Lab 8

Understanding our Robot Servos and Encoders

CMPE-110
Intro to Computer Engineering
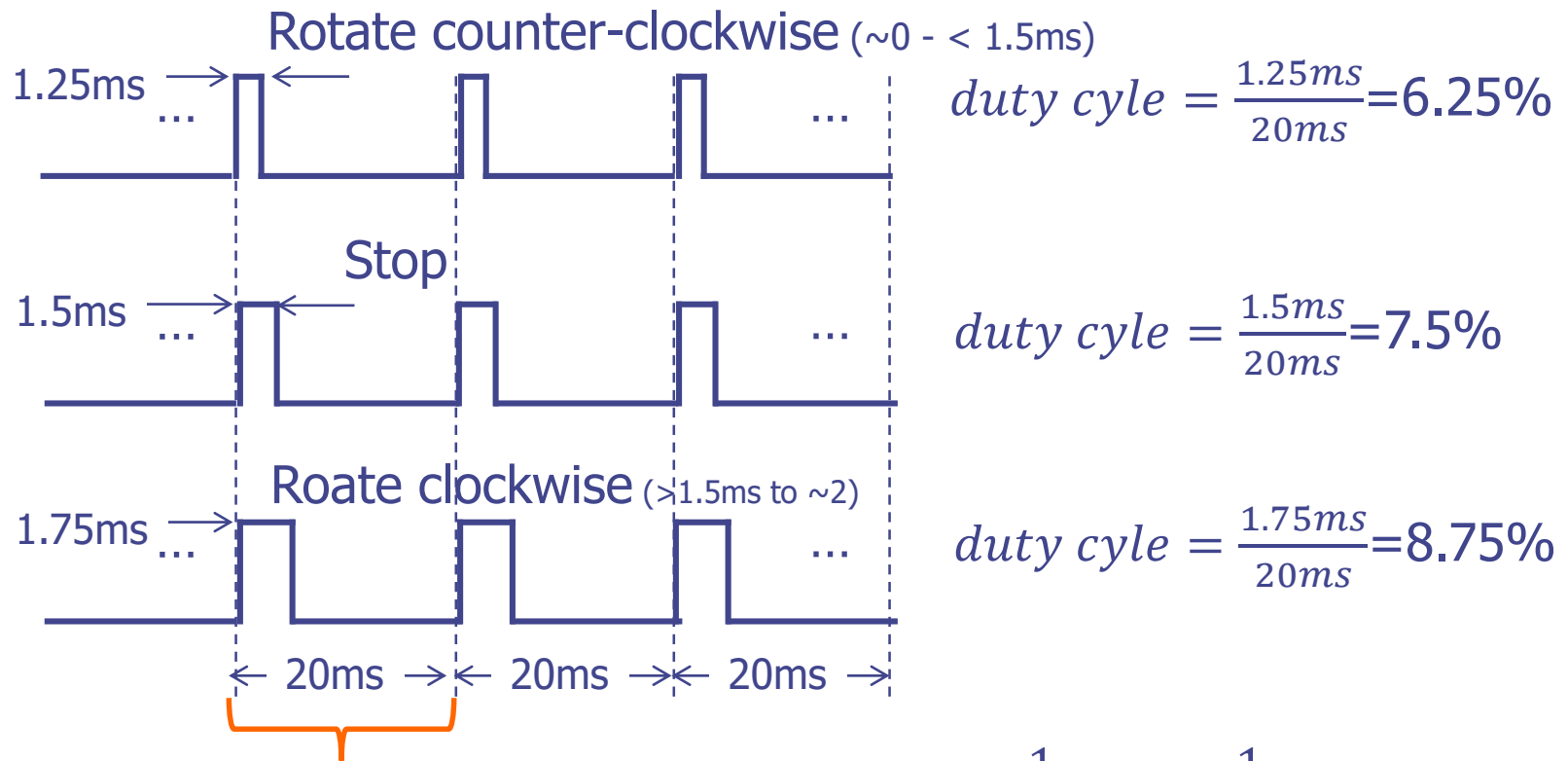
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Servo Motors

Output Spline — Drive Gears — Servo Case — Control Circuit — Potentiometer — Motor

- Servo motors are small DC motors with an integrated gearbox and controller board.

- Servos often have integrated stops at +/- 60°, +/- 90°, or no stops at all for continuous rotation.

- In general, an integrated potentiometer measures position of the output shaft for the controller board.

- Servos use proportional control. The more power applied, the faster the servo turns.

- Microcontrollers tell the controller boards inside servos how to turn based on inputting pulse signals.

- These signals are called pulse width modulation.

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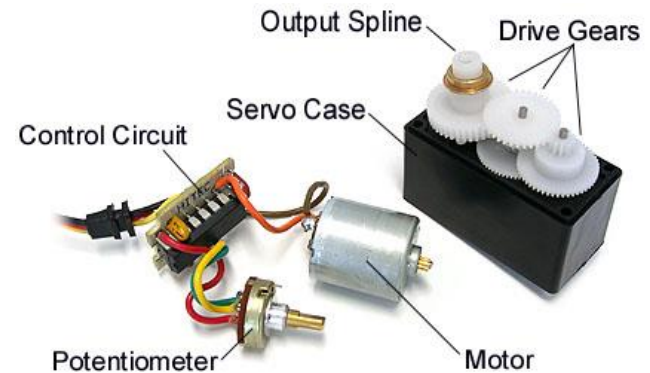
Pulse Width Modulation

◈ The pulses repeat at a period rate

◈ How long the pulse is high is what changes

Rotate counter-clockwise (~0 - < 1.5ms)

1.25ms ...

$$duty\ cyle = \frac{1.25ms}{20ms} = 6.25\%$$

Stop

1.5ms ...

$$duty\ cyle = \frac{1.5ms}{20ms} = 7.5\%$$

Roate clockwise (>1.5ms to ~2)

1.75ms ...

$$duty\ cyle = \frac{1.75ms}{20ms} = 8.75\%$$
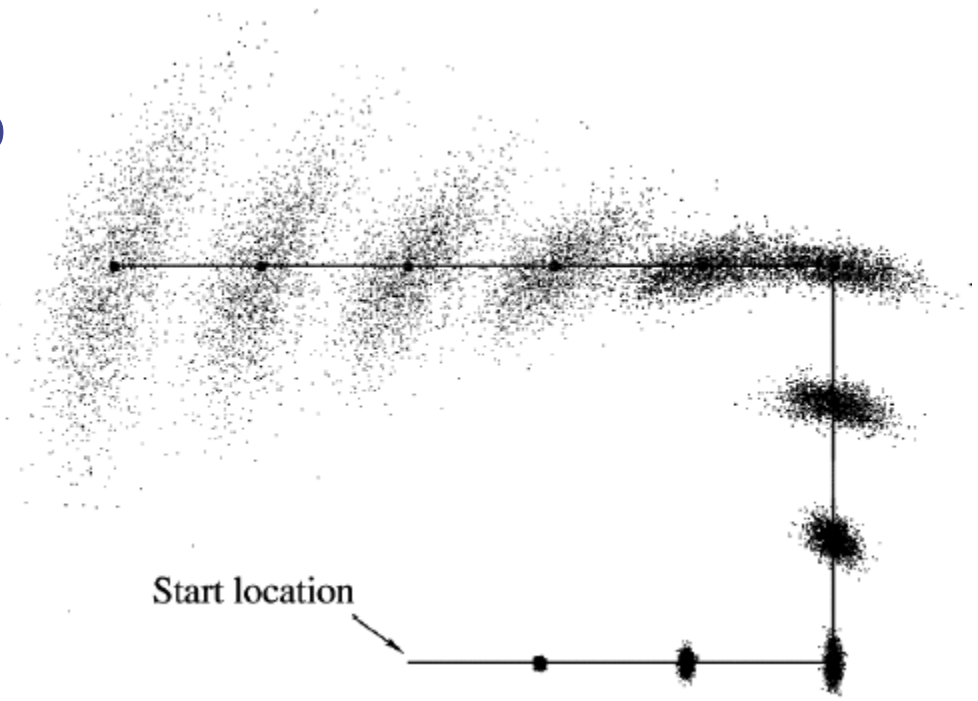
← 20ms → ← 20ms → ← 20ms →

Period = 20ms

$$frequency = \frac{1}{period} = \frac{1}{20ms} = 50Hz$$

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Dead Reckoning

◈ Last week we used simple commands to our bot (i.e. fwd, rev, turn, stop).

◈ These commands did not use any sensors to observe/know where the robot was. This is referred to as dead reckoning. The longer the robot moves, the less we know the robots true location.

Start location

Its like trying to find your way in the dark

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Sensing the World

- ◆ Sensors are used to improve our location and path planning.

- ◆ There are many types of sensors:
  - Proximity/Range
    - ◆ Mechanical (e.g. tactile switches)
    - ◆ Reflective (e.g. infrared, ultrasonic)
  - Environmental
    - ◆ Temperature, Pressure

- ◆ Our robots have 3 sets of sensors:
  - Two magnetic encoders (one on each wheel)
  - Six bump sensors
  - Eight line following sensors

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Magnetic Sensors

The robot has a disc attached to the shaft on each motor. The disc has 8 magnetic poles on it (4 North and 4 South).

A Hall Effect sensor detects when the magnets pass by it.

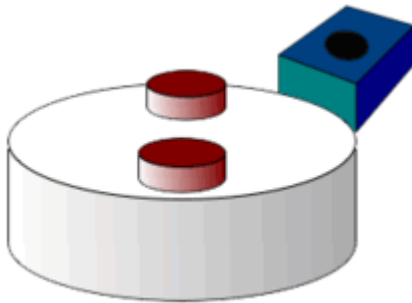The illustration shows a disc with 2 poles:

Image Credit: https://en.wikipedia.org/wiki/Hall_effect_sensor

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