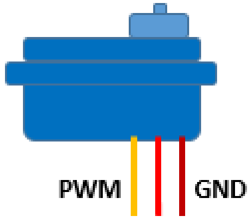
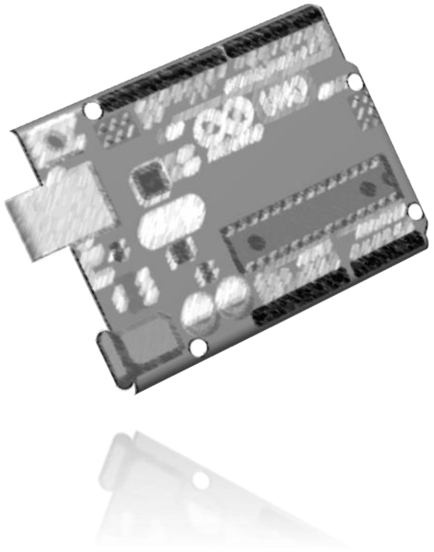
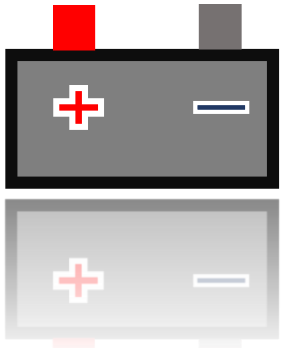
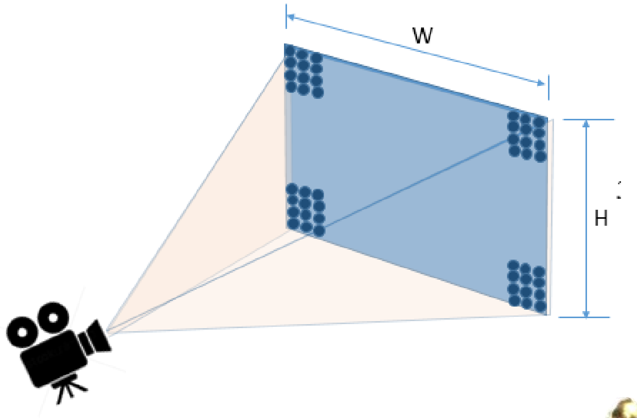
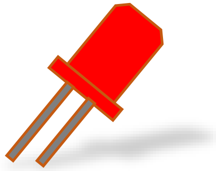
Controller

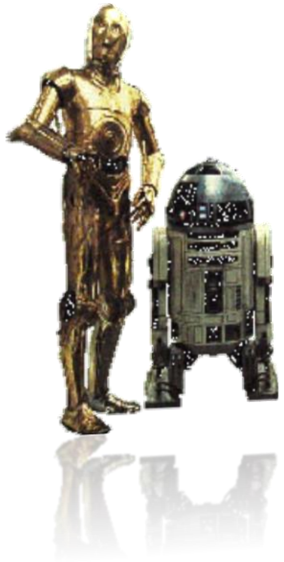


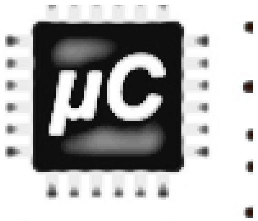




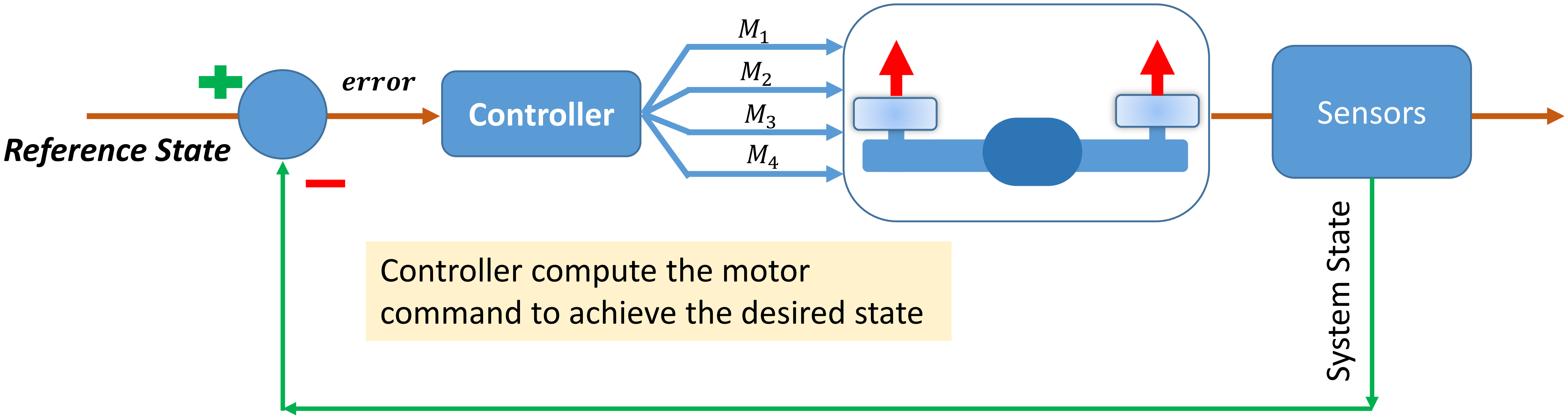








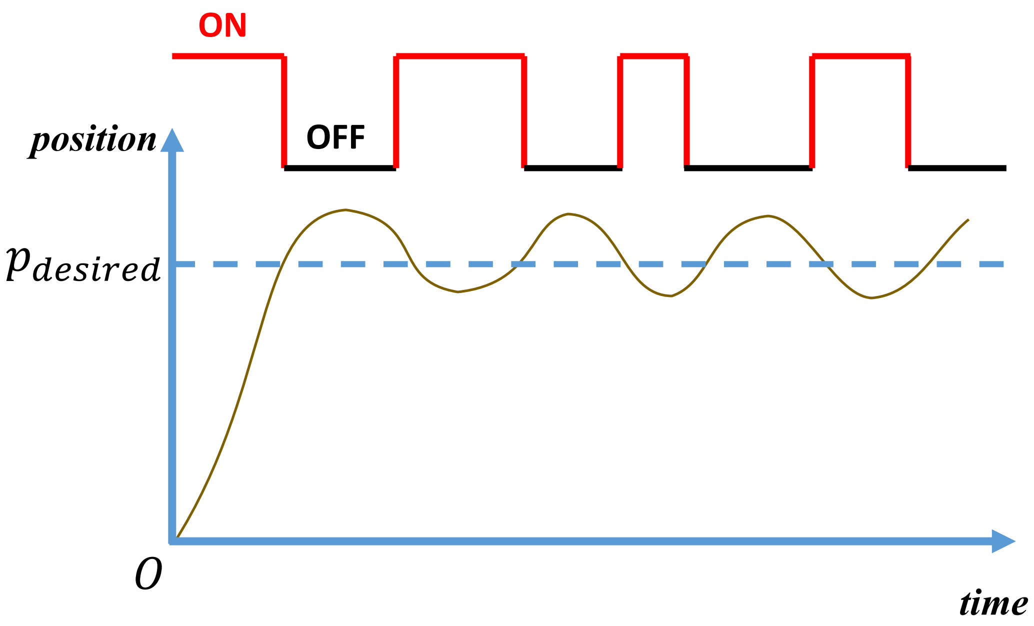
Controller

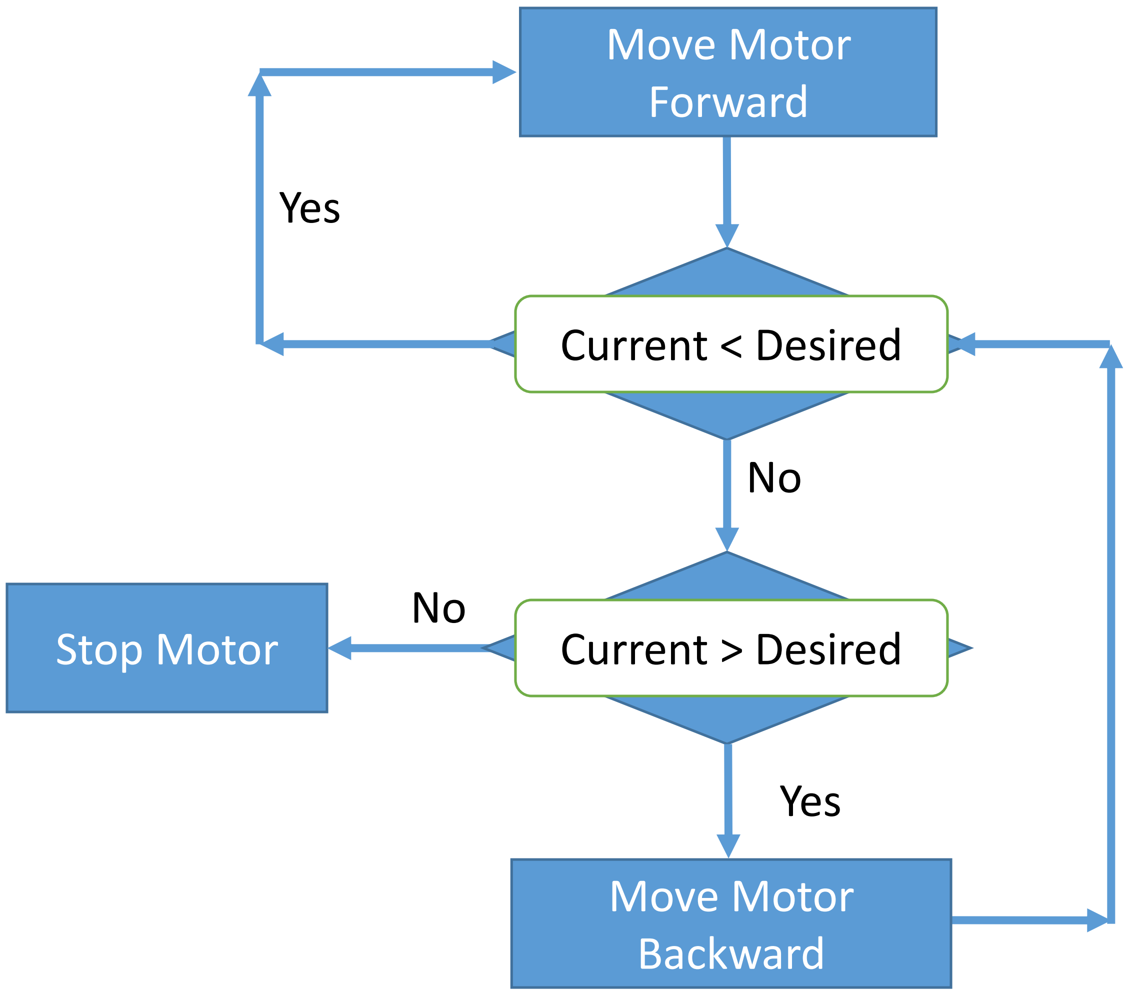


u takes r and produces a control signal that hits the state x of the system to produce output y.

Control Action

On-Off Control





PID Control

Proportional Control

$$e_a(t) = K_p e(t)$$

Integral Control

$$e_a(t) = K_I \int e(t)dt$$

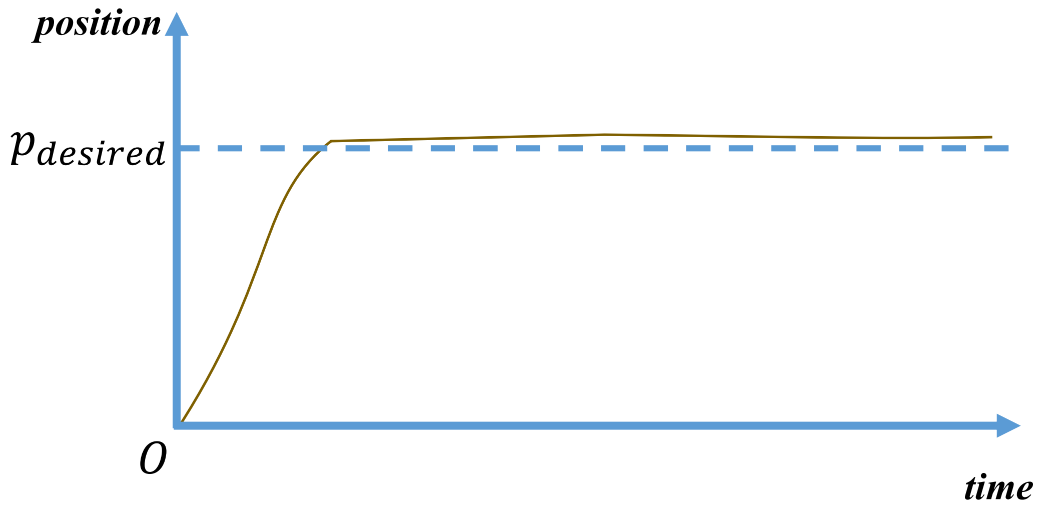
Derivative Control

$$e_a(t) = K_d \frac{de(t)}{dt}$$

PID controller will adjust the motor speed such that the position stays as close as possible to the desired value, with little variation

PID control is useful in any application where it's critical that there's very little variation in the variable that's being PID controlled.

- flight controller for quadcopters and planes
- an incubator,
- a fermentation tank etc

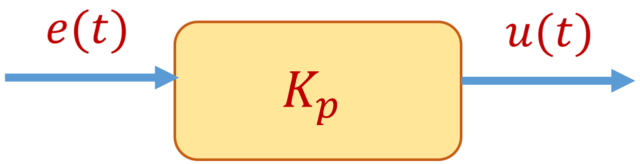


Proportional term: output proportional to the size of the error signal.

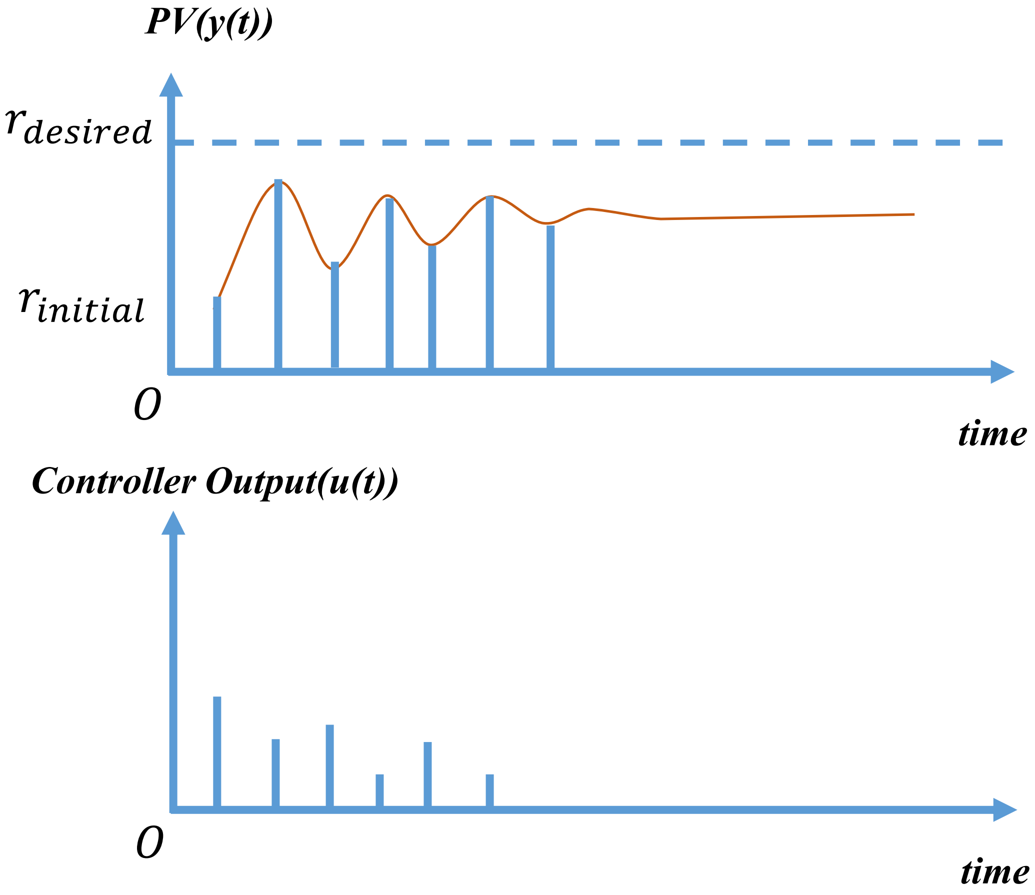
Integral term: output depends on the amplitude and duration of the error signal.

Derivative term: output depends on the rate of change of the error signal.

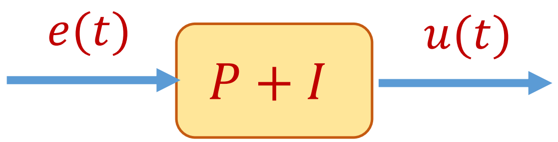
Proportional Controller



$$u(t) = K_p e(t)$$

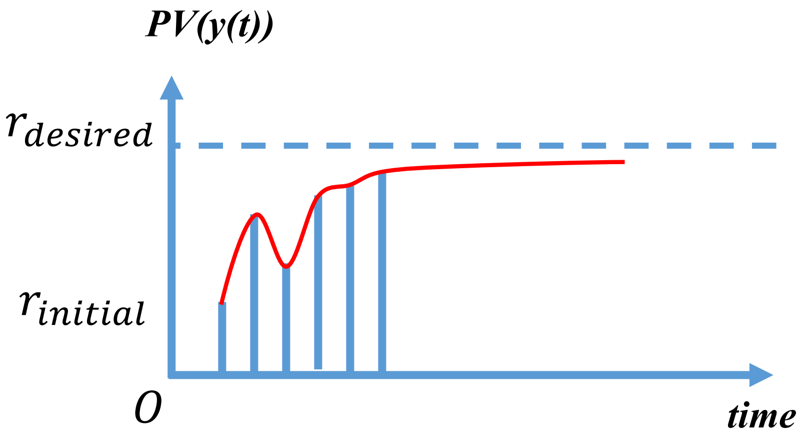


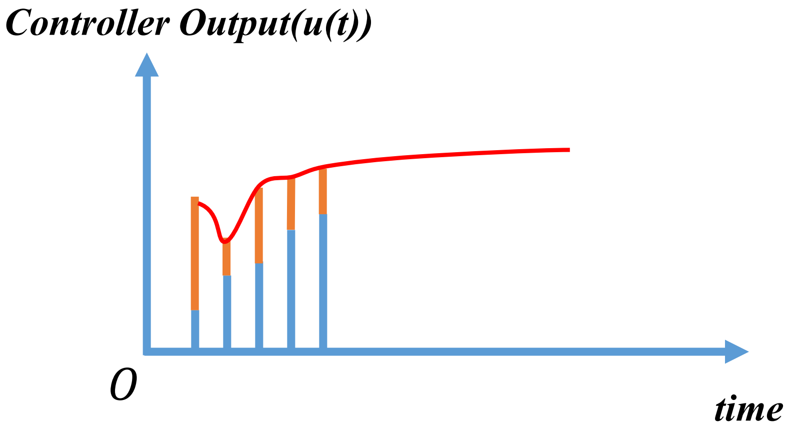
Proportional and Integral Controller



$$u(t) = K_p e(t) + K_I \int e(t)dt$$

$$u(t) = K_p e(t) + K_I \sum e(t)$$





PID Tuning

Parameters	Rise Time	Overshoots	Steady-State Error	Stability
K_p	Decreases	Increases	Decreases	Degrades
K_I	Decreases	Increases	Eliminate	Degrades
K_d	Minor Change	Decreases	No Effect	Improves a bit

Thanks