Lab 1

ELEC ENG 3CL4

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C02

L06

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Description

Our laboratory equipment consisted of 5 pieces of equipment: the Simulink controller, the data acquisition card (DAQ), the servomechanism electronics unit (SEU), the DC motor, and the incremental encoder. The Simulink controller was accessed from the lab room computers and we were able to alter the constants in order to manipulate the prebuilt circuit to obtain our desired results. The DAQ connects the software to the SEU and acts as a digital-to-analog converter. From there, the SEU contains the physical circuit that converts the analog command to a PWM voltage which powers the DC motor. Finally, the incremental encoder measures the incremental changes in the angular position of the DC motor. This data is then sent back to the DAQ through the SEU so that it can read the encoder output and return the measured angular position.

Plot

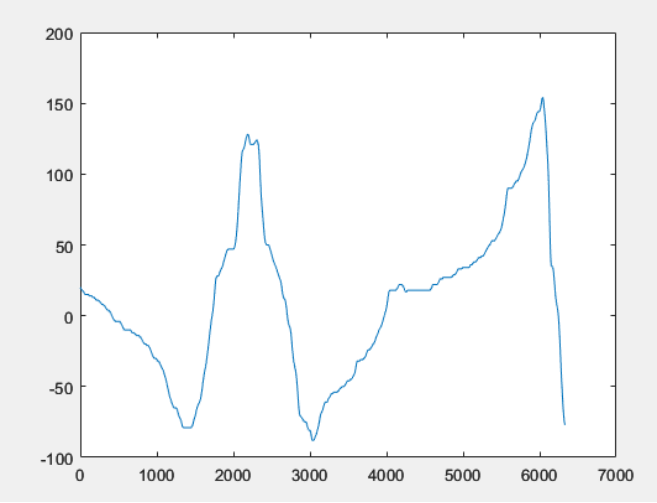

Figure 1: Angular Position vs Time Plot for a Manual Input Using the Flange

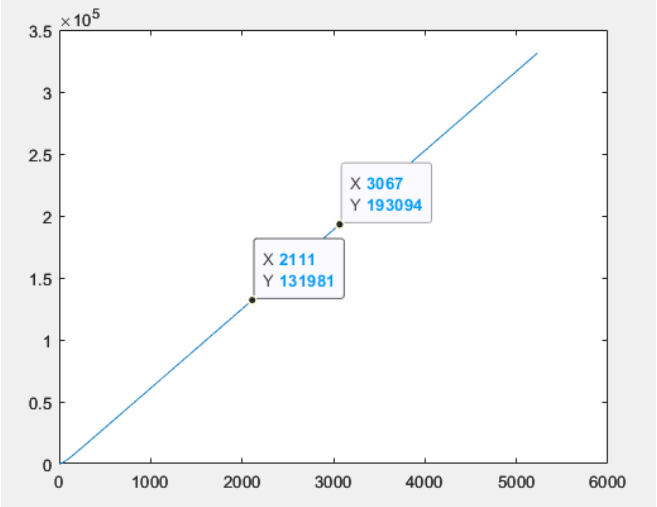

Figure 2: Angular Position vs Time Plot for an Input Amplitude of 5

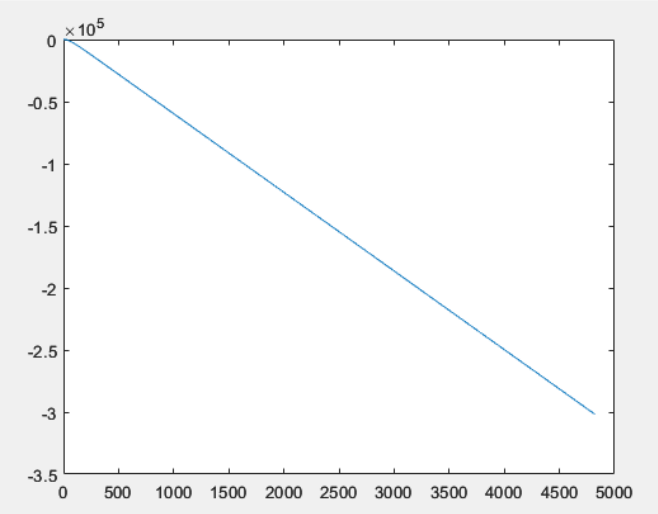

Figure 3: Angular Position vs Time Plot for an Input Amplitude of -5

Explanation

The plots obtained in this lab illustrate the angular position of the DC motor over time. The direction of the slope signifies the direction of motor rotation. After completing the experiment, we observed that the stepwise changes and the encoder measurements had a direct relationship. It was noted that when the encoder was spinning clockwise, the slope was positive and when the encoder was spinning counter-clockwise, the slope was negative. The slope signifies the angular velocity of the motor, as it is the rate of change of the angular motor position. It was also noted that in the experiments where the amplitude was preset, the absolute value of the slope in both these scenarios was the exact same value of about 63, and as expected the positive amplitude had a positive slope, while the negative amplitude had a negative slope. This demonstrates a direct relationship between the input amplitude and the angular velocity of the motor, with the negative/positive sign indicating the direction of rotation.

When analyzing the stepwise changes in encoder measurements observed in activity VIII, we were able to determine that each step had a height of around 7 or 8 for each degree of rotation. This makes sense, as this would signify an approximate max measurement resolution of 0.14 degrees, which is similar to the rated resolution of 0.15 degrees of the encoder indicated in the lab manual. Furthermore, when spinning the flange clockwise, the change in angular position would be read as an increase, and counter-clockwise was read as a decrease as seen by the direction of the slope.

Activity XI of the lab required us to set the input amplitude to 5, which is representative of around 50% of the maximum input voltage. When the input was set to +5, this resulted in a clockwise rotation of the motor, indicated by the rapid rotation of the flange. With the positive voltage, the angular velocity of the motor was found to be positive, and lay at a constant value of around 63. When the input was set to -5, the motor spun counter-clockwise, and the angular velocity of the motor was identical to that of the earlier clockwise spinning motor. This indicates a linear motor response where the angular velocity of the motor is directly proportional to the input voltage, where clockwise rotation is set as the positive direction. A constant input voltage results in a constant angular velocity, and a variable voltage would likely result in a variable angular velocity.