ECE 53800 Digital Signal Processing I **Homework 1**

Uploaded to Brightspace, Sunday by midnight, 2 October 2022

My New Version of Problem. *2.65.* pp. 144-145 of 4th Ed. Proakis and Manolakis Textbook.
This is the model to simulate for all parts:

$$y[n] = x[n-20] + a_2 x[n-D_2] + v[n], \quad n = 0, 1, ..., 199.$$

where for every value of n, $v[n]$ is a zero-mean, independent, Gaussian random variable with a standard deviation of 1, for all parts.
For each of 3 different sequences,

(a) $x[n]$ of length $M = 15$ generated according to shift-register defined in Prob. 2.65. $x[n] = \{-1, -1, -1, 1, 1, 1, 1, -1, 1, -1, 1, 1, -1, -1, 1\}$ ($M = 15$) The shift-register is of length 4.

(b) $x[n]$ of length $M = 63$ generated according to shift-register defined in Prob. 2.65. The shift-register is of length 6.

(c) $x[n]$ of length $M = 127$ generated according to shift-register defined in Prob. 2.65. The shift-register is of length 7.

Simulate 3 different values of the parameter pair $\{a_2, D_2\}$,

(1) $a_2 = 1$, $D_2 = 22$

(2) $a_2 = 1$, $D_2 = 21$

(3) $a_2 = -1$, $D_2 = 21$

and do the following 3 plots.

(i) Plot the values of $x[n]$, for $n = 0, 1, ..., M-1$, where M is either 15, 63, or 127.

(ii) Plot the values of $y[n]$, for $n = 0, 1, ..., 199$.

(iii) Plot the cross-correlation $r_{yx}(\ell)$, for $n = 0, 1, ..., 59$.

Put 3 plots per page so that there is a total of 9 pages of plots. Label each page with the values of M, a_2, and D_2. You can do either stem plots or line plots.

Page 1: $a_2 = 1$, $D_2 = 22$, $M = 15$: do plots (i), (ii), and (iii)

Page 2: $a_2 = 1$, $D_2 = 21$, $M = 15$: do plots (i), (ii), and (iii)

Page 3: $a_2 = -1$, $D_2 = 21$, $M = 15$: do plots (i), (ii), and (iii)

Page 4: $a_2 = 1$, $D_2 = 22$, $M = 63$: do plots (i), (ii), and (iii)

Page 5: $a_2 = 1$, $D_2 = 21$, $M = 63$: do plots (i), (ii), and (iii)

Page 6: $a_2 = -1$, $D_2 = 21$, $M = 63$: do plots (i), (ii), and (iii)

Page 7: $a_2 = 1$, $D_2 = 22$, $M = 127$: do plots (i), (ii), and (iii)

Page 8: $a_2 = 1$, $D_2 = 21$, $M = 127$: do plots (i), (ii), and (iii)

Page 9: $a_2 = -1$, $D_2 = 21$, $M = 127$: do plots (i), (ii), and (iii)

Note 1: This homework is worth 15/3=5 points of your final grade.

Note 2: The goal of this Matlab homework is to exercise you on the practical applications of discrete-time cross-correlation. An additional goal is to get you started on using Matlab.

General Information.

Deliverables for this project include 27 plots. Each plot should be clearly labeled, and should be accompanied by a brief explanation. The collection of plots and accompanying explanations should be put together in a cohesive manner in the form of a very brief report. Don't go overboard – this is simply a homework, **not** a project. Append source code to the report.

You may use any Matlab command you like in solving these problems. Each student is expected to do his/her own work and each must turn in his/her own report. Again, your write-up for this homework should be in the form of a very brief report. Handwriting is acceptable but please be sure it is legible. Your report should include:

- The 27 plots and observations/explanations