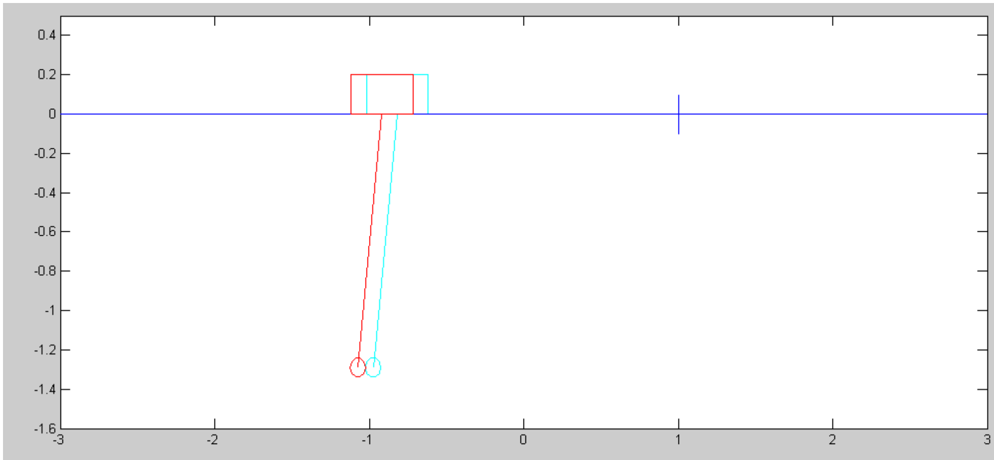
ECE 463/663 - Test #2: Name ________________

Due midnight Sunday, March 24th. Individual Effort Only (no working in groups)



The linearized dynamics for a gantry system (homework #4) are:

$$s\begin{bmatrix} x \\ \theta \\ \dot{x} \\ \dot{\theta} \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 2.45 & 0 & 0 \\ 0 & -9.42 & 0 & 0 \end{bmatrix}\begin{bmatrix} x \\ \theta \\ \dot{x} \\ \dot{\theta} \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 0.25 \\ -0.1923 \end{bmatrix}(F+d)$$

C Level (max 80 points)

Design a feedback control law for the gantry system assuming

- All states are measured (no observer is needed)
- A sinusoidal set point (R(t) = sin(0.5t)), and
- A constant disturbance (d(t) = 1)

Validate your feedback control law on the linear system

Validate your feedback control law on the nonlinear system

- With d(t) = 0 and
- With d(t) = 1 (a cross-breeze pushes the gantry system to the right)

B Level (max 90 points)

1) Design a feedback control law for the gantry system assuming

- Only position and angle are measured, (observer is required)
- A sinusoidal set point (R(t) = sin(0.5t)), and
- No disturbance (d(t) = 0)

2) Validate your feedback control law on the linear system

3) Validate your feedback control law on the nonlinear system

- Using the actual states for feedback (cheating)
```
d = 0
U = -Kz*Z - Kx*X
```
- Using the observer states
```
d = 0
U = -Kz*Z - Kx*Xe
```

A Level (max 100 points)

1) Design a feedback control law for the gantry system assuming

- Only position and angle are measured, (observer is requried)
- A sinusoidal set point (R(t) = sin(0.5t)), and
- A constant disturbance (d(t) = 1)

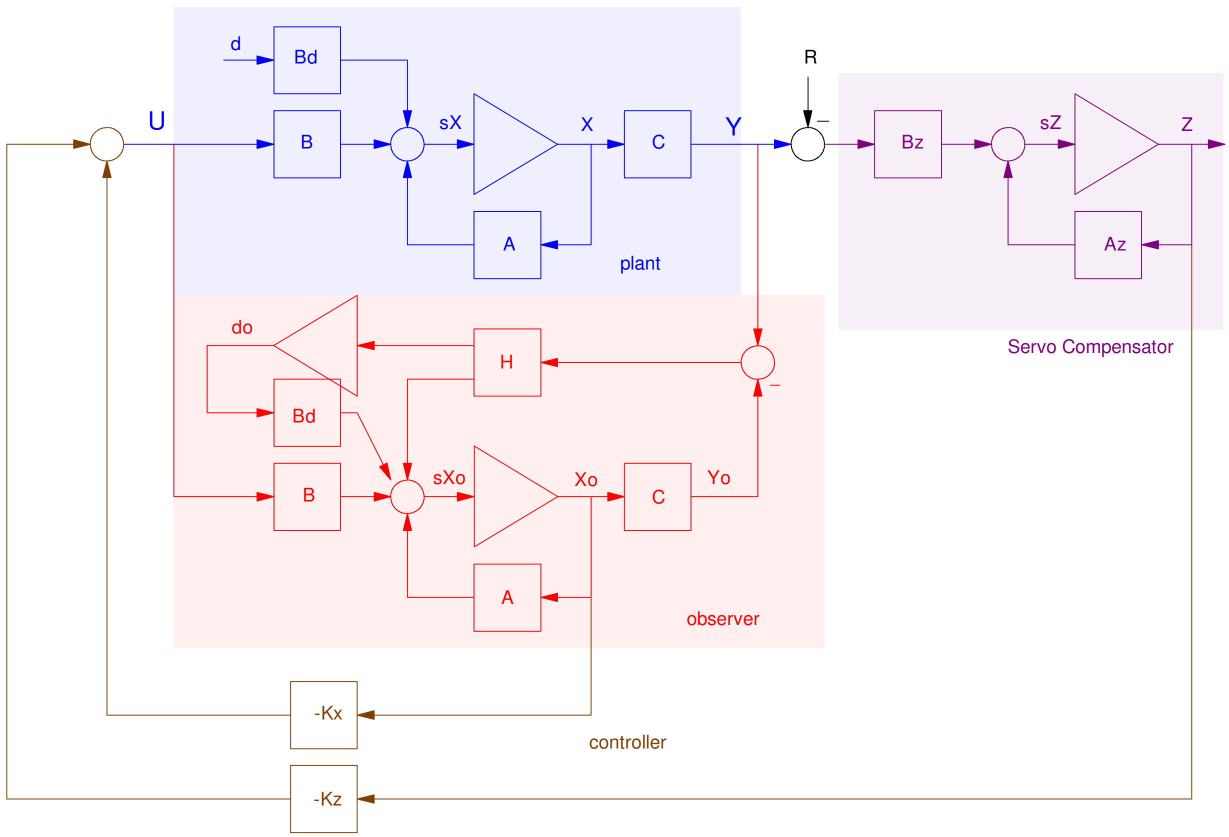
2) Validate your feedback control law on the linear system

3) Validate your feedback control law on the nonlinear system when d = 0

- Using the actual states for feedback (cheating)
```
d = 0
U = -Kz*Z - Kx*X
```
- Using the observer states
```
d = 0
U = -Kz*Z - Kx*Xe
```

4) Validate your feedback control law on the nonlinear system when d = 1

- Using the actual states for feedback (cheating)
```
d = 1
U = -Kz*Z - Kx*X
```
- Using the observer states
```
d = 1
U = -Kz*Z - Kx*Xe
```



Block diagram for the Plant, Servo Compensator, Disturbance, Observer, and Full-State Feedback (A-Level)