ECE113: DSP

Homework 2

Due 04/16/2021, 11:59pm

Problem 1: Problem 2.24 in R1 (i.e., Proakis 4th Edition)

Problem 2: Problem 2.32 in R1

Problem 3: Problem 2.35 in R1

Problem 4: Problem 2.57 in R1

Problem 5: Problem 5.5 in R1

Problem 6: Problem 5.24 in R1

Problem 7: Problem 9.5 in R1 (In this problem, "transposed structure" refers to transposed Direct Form II).

Problem 8: Problem 9.9 in R1 (Find Direct Form I, Direct Form II, and Cascade realization for Part b only. Parallel realization optional).

Problem 9:

[redacted] Consider a discrete-time sinewave sequence defined by $x(n) = \sin(\pi n/4)$ which was obtained by sampling a CW tone $x(t) = \sin(2\pi F_0 t)$ with the frequency F_0 Hz. If the sampling rate was $F_s = 160$ Hz, what are the possible positive frequency values for F_0, measured in Hz, that would result in the sequence $x(n)$?

MATLAB:

P2.19 A linear and time-invariant system is described by the difference equation

$$y(n) - 0.5y(n-1) + 0.25y(n-2) = x(n) + 2x(n-1) + x(n-3)$$

1. Using the `filter` function, compute and plot the impulse response of the system over $0 \leq n \leq 100$.
2. Determine the stability of the system from this impulse response.
3. If the input to this system is $x(n) = [5 + 3\cos(0.2\pi n) + 4\sin(0.6\pi n)]\, u(n)$, determine the response $y(n)$ over $0 \leq n \leq 200$ using the `filter` function.

P3.16 For a linear, shift-invariant system described by the difference equation

$$y(n) = \sum_{m=0}^{M} b_m x(n-m) - \sum_{\ell=1}^{N} a_\ell y(n-\ell)$$

the frequency-response function is given by

$$H(e^{j\omega}) = \frac{\sum_{m=0}^{M} b_m e^{-j\omega m}}{1 + \sum_{\ell=1}^{N} a_\ell e^{-j\omega \ell}}$$

Write a MATLAB function `freqresp` to implement this relation. The format of this function should be

```
function [H] = freqresp(b,a,w)
% Frequency response function from difference equation
%  [H] = freqresp(b,a,w)
% H = frequency response array evaluated at w frequencies
% b = numerator coefficient array
% a = denominator coefficient array (a(1)=1)
% w = frequency location array
```