Introduction to PID control

Control theory — the idea We want a system's output to be what we want. Here's a system: 

. We want y to be some command r. If it's not, we call that an error e, where

Enter control theory. It prescribes feedback: measuring the output y to compute the error e and prescribing the input u to decrease e. We usually represent this in a block diagram as follows.

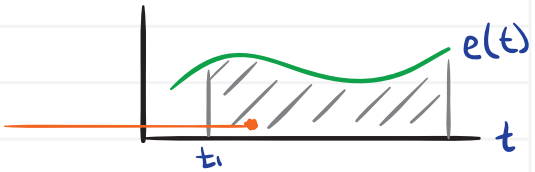
For instance, our system could be a motor with a link attached to its shaft, such as many robots have. Let the output y be the link's angular position and u be the voltage applied by a controller to the motor. Let r be the desired angular position, the the error is $e = r - u$.

Three operations on the error / PID control / all of Calculus

The error changes with time, so it's a function of it: $e(t)$. Our controller must perform operations on $e(t)$ to determine the system input u (e.g. voltage). We here consider three types:

Proportional, which scales the error:

Integral, which integrates the error:



Derivative, which differentiates the error: