**Latency Measurement of Multiple Servo Network**

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**Abstract – Accomplishing complex tasks in robotics often utilize robots with multiple degrees of freedom, using sophisticated servo motors to precisely control position and velocity of individual limbs. As more of these servos are added to the system, the problem of latency between robot controller and the network of servos becomes a matter of concern. Using Dynamixel AX12 servo motors, we measure the time delay between a command to the servo and the servo response. We repeat this measurement with an increasing number of servo motors in the network, and determine if there is a significant difference in latency between smaller and larger network sizes.**

# INTRODUCTION

Many industries implement robotics to maintain a competitive advantage in terms of cost and labor. As these industries continue to grow, the need for more sophisticated robots grows proportionally. A key component to robotics is servo motors, which are actuation devices capable of precise control of angular position, velocity and acceleration.

The motivation of this study is a result of the development of a bipedal humanoid robot, which uses up to twenty AX12 servos simultaneously in order to perform functions such as legged locomotion. AX12 servos are high performance servos capable of precise position control, and are also capable of continuous rotation, making them useful in developing particularly complicated robots.

# METHODOLOGY

To determine the delay between the microcontroller command signal and the servo response, an oscilloscope probe is placed at the signal wire between the microcontroller and the servo, while another probe is similarly placed at the voltage wire, between the supply and the servo. The oscilloscope is set to single trigger, on the falling edge of the voltage signal. The microcontroller is connected to a PC, and an instruction to move the servo is sent via a terminal program called Robo Terminal.

As the command is executed, the microcontroller sends out a command packet to the servo, and the servo will draw current from the power supply in order to move. This results in a small, but measurable drop in voltage that will be detected by the oscilloscope. The oscilloscope will trigger, and capture both the voltage change and the command packet. The delay is measured between the rising edge of the servo command and the falling edge of the voltage drop.

This procedure is done on a single servo setup, a three servo setup, a six servo setup and a nine servo setup.

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Figure 1 - Measurement of the delay between the command and the servo response on oscilloscope.

# RESULTS

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| A screenshot of a cell phone  Description automatically generated | Figure 2 - Single servo measurements with mean delay of 822.95 µs. |
| A screenshot of a cell phone  Description automatically generated | Figure 3 - Three servo measurements with mean delay of 854.25 µs. |
| A screenshot of a cell phone  Description automatically generated | Figure 4 - Six servo measurements with mean delay of 837.63 µs. |
| A screenshot of a cell phone  Description automatically generated | Figure 5 - Nine servo measurements with mean delay of 876.71 µs. |

# ANALYSIS

# CONCLUSION

# REFERENCES

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