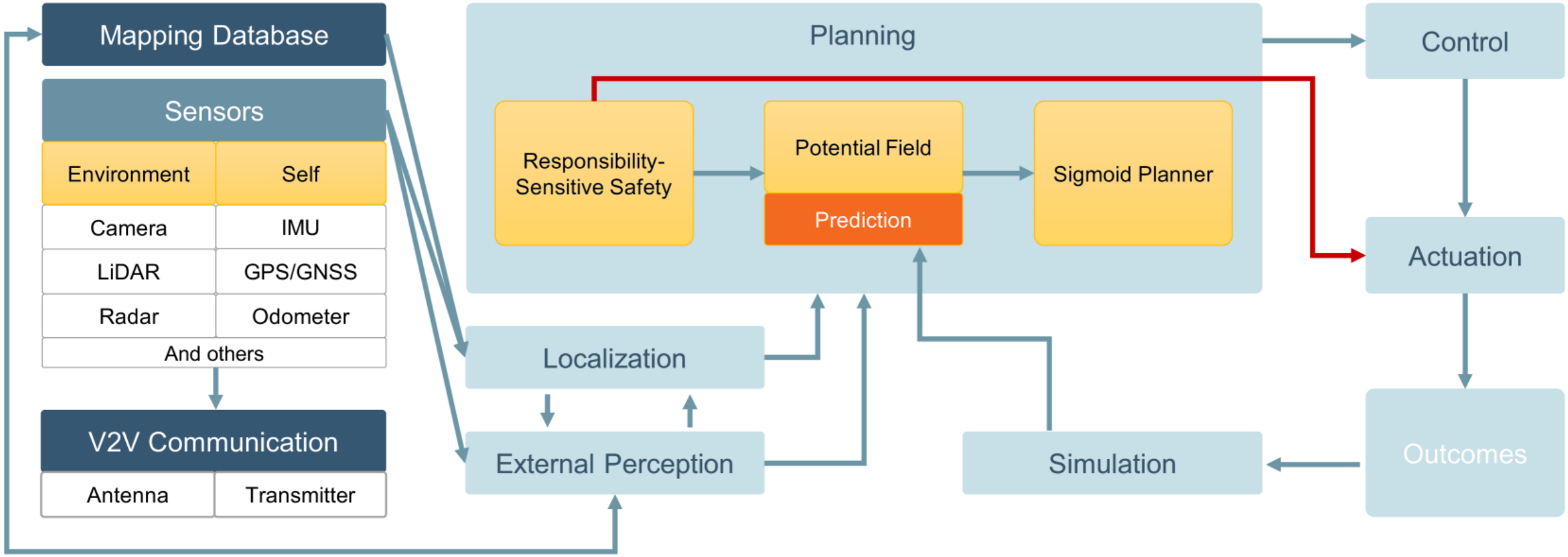
Motor Control

Mobile Robotics

Anthony J. Clark

Rule-Compliance Path Planner

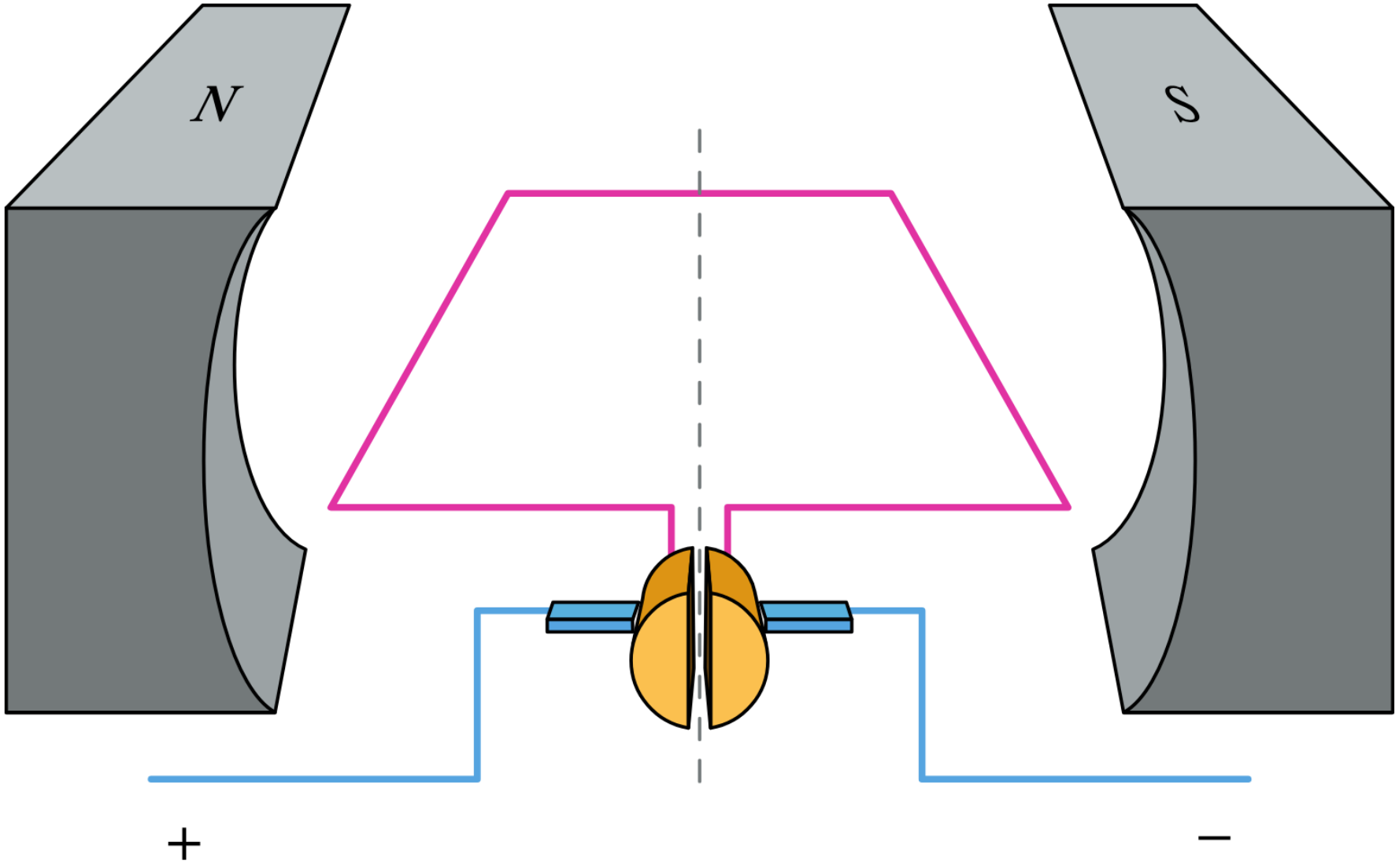


Pengfei Lin, 2024

Today

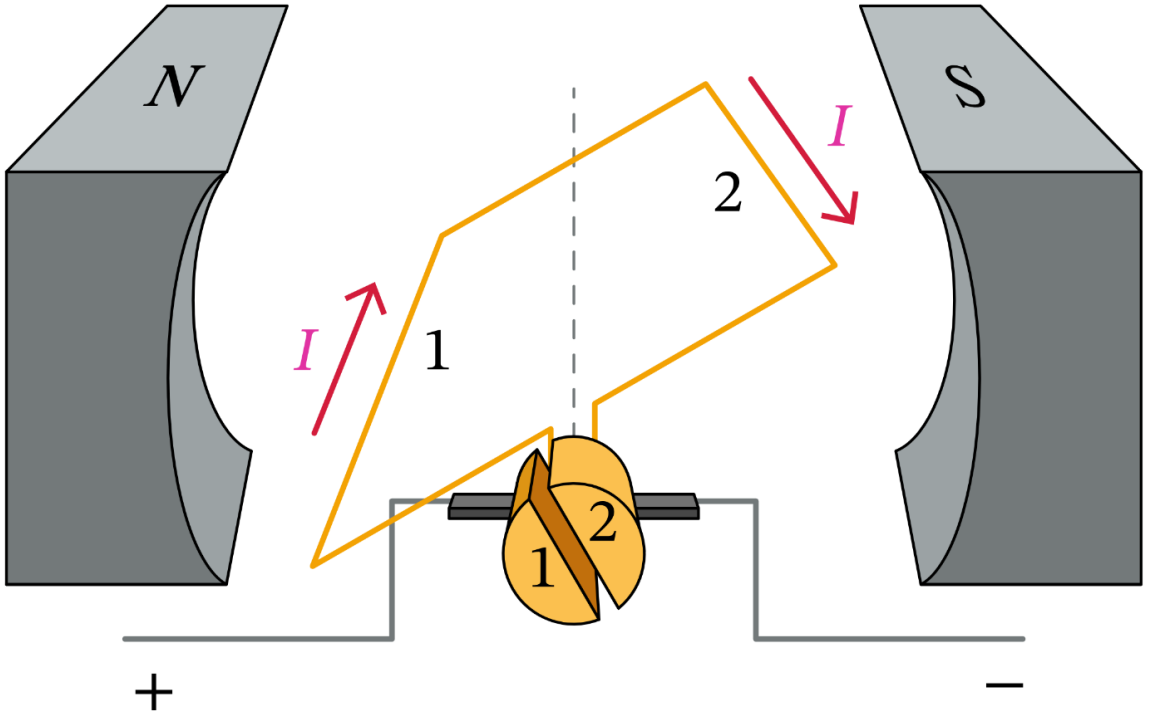
- DC Motors
- H-bridge motor driver (vary motor direction)
- Pulse-width modulation (PWM) (vary motor speed)
- Quadrature encoders (measure motor motion)
- Proportional control (control motor speed)

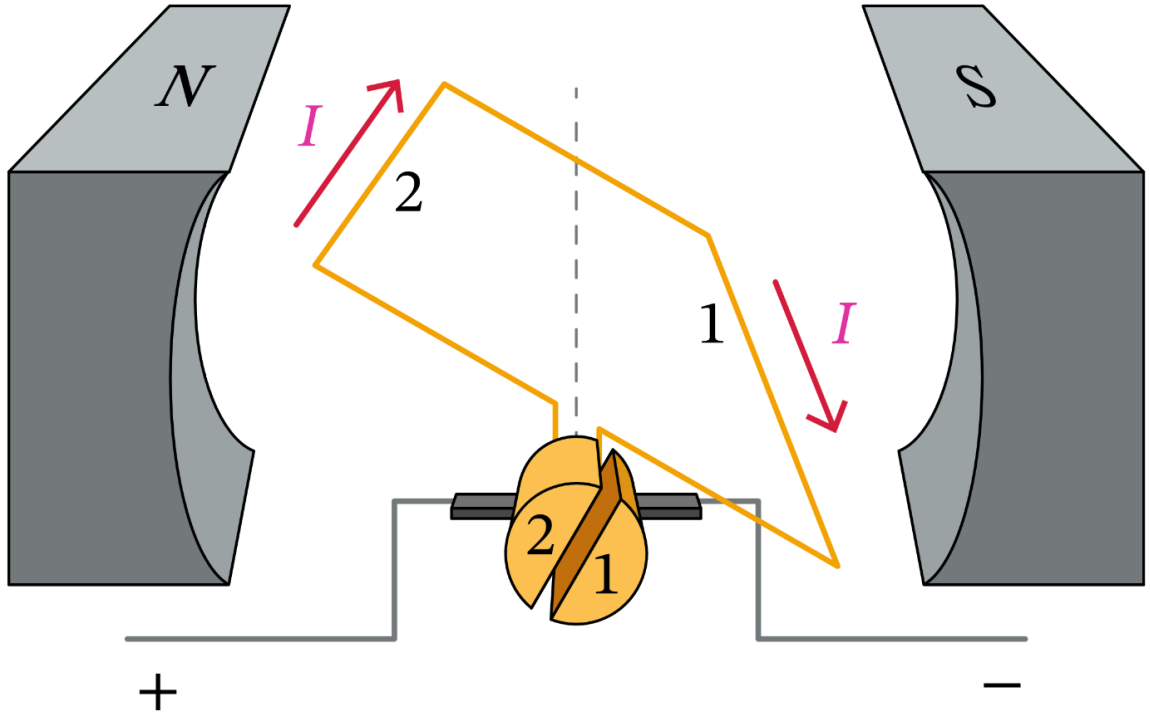
DC Motor Diagram



Lesson Explainer: Direct Current Motors | Nagwa

DC Motor Diagram





[Lesson Explainer: Direct Current Motors | Nagwa]

DC Motor Model

$$v = \frac{\alpha}{K_v} + Ri + L\frac{di}{dt}$$

DC Motor Model

$$v = \frac{\alpha}{K_v} + Ri + L\frac{di}{dt}$$

Where

v is the voltage applied (or measured) across the motor terminals

α is the angular velocity of the motor shaft

K_v is the speed constant of the motor

R is the resistance of the motor

i is the current through the motor

L is the motor's inductance

$\frac{di}{dt}$ is the rate of change of current

See Kirchhoff's circuit laws - Wikipedia

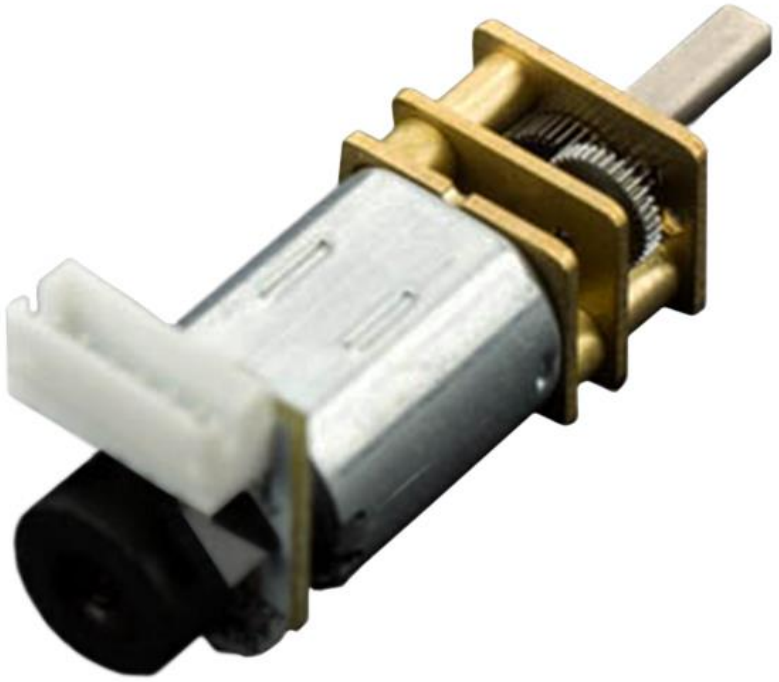
DC Motor Speed Vs. Voltage

H-Bridge

Pulse-Width Modulation (PWM)

$$V_{\text{effective}} = {}^{V}T_{\text{duty}-\text{cycle}}$$

Quadrature Encoders



System Diagram

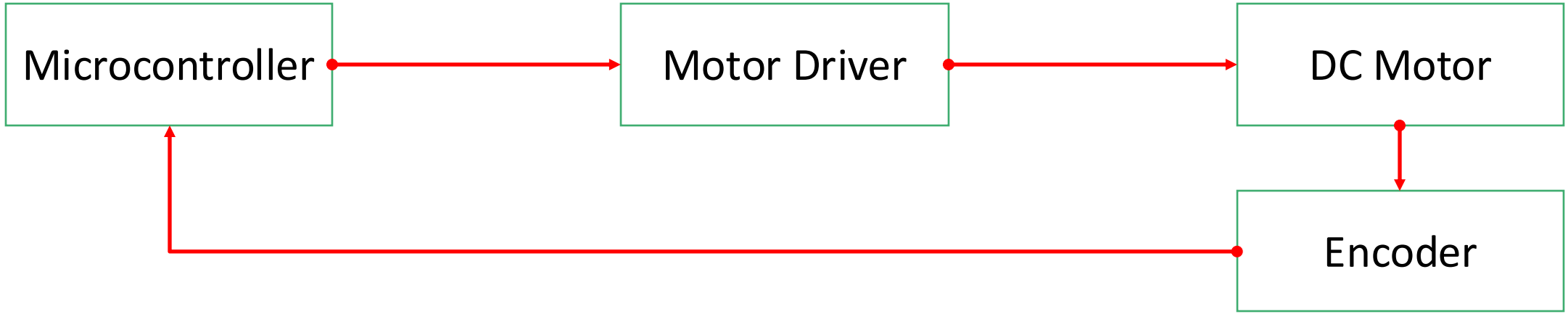
Microcontroller

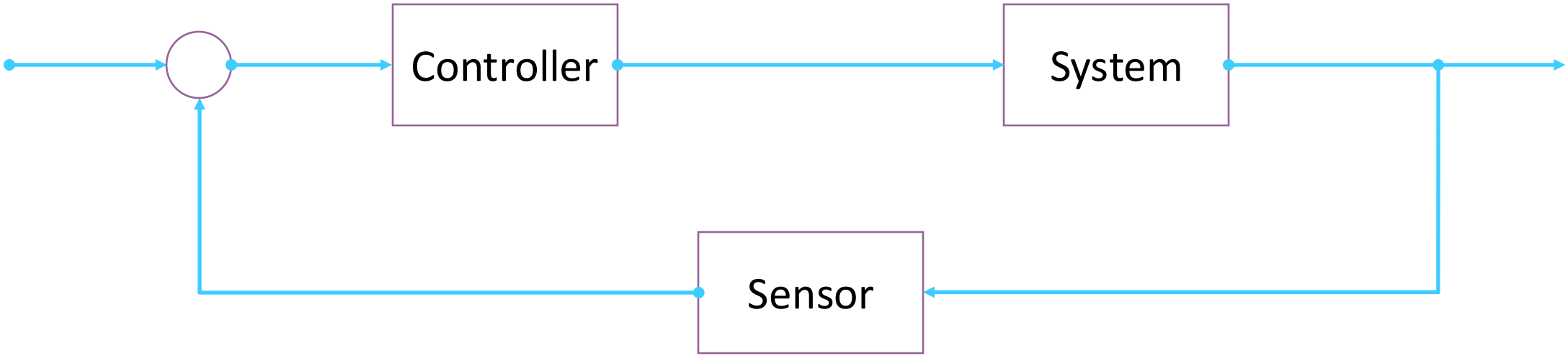
Motor Driver

DC Motor

Encoder

System Diagram





Proportional Control

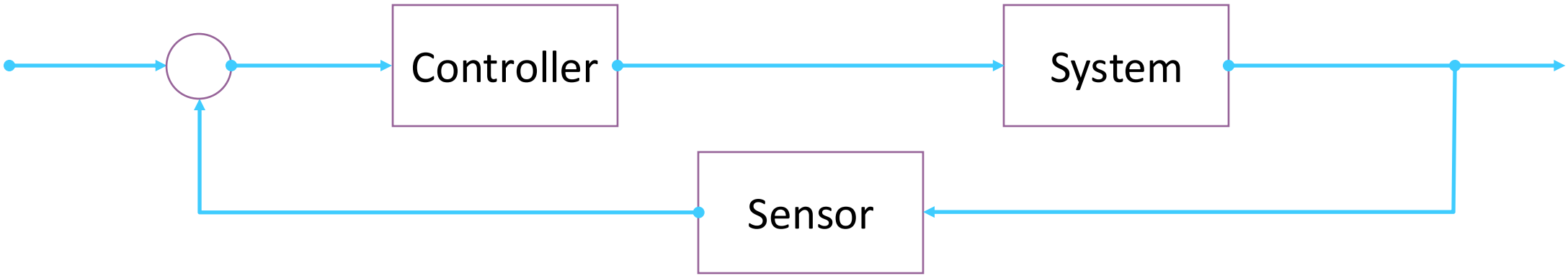
$$u = K_p e$$

Where

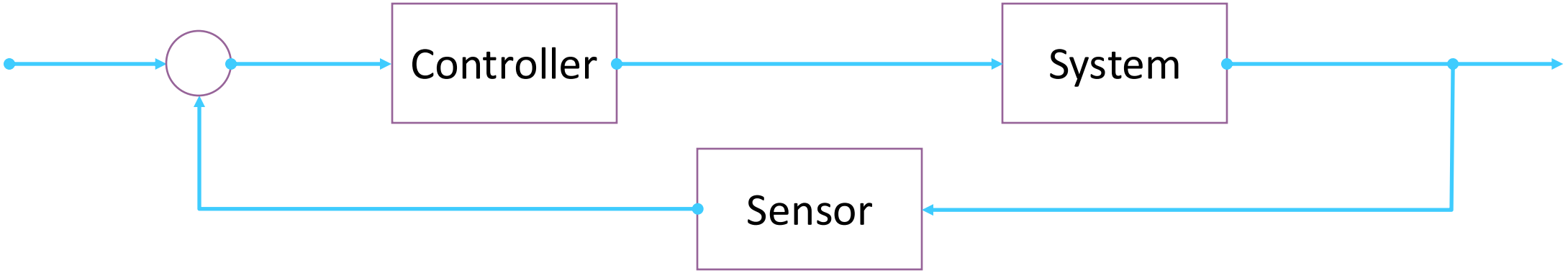
u is the controller output

K_p is a unitless proportional gain

$e = r - \hat{y}$ is the error between the reference and the measured values



Proportional Control



r	$\hat{y}$	e	u	y	**PWM**