DSP lab (final project)

(1) Sampling and periodicity of sinusoidal signals :

a-

Generate the following periodic sequences and plot their samples (using the `stem` function) over the indicated number of periods.

1. $\tilde{x}_1(n) = \{\ldots, -2, -1, \underset{\uparrow}{0}, 1, 2, \ldots\}_{\text{periodic}}$. Plot 5 periods.
2. $\tilde{x}_2(n) = e^{0.1n}[u(n) - u(n-20]_{\text{periodic}}$. Plot 3 periods.
3. $\tilde{x}_3(n) = sin(0.1\pi n)[u(n) - u(n-10)]$. Plot 4 periods.
4. $\tilde{x}_4(n) = \{\ldots, \underset{\uparrow}{1}, 2, 3, \ldots\}_{\text{periodic}} + \{\ldots, \underset{\uparrow}{1}, 2, 3, 4, \ldots\}_{\text{periodic}}$, $0 \leq n \leq 24$. What is the period of $\tilde{x}_4(n)$?

b-

Let $x(n) = \{2, 4, -3, \underset{\uparrow}{1}, -5, 4, 7\}$. Generate and plot the samples (use the `stem` function) of the following sequences.

1. $x_1(n) = 2x(n-3) + 3x(n+4) - x(n)$
2. $x_2(n) = 4x(4+n) + 5x(n+5) + 2x(n)$
3. $x_3(n) = x(n+3)x(n-2) + x(1-n)x(n+1)$
4. $x_4(n) = 2e^{0.5n}x(n) + \cos(0.1\pi n)\, x(n+2)$, $-10 \leq n \leq 10$

(2) Time domain analysis of LTI systems:

Compute and plot the convolution between the following pair of sequences:

i. $x_1[n] = [\hat{1}, 2,4], h_1[n] = [1,1, \hat{1}, 1,1]$.

ii. $x_2[n] = [\hat{0}, 1, -2,3, -4], h_2[n] = [0.5,1, \hat{2}, 1,0.5]$.

iii. $x_3[n] = [\hat{1}, 2,3,4], h_3[n] = [\hat{4}, 3,2,1]$.

iv. $x_4[n] = [\hat{1}, 2,3,4], h_4[n] = [\hat{1}, 2,3,4]$.

where $\hat{}$ is the zeroth index

(3) Z-transform analysis of discrete systems:

(a) Consider the system:

$$H(z) = \frac{1 - 2z^{-1} + 2z^{-2} - z^{-3}}{(1 - z^{-1})(1 - 0.5z^{-1})(1 - 0.2z^{-1})}$$

i. Sketch the pole-zero pattern. Is system stable? (search and Use "tf" ,"zplane"and "pzmap" commands).

ii. Determine impulse response of system.

(b) A discrete time control system is characterized by difference equation:

$$y(n) - 2.8y(n-1) + 3.02y(n-2) - 1.468(n-3) + 0.27y(n-4) =$$

$$0.03(\ ) - 0.02x(n-1) + 0.01x(n-2) .$$

Use the Z-transform to find system transfer function H (z).Find the pole-zero plot and discuss the stability. Then determine and plot the system output when

$x(n) = 5u(n)$.

(4) Fourier-transform analysis of discrete systems:

Draw the magnitude and the phase of Fourier transform of the following signals:

$(a)\ x(n) = u(n) - u(n-6), 0 \le n \le 10$

$(b)\ x(n) = 2^n u(-n), 0 \le n \le 10$

$(c)\ x(n) = \left(\frac{1}{4}\right)^n u(n+4), 0 \le n \le 10$

$(d)\ x(n) = (0.25^n \sin(2\pi * 0.25n))u(n), 0 \le n \le 10$

$(e)\ x(n) = (0.5^n \sin(2\pi * 0.25n), 0 \le n \le 10$

$(f)\ x(n) = \left\{\begin{matrix} 2 - 0.5n\,, & |n| \le 4 \\ 0 & elsewhere \end{matrix}\right\}$

$(g)\ x(n) = \left\{-2, -1, \underset{\smile}{0}, 1, 2\right\}$

Project's regulations

• Each one will prepare **a softcopy report** referencing all steps and results you have made, as well as MATLAB code .

• Submit report electronically to :

engmarwamostafa@yahoo.com

- Deadline of submission is **19/5/2018**.
- Individual group.
- Copied reports will take zero .