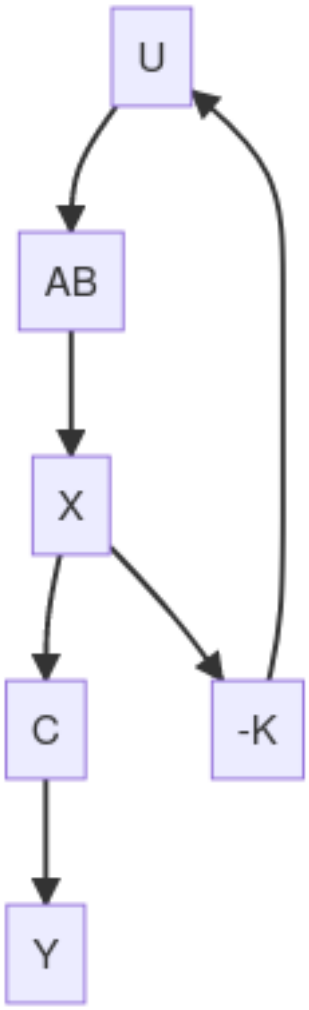
Lecture 11

State Space Control

- $x_{m+1} = Ax_m + Bu_m$
- $y_m = Cx_m$
  - No noise
  - Controllable
  - Observable
- Full state feedback control



- $u_m = -kx_m$
- $x_{m+1} = Ax_m - BKx_m$
- $= (A - BK|x_m)$
- We get to pick the value of K
- $x_m = 0$

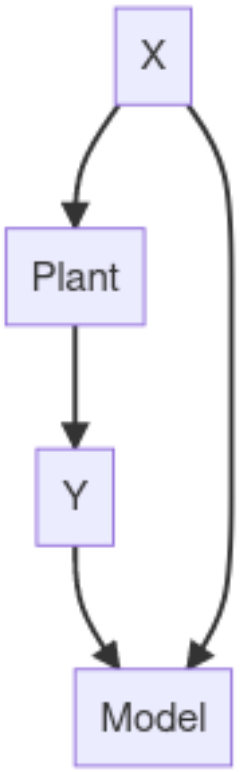
- $x_{m+1} = A * 0 - KB0$
- $x_{m+1} = (A - BK)x_m$
- $||x_{m+1}|| = ||(A - BK)x_m||$
- $||x_{m+1}|| <= ||A - BK||||x_m||$

Control Example

- $y'' + y' + y = u$
- $x_{m+!} = Ax_m$
- Want to control to y*
- $u = K(x^* - x)$

Observer

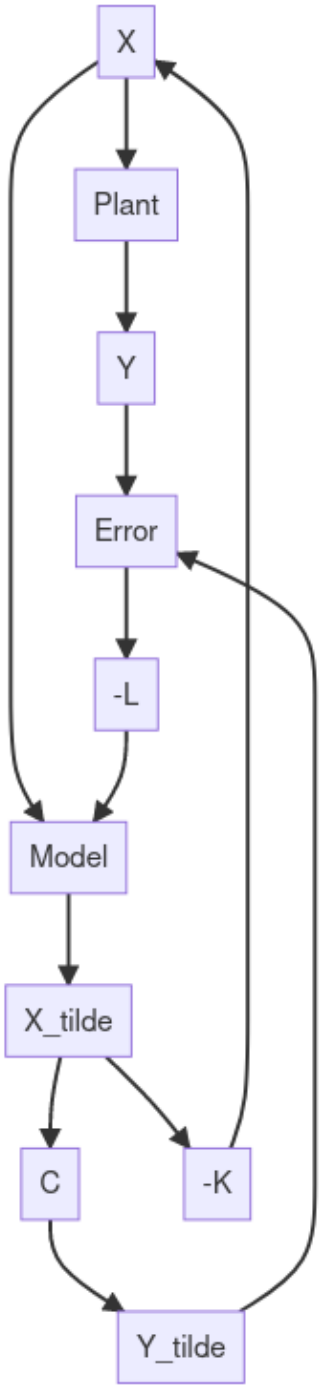
- Estimates the current state



- Model means that you know A, B, C
- $\widetilde{x_{m+1}} = A\widetilde{x_m} + Bu_m$
- As long as you know X_0
- $\widetilde{x_0} = x_0$
- $\widetilde{x_1} = Ax_m + Bu_m$
- This is open loop control

Construct an observer

- Control observation error to zero
- $\widetilde{x_{m+1}} = A\widetilde{x_m} + Bu_m + L(y_m - \widetilde{y_m})$


X
Plant
Y
Error
-L
Model
X_tilde
C
-K
Y_tilde

Plant

- $x_{m+1} = Ax_m + Bu_m$
- $y_m = Cx_m$

Model

- $\widetilde{x_{m+1}} = A\widetilde{x_m} + Bu_m + L(y_m - \widetilde{y_m})$
- $\widetilde{y_m} = C\widetilde{x_m}$

Error Analysis

- $x_{m+1} - \widetilde{x_{m+1}}$
- $Ax_m = Bu_m - A\widetilde{x_m} - Bu_m - L(y_m - \widetilde{y_m}) - cx_m + c\widetilde{x_m}$
- $= (A - Lc)(x_m - \widetilde{x_m})$
- Pick L so poles are in the unit circle
- (A - Bk) = luneberg observer