Andre Winkel October 8, 2025

Lab 1

EE141, Digital Signal Processing, Fall 2025

Problem 1: Converting functions into zero-pole-gain form

In this problem, we are given a series of functions in transfer function form to convert into zero-pole-gain form. We can do so by using the `matlab` function `roots([coefficients])` to find the zeros and poles of the functions.

a) Given the transfer function

$$H(z) = \frac{2 + 16z^{-1} + 34z^{-2} + 20z^{-3}}{1 - 10z^{-1} + 35z^{-2} - 50z^{-3} + 24z^{-4}}$$

we can find the zeros and poles by finding the roots of the numerator and denominator, respectively. Finding them in MATLAB and plugging them into our standard zero-pole-gain form, we get

$$H(z) = 2\frac{z(z+1)(z+2)(z+5)}{(z-1)(z-2)(z-3)(z-4)}$$

b) Given the transfer function

$$H(z) = \frac{10 - 21z^{-1} + 14z^{-2} - 3z^{-3}}{3 - 3z^{-1} - 6z^{-2}}$$

we do the same process as above to find the zeros and poles. Finding them in MATLAB gives us

$$H(z) = \frac{10}{3}\frac{(z-0.5)(z-0.6)(z-1)}{z(z+1)(z-2)}$$

c) And again, given the transfer function

$$H(z) = \frac{1 - z^{-4}}{1 - z^{-8}}$$

we find

$$H(z) = \frac{(z+1)(z-j)(z+j)(z-1)}{(z+1)()}$$

Problem 2: Converting functions into transfer function form

a)

Problem 3: Finding partial fraction expansions

a)

Problem 4: Plotting the pole-zero diagrams

In this problem, we will plot the pole-zero diagrams using our values obtained in problem 1. We will use the `zplane(zeros, poles)` function to plot the pole-zero diagrams.

a)