

*Due Date for On-Campus Students:* Turn in printout on Monday, 5 October 2020

*Due Date for Off-Campus Students:* Due by e-mail on Oct. 5.

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

$$y[n] = x[n - 20] + a_2x[n - D_2] + v[n], \quad n = 0, 1, \dots, 199.$$

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)  $x[n] = \{1, 1, 1, 1, 1, -1, -1, 1, 1, -1, 1, -1, 1\}$  ( $M = 13$ )
- (b)  $x[n] = \{-1, -1, -1, 1, 1, 1, 1, -1, 1, -1, 1, 1, -1, -1, 1\}$  ( $M = 15$ )
- (c)  $x[n]$  of length  $M = 127$  generated according to shift-register defined in Prob. 2.65.

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  $n = 0, 1, \dots, M - 1$ , where  $M$  is either 13, 15, or 127.
- (ii) Plot the values of  $y[n]$ , for  $n = 0, 1, \dots, 199$ .
- (iii) Plot the cross-correlation  $r_{yx}(\ell)$ , for  $n = 0, 1, \dots, 59$ .

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:  $a_2 = 1, D_2 = 22, M = 13$ : do plots (i), (ii), and (iii)

Page 2:  $a_2 = 1, D_2 = 21, M = 13$ : do plots (i), (ii), and (iii)

Page 3:  $a_2 = -1, D_2 = 21, M = 13$ : do plots (i), (ii), and (iii)

Page 4:  $a_2 = 1, D_2 = 22, M = 15$ : do plots (i), (ii), and (iii)

Page 5:  $a_2 = 1, D_2 = 21, M = 15$ : do plots (i), (ii), and (iii)

Page 6:  $a_2 = -1, D_2 = 21, M = 15$ : 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:

- Answers to all questions posed including mathematical development where necessary.
- The 27 plots and observations/explanations