ECE-520: Discrete-Time Control Systems
Project Part B

In this part of the project you will implement a recursive least-squares algorithm with a forgetting factor in Simulink using the Matlab embedded system toolbox. *You need to put this in a separate block from the time-varying plant block. The input to this block should be the input to the plant and the output from the plan (with some possible delays).* You need to run the Simulink from the Matlab driver file you used in your homework, and show that your results are the same (identical for Matlab and Simulink) for all of the homework problems.

Mathematical Background: Consider a simple discrete-time transfer function with input $R(z)$ and output $Y(z)$,

$$G_p(z) = \frac{Y(z)}{U(z)} = \frac{b_0 + b_1 z^{-1} + b_2 z^{-2}}{1 + a_1 z^{-1} + a_2 z^{-2}}$$

Cross multiplying we get

$$Y(z) + a_1 z^{-1} Y(z) + a_2 z^{-2} Y(z) = b_0 U(z) + b_1 z^{-1} U(z) + b_2 z^{-2} U(z)$$

In the time-domain this becomes

$$y(n) = -a_1 y(n-1) - a_2 y(n-2) + b_0 u(n) + b_1 u(n-1) + b_2 u(n-2)$$

We can write this as

$$y(n) = \phi^T(n)\theta$$

where

$$\phi^T(n) = \begin{bmatrix} y(n-1) & y(n-2) & u(n) & u(n-1) & u(n-2) \end{bmatrix}$$
$$\theta^T = \begin{bmatrix} -a_1 & -a_2 & b_0 & b_1 & b_2 \end{bmatrix}$$

The output of your system identification should be called theta_est, to match the Matlab plotting program.

To turn in: write a short memo including your graphs (with captions and figure numbers), and any suggestions you may have for improving this part of the project. E-mail me your memo and both your Matlab and Simulink.