EHB 315E Digital Signal Processing
Fall 2020
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İTÜ

MATLAB HOMEWORK 2

Starting Date: 02.01.2021
Due Date: 22.01.2021

1 [30 pts] For the linear and time-invariant systems described by the following system functions, determine (i) the impulse response representation using function `residuez`, (ii) the pole-zero plot using function `zplane`, (iii) the output $y(n)$ if the input is $x(n) = 3\cos(\pi n/3)u(n)$ using function `filter`

(a) $H(z) = (z+1)/(z-0.5)$,

(b) $H(z) = \left(1 + z^{-1} + z^{-2}\right) / \left(1 + 0.5z^{-1} - 0.25z^{-2}\right)$,

(c) $H(z) = \left(1 + z^{-1} + z^{-2}\right)^2$

2 [30 pts] Let $x_1(n) = \delta(n) + 2\delta(n-1) + 2\delta(n-2)$ and $x_2(n) = \delta(n) + 2\delta(n-1) + 3\delta(n-2) + 4\delta(n-3)$.

(a) Compute the linear convolution of these signals $x_1(n) * x_2(n)$. Use function `conv_m` to calculate convolution.

(b) Compute the 4-point circular convolution of these signals $x_1(n)$ ④ $x_2(n)$. Use function `cconv` to calculate circular convolution.

(c) Compute the 5-point circular convolution of these signals $x_1(n)$ ⑤ $x_2(n)$. Use function `cconv` to calculate circular convolution.

3 [40 pts] Use each of the Hamming, Hann, Blackman, and Kaiser windows to design four linear-phase FIR digital lowpass filters. Each of the four filters should be of the same length. It is desired that the filters meet the following specifications: passband edge f_p at 2 Hz, stopband edge f_s at 4 Hz, maximum passband attenuation of 0.1 dB, minimum stopband attenuation of 40 dB. The filter is to operate at a sampling frequency Fs of 20 Hz. First, determine the length of the filter using the MATLAB command `kaiserord` and the specifications listed above. Use the length provided by `kaiserord` for each of the four filters. You should find that the Kaiser window leads to a filter that meets the specifications, but that the other windows lead to filters that do not quite meet the specification. Display the amplitude response and magnitude response in dB. You will use the commands `sinc, hamming, hanning, blackman, and kaiser`. Comment on your observations