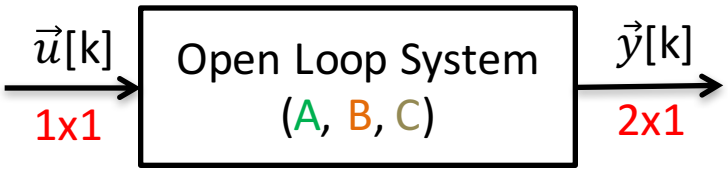
EE16B
Project SIXT33N

Controls Introduction

Last week…

Open loop modeling: Given some inputs $\vec{u}$[k] and the current state, how does the system behave?

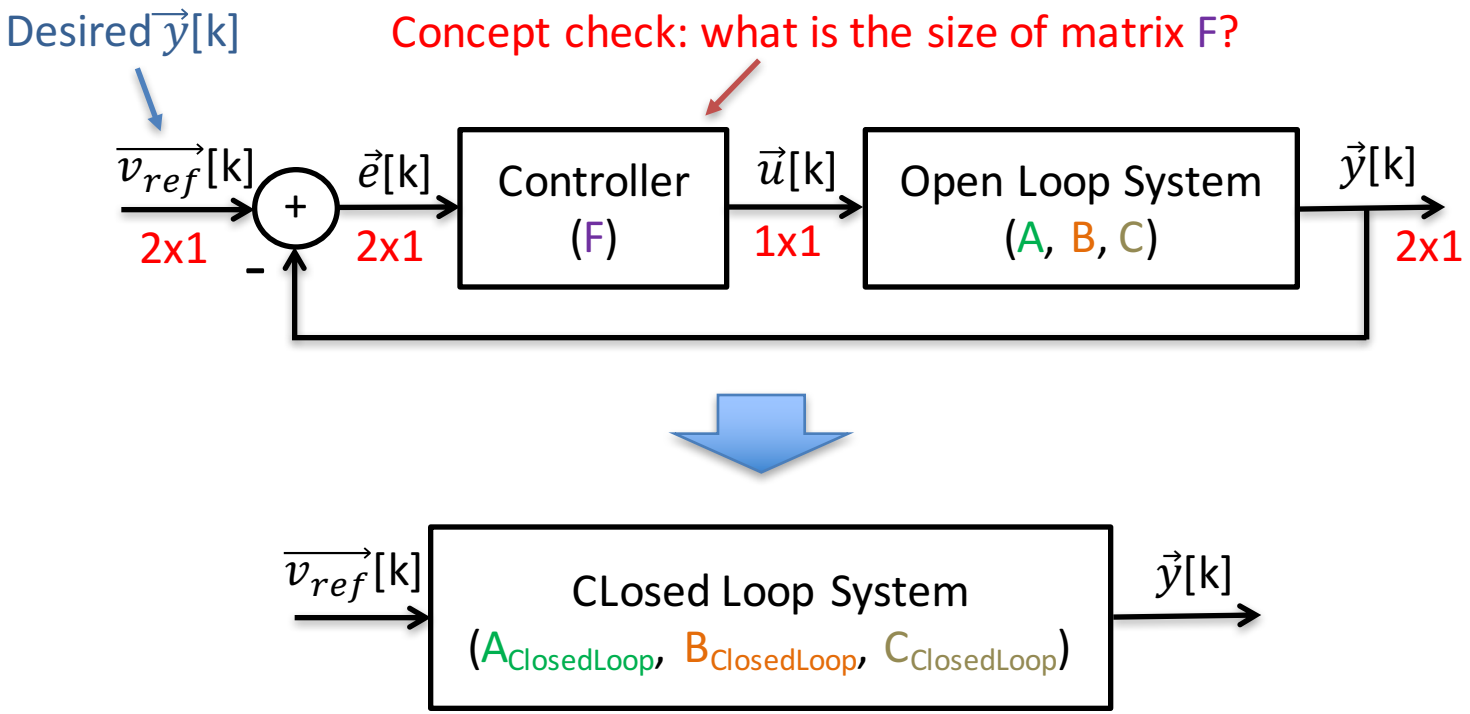


$$\vec{x}[k+1] = A\vec{x}[k] + B\vec{u}[k]$$
$$\vec{y}[k] = C\vec{x}[k]$$

$$\vec{x}[k] = \begin{bmatrix} d \\ v \end{bmatrix}, A = \begin{bmatrix} 1 & Ts \\ 0 & 1 \end{bmatrix}, B = \begin{bmatrix} b_1 \\ b_2 \end{bmatrix}, C = I$$

This week

Controlling the car through a closed-loop controller

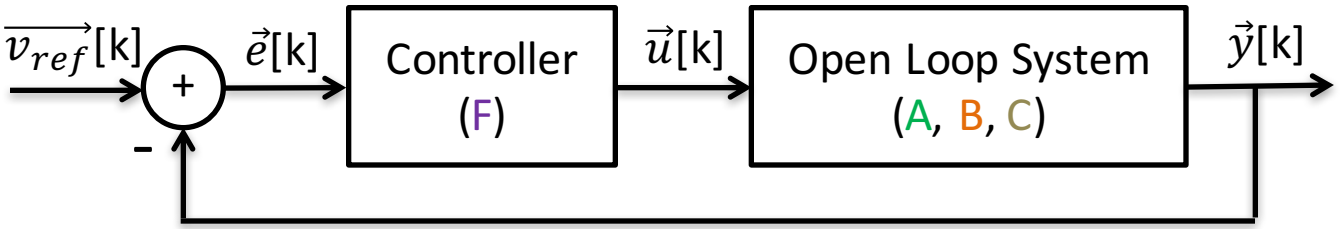


Closed Loop Controls

$$\vec{e}[k] = \overrightarrow{v_{ref}}[k] - \vec{y}[k]$$

$$\vec{u}[k] = F\vec{e}[k] = F(\overrightarrow{v_{ref}}[k] - \vec{y}[k])$$

$\vec{y}[k] = C\vec{x}[k]$



From open loop equations

$$\vec{x}[k+1] = A\vec{x}[k] + B\vec{u}[k]$$

$$= A\vec{x}[k] + BF(\overrightarrow{v_{ref}}[k] - C\vec{x}[k])$$

$$= (\underbrace{A - BFC}_{A_{ClosedLoop}})\vec{x}[k] + \underbrace{BF}_{B_{ClosedLoop}}\overrightarrow{v_{ref}}[k]$$

Stability

$$\vec{x}[k+1] = (\underbrace{A - BFC}_{A_{ClosedLoop}})\vec{x}[k] + \underbrace{BF}_{B_{ClosedLoop}}\overrightarrow{v_{ref}}[k]$$

- How do we make this system stable given some constant input $\overrightarrow{v_{ref}}[k]$?
- Think of eigenvalues…