PID Motor Control

How do you control the speed of a motor? Let S_D be the desired speed, S_M be the measured speed, and PWM be the PWM value. Define the error as

$$e(t) = S_D - S_M$$

1. Proportional control:
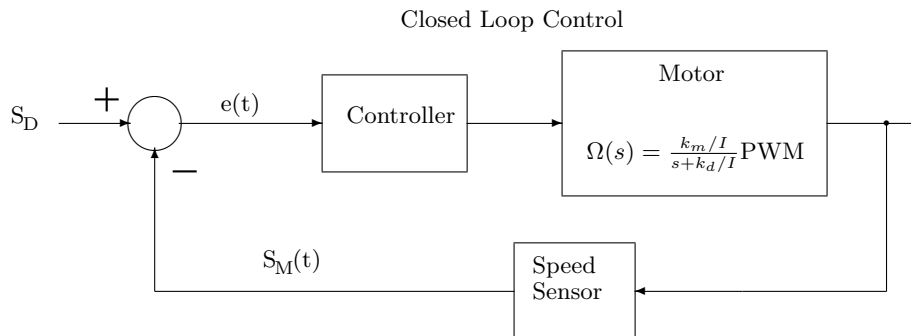
$$\text{PWM}_P = k_P e(t)$$

2. Integral control:

$$\text{PWM}_I = k_I \int_0^t e(\tau)d\tau$$

3. Differential controld:

$$\text{PWM}_D = k_D \frac{de(t)}{dt}$$

Then $\text{PWM} = \text{PWM}_P + \text{PWM}_I + \text{PWM}_D$

Engineering is to find k_P, k_I and k_D such that motor responds in a "good" way. Control theory shows how to find "good" values for k_P, k_I and k_D, based on the characteristics of the system.

Closed Loop Control

Type	Controller
Proportional	k_P
Integral	k_I/s
Differential	sk_D

k_d is the viscous friction of the motor

k_m relates torque to PWM

Fuzzy Logic Motor Control

Traditional control theory requires one to make a complex mathematical model of the plant to be controlled, then mathematically analyze the closed-loop control system to find a "good" controller. Newer control methods have been developed which try to control a system in an intuitive way, like a human or an animal might. Three methods often used are `neural networks`, `genetic algorithms` and `fuzzy logic`. The MC9S12 has instructions specifically for fuzzy logic control.

References: `http://focus.ti.com/lit/an/slaa235/slaa235.pdf`, `http://www.fuzzy-logic.com/ch3.htm`