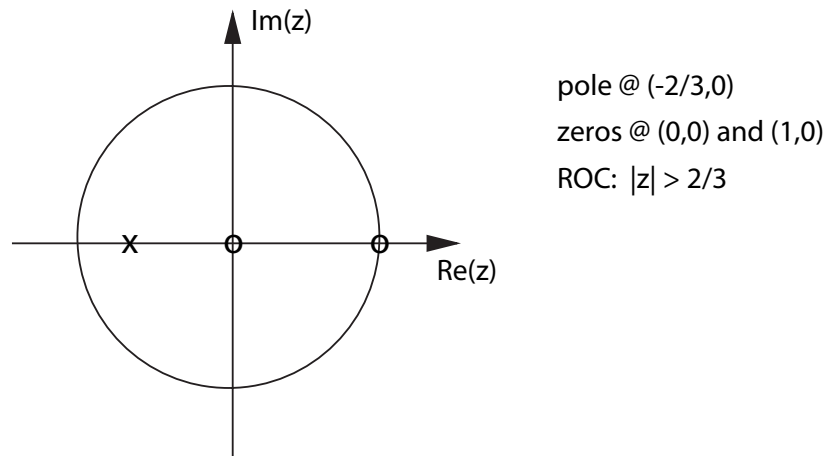


ECE 431
Digital Signal Processing
Homework 10

Due Friday, December 1, 2006

1. 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.
2. Suppose we are designing part of a communications system. We would like to detect the presence (or absence) of a narrowband signal at 500 Hz. To accomplish this using digital technology, we must first sample the total received signal at 4 kHz, and then process the received signal with a digital bandpass filter centered at 500 Hz. 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 z -transform and difference equation for the filter
- c. Plot the magnitude of the frequency response using Matlab

3. Consider the magnitude frequency response depicted in Figure 1 below. Notice that the passband is approximately $\pi/8$ in width. If we want to reasonably approximate this frequency characteristic, what is the minimum length FIR filter that you would recommend. **HINT:** Think about how much frequency resolution you can achieve with a length N signal (i.e., think about DFT basis vectors).

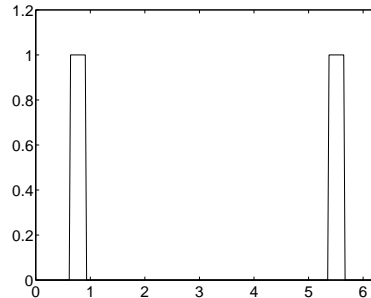


Figure 1:

Now consider another magnitude frequency response depicted in Figure 2 below. This frequency response was generated using a two-pole IIR filter (two conjugate symmetric poles and two zeros at the origin).

- Where are the pole locations that generated this filter? Verify in Matlab that your proposed pole locations produce the desired response characteristic.
- If you wanted to approximate this IIR filter using an FIR filter, then what length FIR filter would you recommend and why?

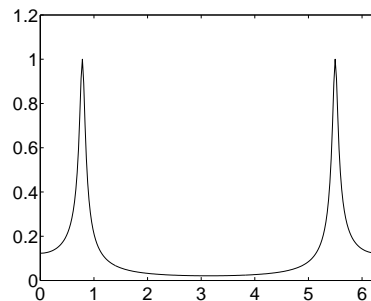


Figure 2: