SERVO MOTOR

Topics Covered

- Hobby Servos for position control.

Prerequisites

- The QNET Mechatronic Actuators has been setup and tested. See the QNET Mechatronic Actuators Quick Start Guide for details.
- You have access to the QNET Mechatronic Actuators User Manual.
- You are familiar with the basics of LabVIEW™.

1 Background

A servomechanism is a device that uses a feedback sensor to automatically adjust the behaviour of a system using feedback control. A DC servo motor, or servo, is a rotary actuator that transforms electrical energy into mechanical energy incorporating a feedback mechanism for position control. It holds the commanded position, even under load, until it is instructed to do otherwise.

A typical servo includes a motor, a gearbox, a potentiometer to sense angular position, and a control circuit. The gearbox is used to generate a high holding torque compared to standalone motors of a similar size. The travel range of servos is typically restricted to be $\pm 180^{\circ}$, with the position command provided as a pulse width modulation (PWM) signal. Whenever the servo is pulsed with a low pulse width, also called *Minimum Pulse*, the motor will remain in the low position. A neutral pulse will result in a rotation of half the range, and a large pulse, also referred to as *Maximum Pulse*, will result in a rotation to the full range of the servo, see Figure 1.1. Note that the pulse length that is required to command a certain position varies between servos. In the case of the servo used on the QNET Mechatronic Actuators, the servo is provided with a 3-5V pulse, at 50Hz. The width of the pulse is varied between 0.9ms and 2.1ms, with a pulse width of 1.5ms corresponding to the neutral (centre) position.

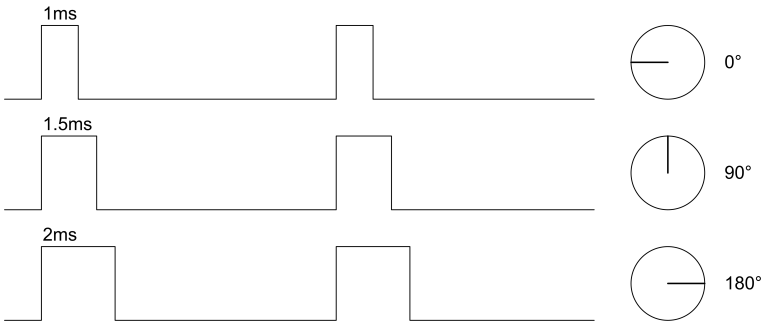

Figure 1.1: Commanding the servo position

2 In-Lab Exercise

1. Open the `QNET Actuators - Servo Motor.vi`. **Make sure the correct Device is chosen.**
2. Run the VI, and enable the servo using the Servo Enable, button.
3. Vary the Servo Pulse Width between 0.9 and 2.1 ms. Measure the resultant servo angles on the cog wheel using a protractor, or other angle measurement device.
4. Based on your measurements, determine a calibration gain to allow you to command the servo using a desired angle command in degrees.
5. Enter your calculated calibration gain into the field on the front panel, and ensure that the Command Type is set to *Position*. Vary the commanded position, and verify that your gain is correct.
6. Using either the position or pulse width command fields, command the servo motor to traverse its full range and record the resultant speed and current profile.
7. Analyze the response and comment on the current control profile. Try moving the servo through a series of positions by sweeping the command dial back and forth. How does the measured current relate to the position of the servo?

   Note: Think about the elements of the servo motor and how it achieves the desired position.

8. Click on the Stop button to stop the VI.

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