Simple Pendulum PID Control

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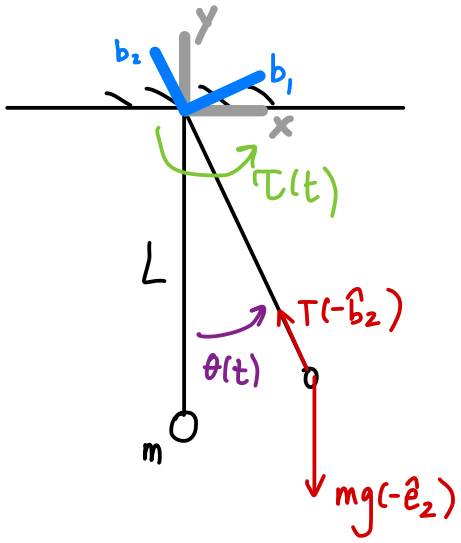
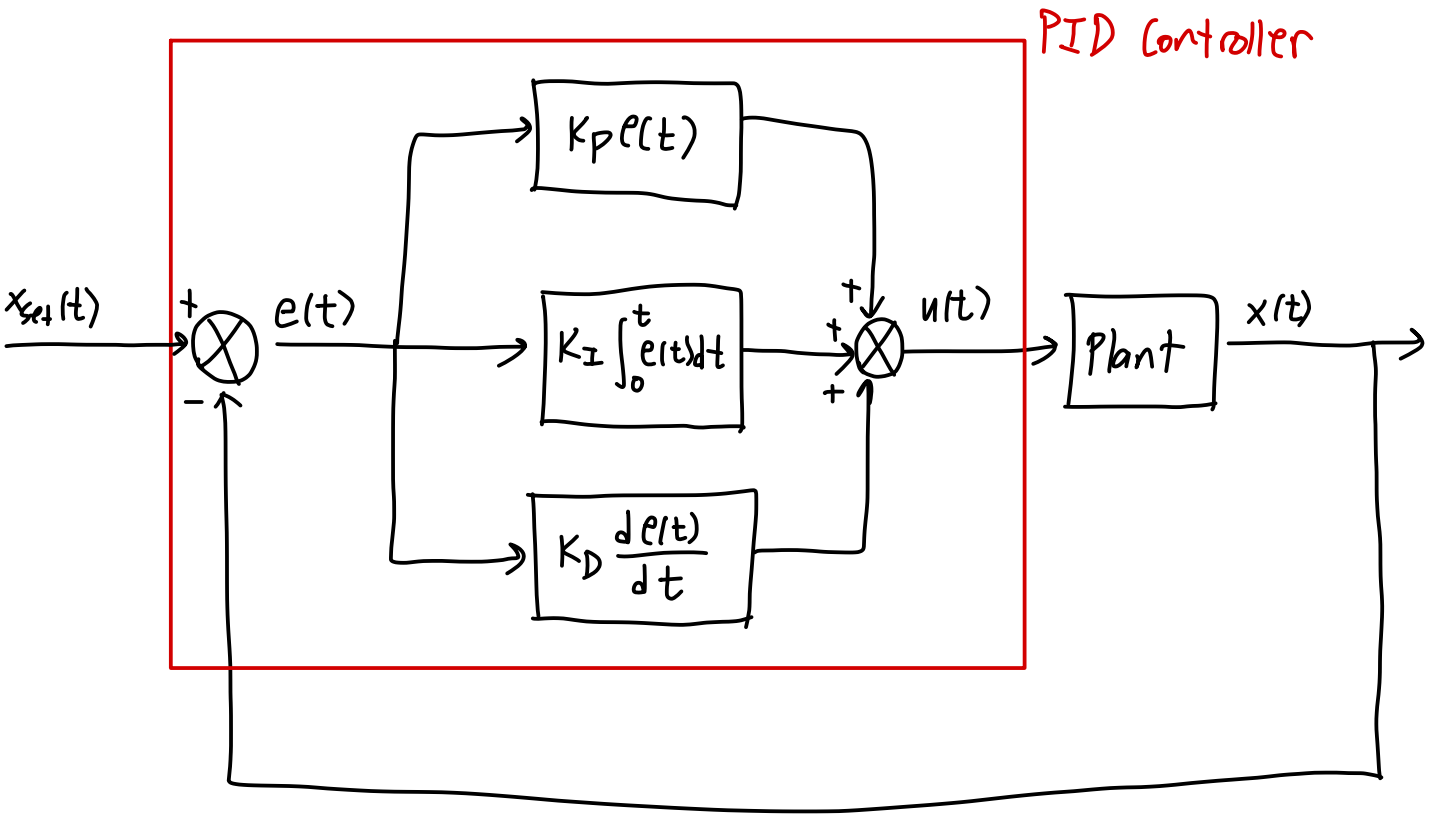


EOM: $ml^2\ddot{\theta} = -mgL\sin\theta + \tau(t)$

$= -mgL\sin\theta + K_{motor}u(t)$



$$\begin{cases} e(t) = \theta_{set} - \theta(t) \\ u(t) = K_p e(t) + K_I \int_0^t e(t)dt + K_D \frac{de(t)}{dt} \end{cases}$$

$$\Rightarrow \begin{cases} u_0 = K_p e_0 \\ u_i = K_p e_i + K_I \sum_{k=0}^{i} \frac{1}{2}\Delta t(e_{i-1} + e_i) + K_D \frac{e_i - e_{i-1}}{\Delta t} \end{cases}$$