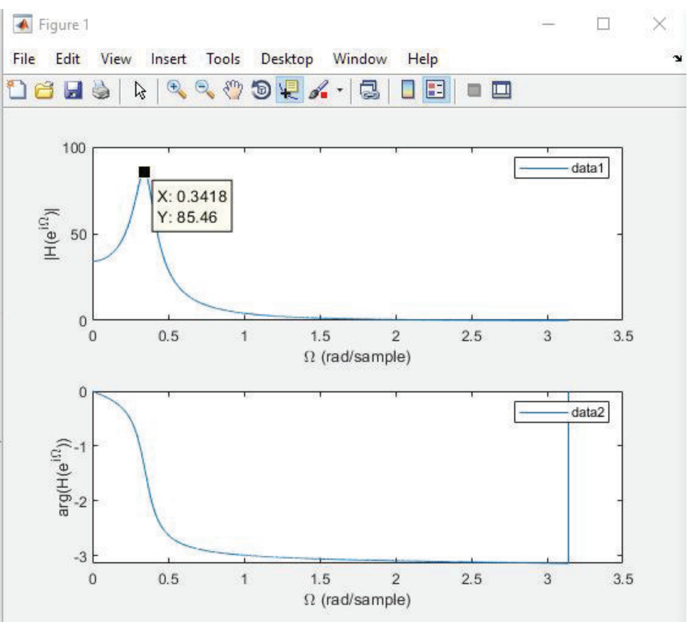
2: $\|H-\bar{H}\|_{L_2[0,2\pi]} = \sqrt{\int_0^{2\pi} \text{above}} = 4.20397$ 2

∞: $\|H-\bar{H}\|_{L_\infty[0,2\pi]} = \text{Max} = 20.6035$ ∞

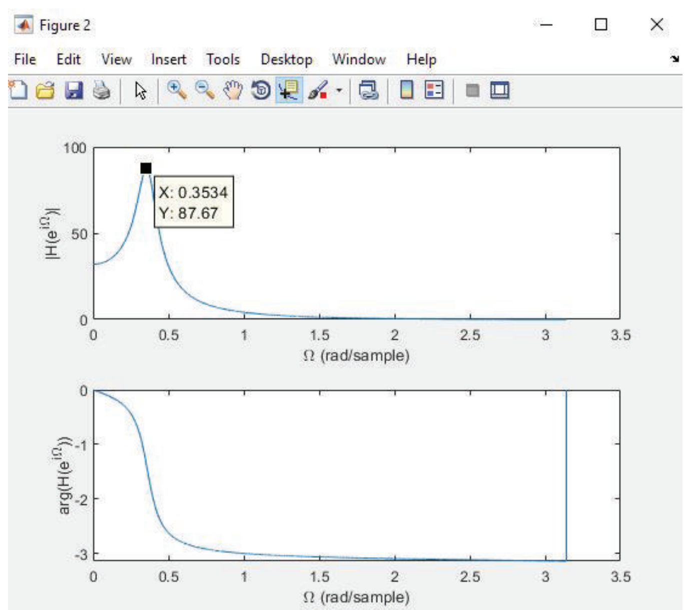
at $z = 0.879748$



10c plot



10e plot (original)



10e plot (approx)