EE 105 Feedback control systems

PID, all together

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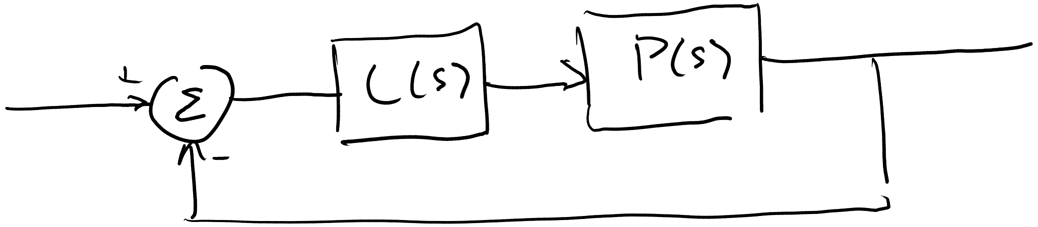
By the end of class today, you should be able to:

- Explain what "Ziegler-Nichols tuning" is, and do it with a reference
- Use the MATLAB pidTuner GUI to examine behavior
- Talk about tuning a PID controller in terms of poles on the s-plane

PID all together

Some plant P(s)



2nd order plant $P(s) = \frac{1}{s^2 + bs + c}$

Let C be a PID controller

$$C(s) = k_p + k_i \frac{1}{s} + k_d \cdot s$$

$$H(s) = \frac{C(s)P(s)}{1 + C(s)P(s)}$$

MATLAB....

$$H(s) = \frac{k_d s^2 + k_p s + k_i}{s^3 + (b + k_d)s^2 + (c + k_p)s + k_i}$$

Ziegler-Nichols tuning

Because it's well-known, not necessarily the best solution

step response of plant

lag

$L = t_d$ Rate $R = \frac{A}{\tau}$

$$P(s) = e^{-st_d} \cdot \frac{A}{\tau s + 1}$$

$$C(s) = k_p\left(1 + \frac{1}{T_I s} + T_D s\right)$$

P only: $k_p = \frac{1}{RL}$

PI: $k_p = \frac{0.9}{RL}$

$T_I = \frac{L}{0.3}$

PID: $k_p = \frac{1.2}{RL}$

$T_I = 2L$

$T_D = 0.5L$

MATLAB pidTuner

How do the parameters change as you adjust the sliders?

(Don't forget about the time scale!)

Ok, but what about the poles?