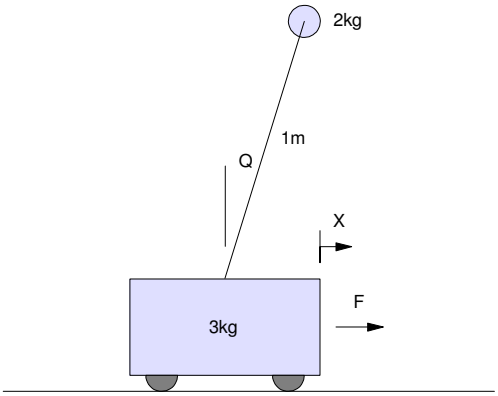
ECE 463/663 - Final Exam

Open book, open notes, internet & matlab permitted - just not other people.
Due Monday, May 11th
No Aid Given Received, or Observer (i.e. you did not get help from someone else) _____



Expand homework set #10 to include

- Two sensors (position and angle)
- Noise on both sensors, and
- A constant disturbance on the angle measurement (the angle it reports is slightly off)

$$s\begin{bmatrix} x \\ \theta \\ \dot{x} \\ \dot{\theta} \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & -6.533 & 0 & 0 \\ 0 & 16.333 & 0 & 0 \end{bmatrix}\begin{bmatrix} x \\ \theta \\ \dot{x} \\ \dot{\theta} \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 0.333 \\ -0.333 \end{bmatrix}(F + n_u)$$

$y_x = x + n_x$ *position is measured with noise*

$y_\theta = \theta + n_\theta + d$ *angle is also measured, with a constant disturbance*

where there is Gaussian noise at the input and output

$n_u \sim N(0, 0.02^2)$ *mean zero, standard deviation 0.02*

$n_x \sim N(0, 0.01^2)$ *mean zero, standard deviation 0.01*

$n_\theta \sim N(0, 0.03^2)$ *mean zero, standard deviation 0.03*

d *constant disturbance (offset) on the measured angle*

1) Design a feedback control law so that the step response to position (x) has

- No error for a step input,
- A 2% settling time of 4 seconds
- The overshoot for a step input is 5% or less

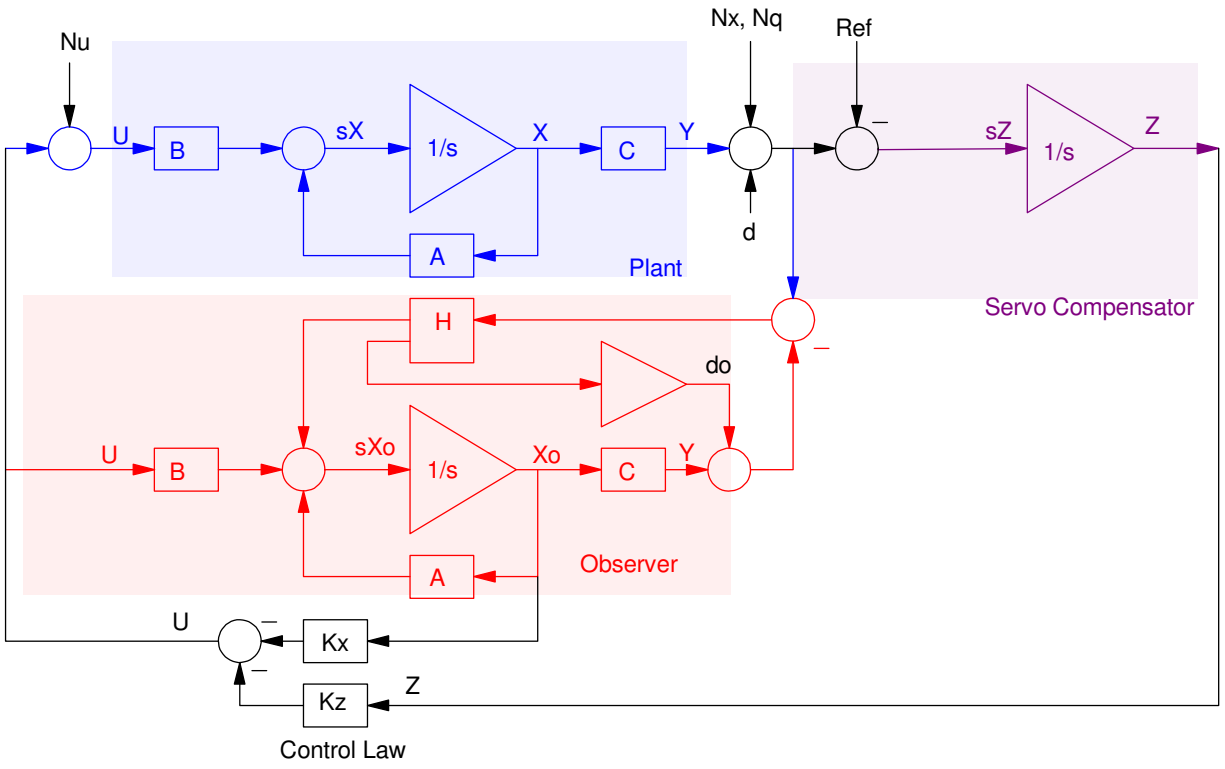
2) Design a Kalman filter to estimate the states and the constant disturbance using both position and angle

3) Simulate the step response of the linear system with d = 0.1 radian and

- Without any noise, and
- With noise

4) Simulate the step response of the nonlinear system with

- the Kalman filter (full-order observer), and
- A disturbance: d = 0.1 radian.



Bonus! (Over)

Bonus!

(If you would like to remain anonymous, please send your response to Anne Campbell and then just note this on your final exam)

Having the unique experience of taking ECE 463/663 both in-person and on-line in the same semester, I'm interested in your opinions.

i) It's very possible that many ECE classes will be available for on-line instruction next fall. If on-line classes were offered (meaning you don't need to even be in Fargo), what is the chance you would take the on-line version?

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0   1   2   3   4   5   6   7   8   9   10
Not a chance                 highly likely
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ii) Please give an example of something done well with the on-line instruction for ECE 463/663

iii) Please give an example of something that needs improving with this class