

ELEC 431
Digital Signal Processing
Homework 10

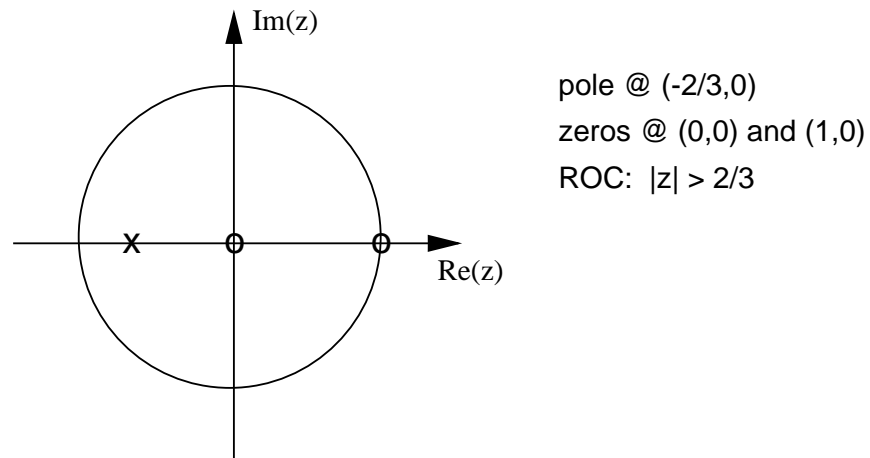
Due Monday, March 3, 2003

1. Consider a system described by the following transfer function:

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

- a. Find the difference equation representation of the time-domain filter that implements this system.
- b. Can the ROC be defined so that the filter is both casual and stable? Sketch the pole/zero plot and the ROC.

2. A discrete-time filter is described by the pole/zero plot below.



a. Find the z-transform and difference equation for the system.

b. Compute the frequency response of the system. Sketch the magnitude frequency response and comment on the filter's function.

3. Suppose we are designing part of a communications system. We would like to detect the presence (or absence) of narrowband signal at 500Hz. To accomplish this using digital technology, we must first sample the total received signal at 4kHz, and then process the received signal with a digital bandpass filter centered at 500Hz. The filter removes interfering signals that may be present at other frequencies. The power at the output of the bandpass filter can be compared to a threshold to decide whether or not the narrowband signal is present.

Using pole/zero placement, design a bandpass filter for this application.

- a. Sketch the pole/zero plot of your design
- b. Find the transfer function and difference equation
- c. Plot the magnitude of the frequency response using Matlab
- d. Draw the block diagram for the Direct Form II filter implementation
(see OSB pp. 347-348)