Discussion 11

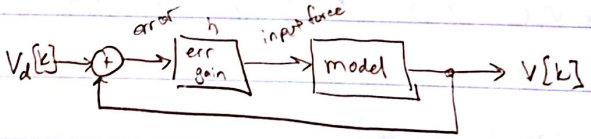
Given some system

$$y(k+1) = A\begin{bmatrix} y(k) \\ v(k) \end{bmatrix} + B\,u[k]$$

$$y(k+1) = \begin{bmatrix} 1 & T_s \\ 0 & 1 \end{bmatrix}\begin{bmatrix} y(k) \\ v(k) \end{bmatrix} + \begin{bmatrix} T_s^2/m \\ T_s/m \end{bmatrix}(F[k] - F_{other})$$

if y is position & v is velocity, what does each coefficient mean?

Now lets put the system in feedback



What is h?

Some translation b/w error & force needed

What is closed loop gain?

Plug everything in together & put back into AB form.

$$x[k+1] = A\begin{bmatrix} y(k) \\ v(k) \end{bmatrix} + Bh v_d(k) - Bh\,[0\ 1]\begin{bmatrix} y(k) \\ v(k) \end{bmatrix} - B F_{off}$$

$$x[k+1] = \underbrace{(A - Bh\,[0\ 1])}_{\text{closed loop gain}}\begin{bmatrix} y(k) \\ v(k) \end{bmatrix} + Bh v_d(k) - B F_{off}$$

- The gain which is added from being in a loop

$$A_{CL} = \begin{bmatrix} 1 & T_s \\ 1 & 0 \end{bmatrix} - \begin{bmatrix} T_s^2/m \\ T_s/m \end{bmatrix} h\,[0\ 1] = \begin{bmatrix} 1 & T_s - h T_s^2/2m \\ 0 & 1 - h T_s/m \end{bmatrix}$$

$$B_{CL} = \begin{bmatrix} h T_s^2/2m & -T_s^2/m \\ h T_s/m & -T_s/m \end{bmatrix}$$

v correction ↗ ↘ offset

Eigen values ?

$$\lambda_1 = 1$$

$$\lambda_2 = 1 - \underbrace{h}_{\text{(small) } h} T_s/m$$