

Don't forget finish Lab 2! It's due on Wednesday, as well.

1. Given the following discrete-time state variable model:

$$x_{k+1} = \begin{bmatrix} 1/4 & -1/4 & 1/2 & 0 \\ 1/4 & 3/4 & -1/2 & 0 \\ -1/4 & -1/4 & 1 & 0 \\ 1/4 & 3/4 & 1/2 & 1 \end{bmatrix} x_k + \begin{bmatrix} 1 & 2 \\ -1 & 1 \\ 2 & -1 \\ 1 & 1 \end{bmatrix} w_k$$

$$y_k = \begin{bmatrix} 1 & -1 & 2 & 0 \\ 2 & 1 & 0 & 1 \end{bmatrix} x_k$$

- Find the controllable and uncontrollable eigenvalues of the open-loop system.
- Is the system stabilizable?
- If yes, design a feedback regulator, $w_k = -\underline{k}x_k$ such that the closed-loop controllable eigenvalues are $\{1/8\}$.
- What is the settling-time of the closed-loop system if $T_s = 10$ msec.
- Now design a controller such that y_k goes to $[3 \ -8]^T$ in steady-state
Of course, we really don't have x_k available to feedback, but we do have $y_k = Cx_k$.
- Find the observable eigenvalues of the discrete-time system in problem 1.
- If detectable is the dual of stabilizable, define detectable and determine if the given system is detectable.
- Design an observer such that all the observable eigenvalues are zero.
- What is the settling time of you observer if $T_s = 10$ msec.
- Draw a block diagram of your combined observer/controller design