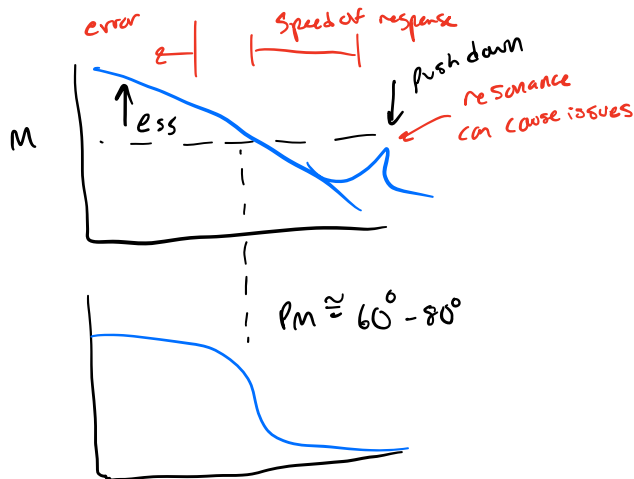


Last time: design PD & PI then combine to PID

→ PID results in conditionally stable system (due to PI)
 - this would not happen with lag

→ watch recorded PID example

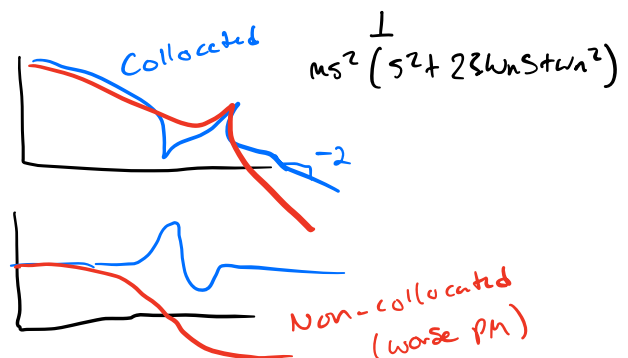


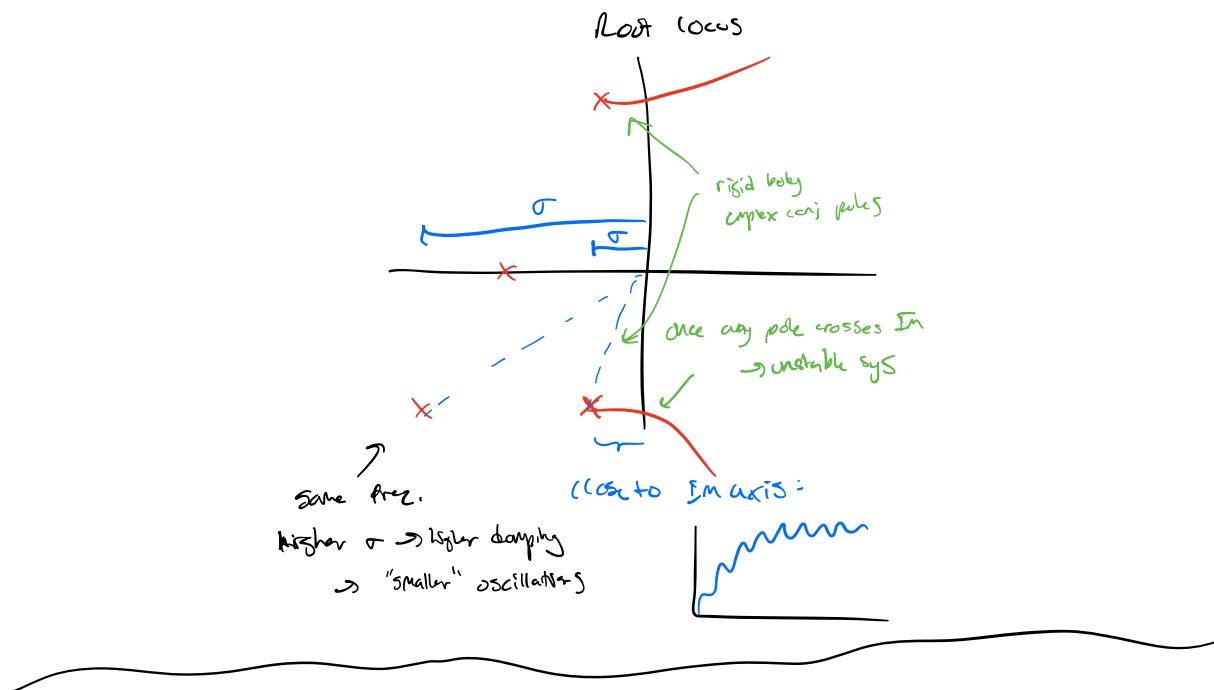
Gain margin compensation

- 1) Low pass filter - attenuates at higher freq.
 - can account for flexible modes changing (gain stabilization) - most robust
- 2) Notch compensator
 - inverse of resonance at exact frequency, most know frequency does not change

Stability & performance dependant on type of feedback

- Collocated: Sensed output & control input act at same "location"
- Non-collocated: output & input at different "locations"



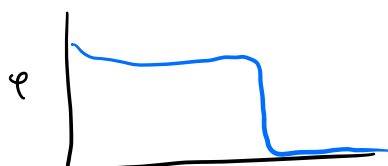
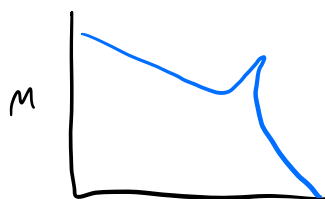


Ex: non-collocated

$$G(s) = \frac{c_1 s + c_2}{s(s^3 \sim \sim \sim)}$$

PM = 70°

$$G(s) = \frac{0.1(s+1000)}{s(s+0.05)(s^2+0.25s+200)}$$



- Set ω_c lower than flexible mode resonance (14 rad/s)
 \rightarrow design lead compensator

\rightarrow lead w/ $\omega_{c, des} = 1$