Servo Control — the lab course of Snake Robot

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Background
Servo Overview

Servo Shells

Helm

Reducer Gears

Cables

Potentiometer

DC Motor

Control Circuit
Servo Principle

\[ V_{\text{error}} = (V_{PWM} - V_{\text{potentiometer}}) \times K_{\text{Amplifier}} \]
Pulse-Width Modulation (PWM)

- Output signal alternates between on and off within specific period

\[ \text{Duty Cycle} = \frac{t_{on}}{t_{on} + t_{off}} \]
PWM in Servo

![PWM in Servo Diagram](image-url)
Servo Modification

\[ R_p = 2R, \; R \approx 2.5k\Omega \]
Arduino Nano Overview

**Tips**

- Power Supply: Mini-B USB, Pin 27 +5V
- 6-PWM Output: D3, 5, 6, 9, 10, 11
- Test LED Pin D13: High-On, Low-Off
Arduino Servo Connection

- brown = ground
- red = power
- orange = control

Digital Pin 9

+5V

Ground
Download and Install

- Download Arduino compiler and development environment from:
  
  https://www.arduino.cc/en/Main/Software?setlang=cn

- Current Version: 1.6.5

- Available for:
  - Windows
  - MacOS
  - Linux

- Before running Arduino, plug in your board using USB cable (external power is not necessary)

- When USB device is not recognized, navigate to and select the appropriate driver from the installation directory
Using the Arduino IDE

- Name of sketch
- Compile sketch
- Upload to board

Program area

Messages / Errors

Serial Monitor

Save

New

Open
Select your Arduino Nano Board

![Arduino IDE screenshot](image-url)

- Arduino Uno
- Arduino Duemilanove w/ ATmega328
- Arduino Diecimila or Duemilanove w/ ATmega168
- Arduino Nano w/ ATmega328
- Arduino Nano w/ ATmega168
- Arduino Mega 2560 or Mega ADK
- Arduino Mega (ATmega1280)
- Arduino Mini w/ ATmega328
- Arduino Mini w/ ATmega168
- Arduino Ethernet
- Arduino Fio
- Arduino BT w/ ATmega328
- Arduino BT w/ ATmega168
- LilyPad Arduino w/ ATmega328
- LilyPad Arduino w/ ATmega168
- Arduino Pro or Pro Mini (5V, 16 MHz) w/ ATmega328
- Arduino Pro or Pro Mini (5V, 16 MHz) w/ ATmega168
- Arduino Pro or Pro Mini (3.3V, 8 MHz) w/ ATmega328
- Arduino Pro or Pro Mini (3.3V, 8 MHz) w/ ATmega168
- Arduino NG or older w/ ATmega328
- Arduino NG or older w/ ATmega168

Note: The screenshot shows a partial list of Arduino boards available in the IDE.
Select Serial Port

![Select Serial Port screenshot]
# Arduino Sketch Structure

- `#include <Servo.h>`
  - Some specific libraries will be included in your Sketch, which will simplify your codes

- `void setup()`
  - Will be executed only when the program begins or reset button is pressed

- `void loop()`
  - Will be executed repeatedly
Servo library-Servo.h

**Functions:**

- `Servo myservo;` //create servo object to control a servo

- `myservo.attach(pin);` //Attach the Servo variable to a pin

- `myservo.write(angle);` //Writes an angle value to the servo

- `myservo.writeMicroseconds(uS);` //Writes an PWM value in microseconds (uS) to the servo

- `delay(ms);`
Example

- **Sweep**
  - Sweeps the shaft of a servo motor back and forth across 180 degrees.

- Find out the stop position after servo modification
  - Find out the stop position by using `writeMicroseconds`

- Those codes will be first simulated by Proteus Software and then will be conducted on the Arduino board.
Practice

- Controlling a servo to sweep by using “Servo.h”
- Modify all the servos and test out the stop points, label the PWM value on the servos