AA/ECE/ME 548 Linear Multivariable Control Sp22 Prof Burden

today:
- course logistics, Canvas, etc
- exam 2 next week – due Sat Jun 4
- HW 7 self-assessment – due ~~next Monday~~ Mon Jun 6
- HW 8 – due this Friday – self-assessment due
- week 9 lectures
- questions / office hours

TODO:
- mixed H_2/H_∞ control paper
- post today's notes & recording

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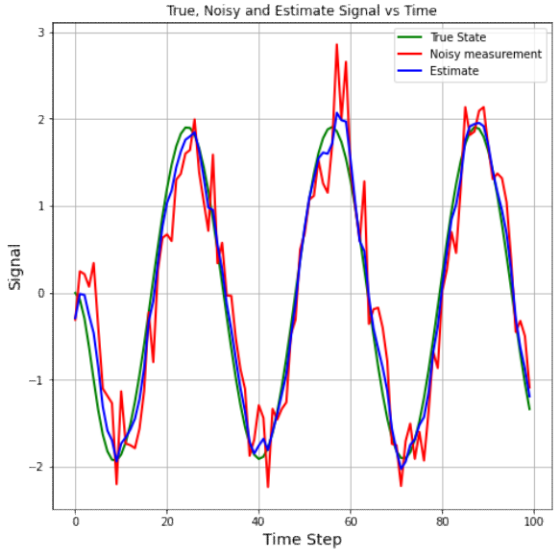
example results from applying Kalman Filter (HW7):



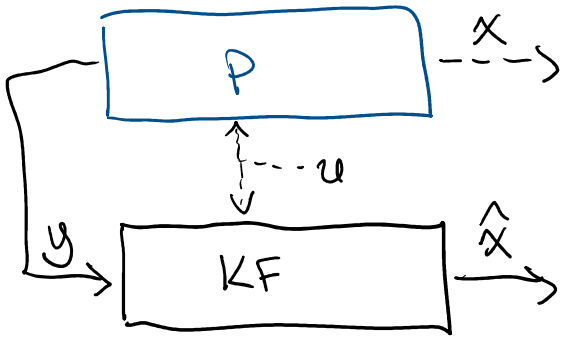
* looks like a low-pass filter
→ is it? if so, why? if not, why not?

- our Kalman filter is defined by:

$$\hat{x}_s = \tilde{x}_s + L_s(y_s - C_s\tilde{x}_s)$$

$$\tilde{x}_s = A_{s-1}\hat{x}_{s-1} + B_{s-1}u_{s-1}$$

i.e. $\hat{x}^+ = \hat{A}\hat{x} + \hat{B}u + Lu$



i.e. $\hat{x}^+ = \hat{A}\hat{x} + \hat{B}u + Ly$

$\Updownarrow$

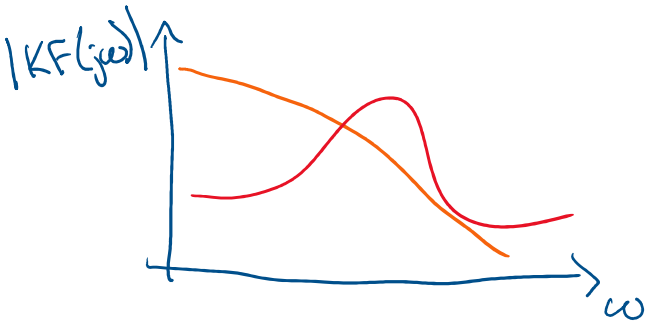
$\hat{X} = \underbrace{\left[(sI - \hat{A})^{-1}L\right]}_{KF} \cdot Y$

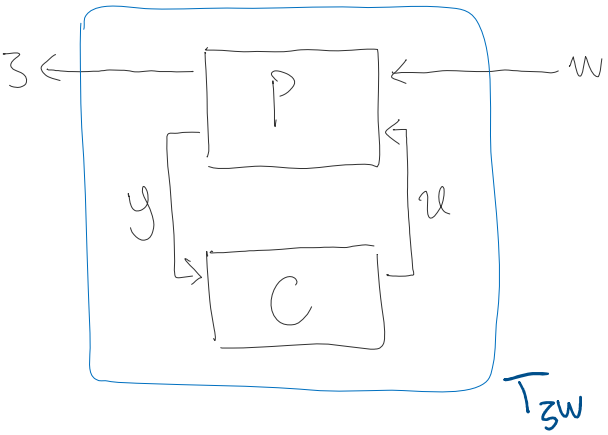
$x^+ = Ax + Bu + \delta$

$y = Cx + Du + \eta$

$\Updownarrow$

$X = \underbrace{\left[C(sI-A)^{-1}B + D\right]}_{P} Y$





LQG problem:

$w = \begin{bmatrix}\delta & \eta\end{bmatrix}$ u

$$P: \begin{matrix} \\ z \\ y \end{matrix} \begin{bmatrix} A & \begin{bmatrix}E & 0\end{bmatrix} & B \\ \begin{bmatrix}Q^{1/2} \\ 0\end{bmatrix} & 0 & \begin{bmatrix}0 \\ R^{1/2}\end{bmatrix} \\ C & \begin{bmatrix}0 & F\end{bmatrix} & \not{0} \end{bmatrix}$$

ex: LQG $w = (\delta, \eta)$, $\delta, \eta \sim \mathcal{N}(0, I)$, $z = (Q^{1/2}x, R^{1/2}u)$

$x^+ = Ax + Bu + E\delta$ $\Rightarrow$ $Cov[E\delta] = E^+E$

$$y = Cx + Fw$$

WANT: $\sum_{s=0}^{\infty} x_s^T Q_s x_s + u_s^T R_s u_s$ small $\iff$ $\|T_{zw}\|_2$ small