## Observers (Part 1)

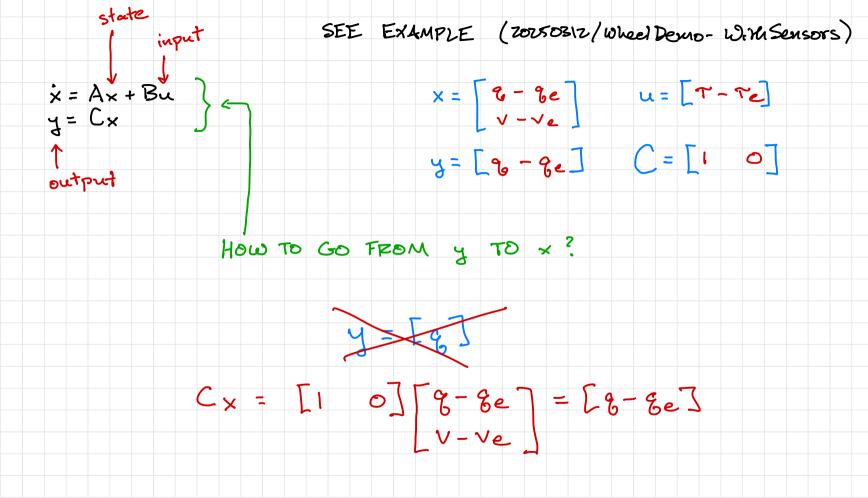
AE353 Spring 2025 Bretl

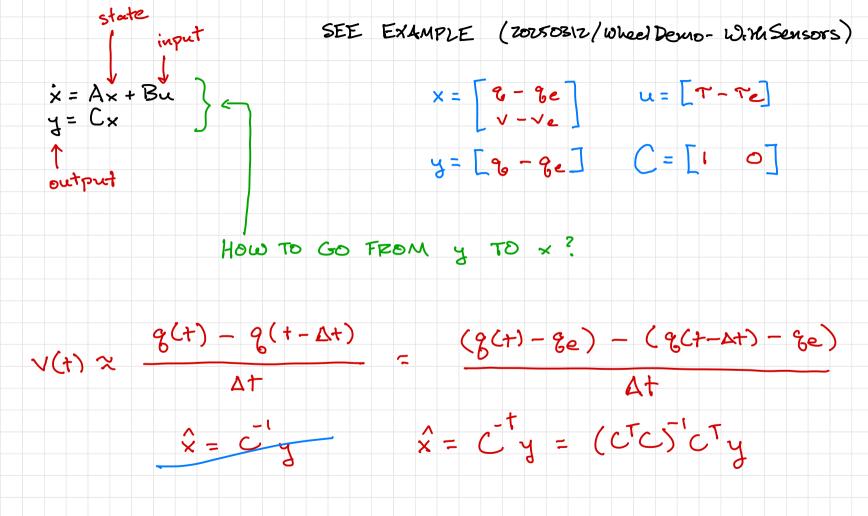
## x = Ax + Be

until now:

from now on:

u=-KX Lour estimate of x - how do we get this?





x = Ax + Bu } how to go from y to x? y = Cx

Take inspiration from state feedback:

x = Ax <- what x does without control

x = Ax - BK (x - x desired)

add a term that is negatively proportional to the error between what we have and what we want

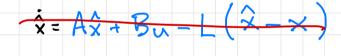
= Ax - BKx = (A-BK) × ← what × does with control

chosse K for stability or whatever



Apply to state estimation :

 $\dot{\mathbf{x}} = \mathbf{A}\dot{\mathbf{x}} + \mathbf{B}\mathbf{u}$ 



 $\dot{\mathbf{x}} = \mathbf{A}\hat{\mathbf{x}} + \mathbf{B}\mathbf{u} - \mathbf{L}(\mathbf{C}\hat{\mathbf{x}} - \mathbf{y})$ 

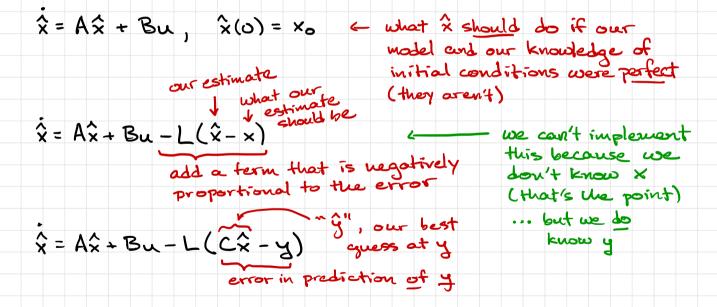
what x should do if our
model and our knowledge of
initial conditions were perfect
(they aren't)

 $\hat{\mathbf{x}}(\mathbf{t}+\mathbf{a}\mathbf{t})\approx\hat{\mathbf{x}}(\mathbf{t})+\mathbf{\Delta t}(\mathbf{A}\hat{\mathbf{x}}(\mathbf{t})+\mathbf{Bu}(\mathbf{t}))$ 

add a term that is negatively proportional to error

x = Ax + Bu } how to go from y to x? y = Cx

Apply to state estimation :



## IMPLEMENTATION

