UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN
Department of Electrical and Computer Engineering

ECE 498MH Signal and Image Analysis

Homework 9

Fall 2014

Assigned: Thursday, 3/30/2017 Due: Thursday, 4/6/2017

Reading: 394–415

Do **one** of the following two problems, and submit by 11:59pm 4/6/2017 (on Compass, if you don't hand it in during class). Homework will be returned on 4/13/2017. If you don't like your grade, then you can hand in the **other** problem for a grade, no later than 4/20/2017.

Problem 9.1

Consider the following IIR filter:

$$y[n] = x[n] - 0.2x[n-1] - 0.2y[n-1] \tag{1}$$

(a) Calculate the impulse response of this system, $h[n]$.

(b) Calculate $H(z)$ by applying the Z transform formula directly to $h[n]$.

(c) Calculate $H(z) = Y(z)/X(z)$ by applying the shift property of the Z transform to Eq. 1.

(d) Use the relationship between Z-transform and DTFT to find the magnitude response, $|H(\omega)|$. Plot $|H(\omega)|$ as a function of ω, for $0 \leq \omega \leq \pi$. Label the amplitude at $\omega = 0$ and at $\omega = \pi$. Is this a lowpass, bandpass, or highpass filter?

Problem 9.2

Consider the following IIR filter:

$$y[n] = x[n] + 0.2x[n-1] + 0.2y[n-1] \tag{2}$$

(a) Calculate the impulse response of this system, $h[n]$.

(b) Calculate $H(z)$ by applying the Z transform formula directly to $h[n]$.

(c) Calculate $H(z) = Y(z)/X(z)$ by applying the shift property of the Z transform to Eq. 2.

(d) Use the relationship between Z-transform and DTFT to find the magnitude response, $|H(\omega)|$. Plot $|H(\omega)|$ as a function of ω, for $0 \leq \omega \leq \pi$. Label the amplitude at $\omega = 0$ and at $\omega = \pi$. Is this a lowpass, bandpass, or highpass filter?