EE 105 Feedback control systems

Control in state space, part 1

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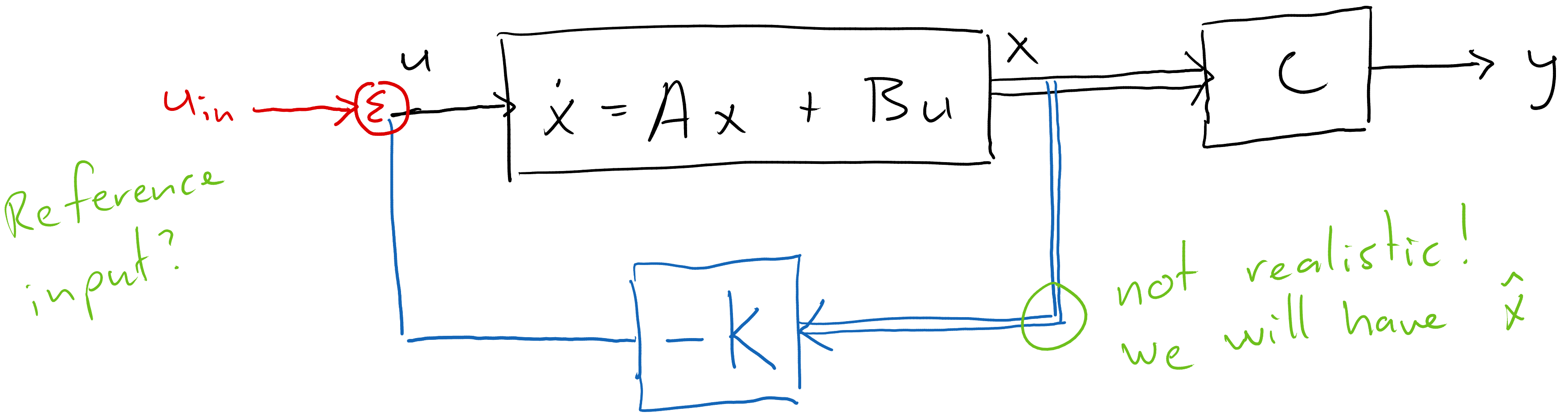
By the end of class today, you should be able to:

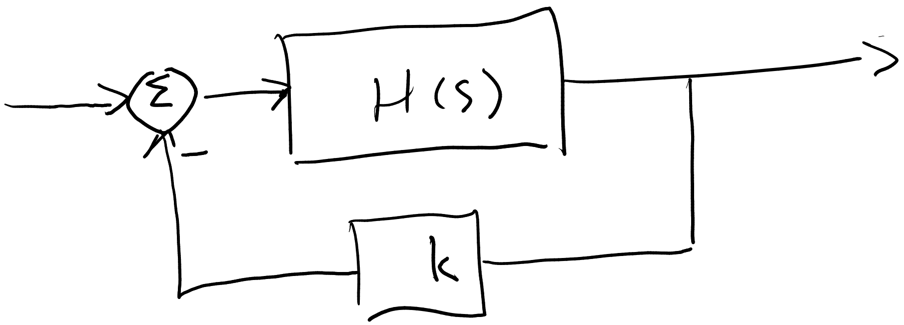
- Draw a diagram of idealized feedback control in state space
- Draw a system block diagram in control canonical form
- Use MATLAB to place poles wherever you want

Control in state space (simple version for now)



Control in state space (simple version for now)

Root locus flashback



Control in state space (simple version for now)

Assume we know x perfectly,

input

$$u = -Kx = -\begin{bmatrix} K_1 & K_2 & \cdots & K_n \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix}$$

Plant

$$\dot{x} = Ax + Bu$$

$$\dot{x} = Ax - BKx = (A - BK)x$$

Poles of complete system are eigenvalues of $(A - BK)$

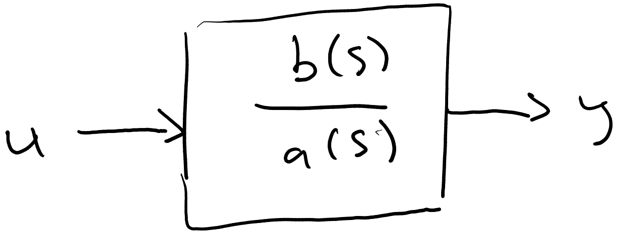
$$\begin{bmatrix} \\ B \\ \\ \end{bmatrix} \begin{bmatrix} & K & \end{bmatrix} \Rightarrow \begin{bmatrix} B_1 K_1 & B_1 K_2 & \cdots \\ B_2 K_1 & \ddots & \\ \vdots & & \ddots \end{bmatrix}$$

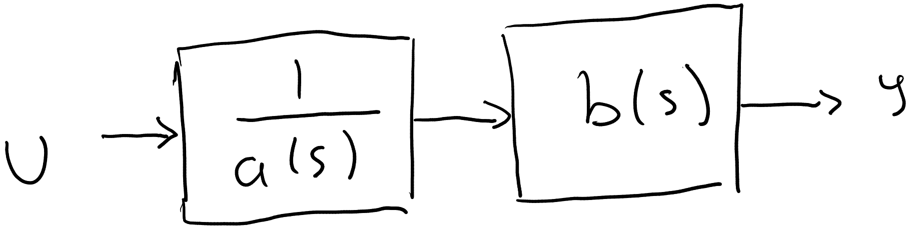
How should we pick K?

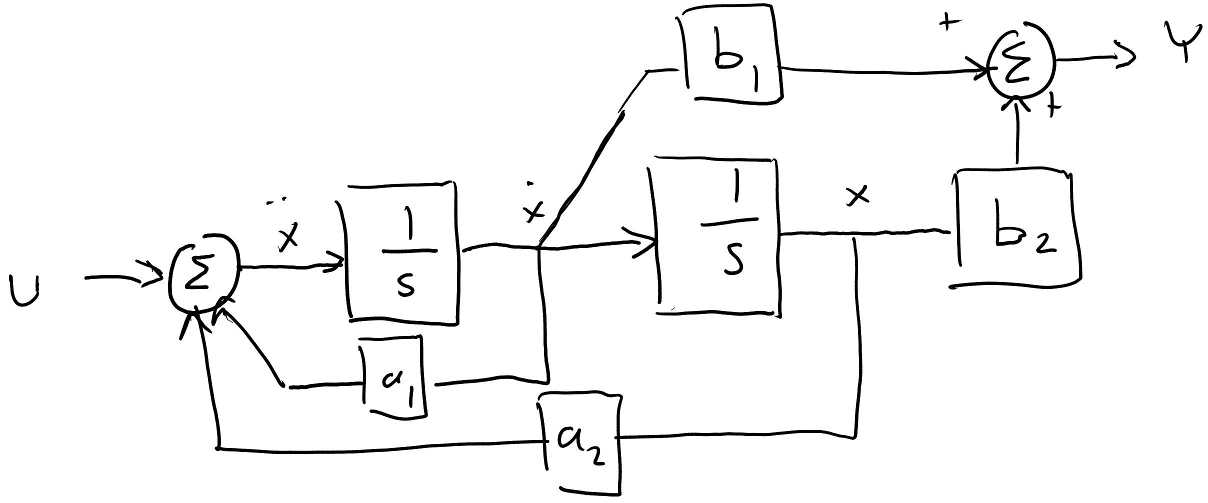
1) Lots of algebra (yuck)

2) Find a clever way to represent the system in state space (A/B/K)

3) MATLAB, obviously







B

$$\begin{bmatrix} \ddot{x} \\ \dot{x} \end{bmatrix} = \begin{bmatrix} a_1 & a_2 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} \dot{x} \\ x \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$$

$$C = \begin{bmatrix} b_1 & b_2 \end{bmatrix}$$

Using MATLAB

acker and place

What could go wrong?

Why not use this method for everything?