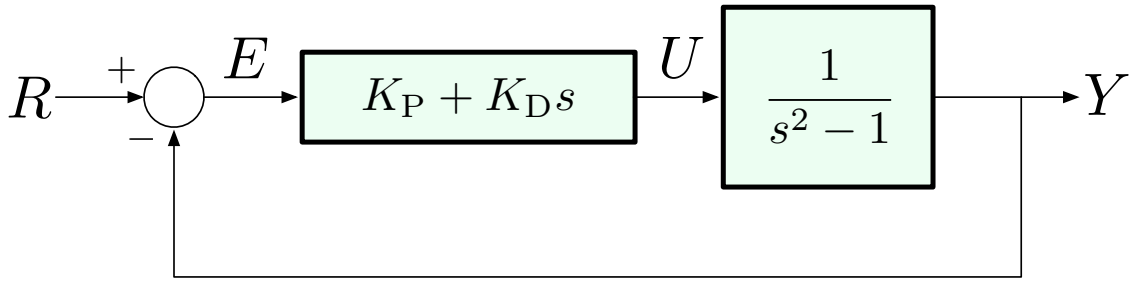
Proportional-Derivative (PD) Control



$$\frac{Y}{R} = \frac{K_P + K_D s}{s^2 + K_D s + K_P - 1}$$

By choosing K_P, K_D, we can achieve arbitrary pole placement!!

Also note that the addition of P-gain moves the zero:

$$K_D s + K_P = 0 \qquad \text{LHP zero at } -\frac{K_P}{K_D}$$

But what's missing? $\qquad \text{DC gain} = \left.\frac{Y}{R}\right|_{s=0} = \frac{K_P}{K_P - 1} \neq 1$

— can't have perfect tracking of constant reference.