2.2 Reading the Encoder

5.

When you recompile the code, the initial angle is set as 0

6.

If you go past one full rotation, the angle will continue to increase.

Counterclockwise rotation is considered positive, and clockwise rotation is considered negative.

7.

Since a full rotation is 2048 pulses, a gain of $\frac{360^\circ}{2048}$ will convert the pulses to degrees.

2.3 Driving the DC Motor

4.

Setting the voltage to a positive value induces a clockwise rotation. At a voltage of 2, the motor rotates clockwise at a constant speed. The angle increases linearly with time.

Setting the voltage to a negative value induces a counterclockwise rotation. At a voltage of -0.5, the motor rotates counterclockwise at a constant speed. The angle decreases linearly with time.

The higher the magnitude of the voltage, the faster the motor rotates.

5.

The deadzone was determined by trial and error. This was determined to be (-0.191V, 0.191V).

2.4 Low-Pass Filtering

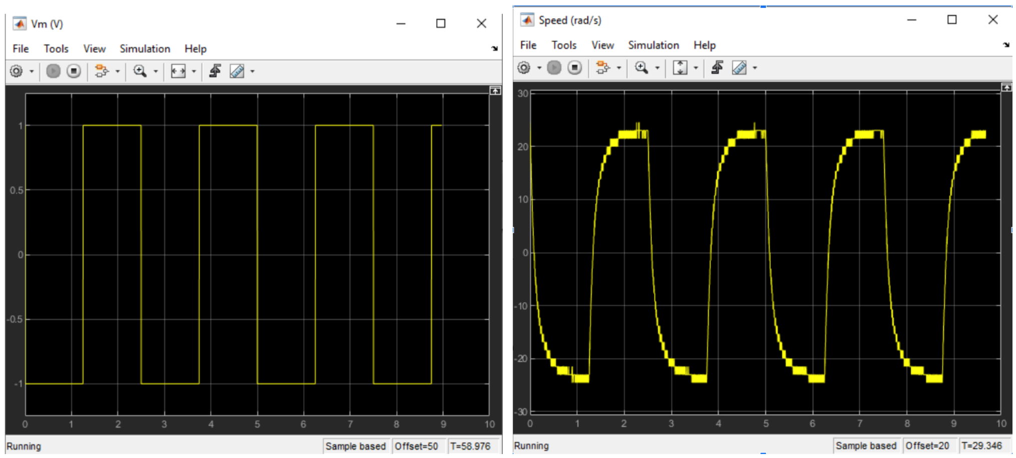
1.

A gain of $\frac{2\pi}{2048}$ will convert the pulses to radians.

3.

A value of 0.4Hz was used. The units in the drop down menu for the signal generator were selected to be Hz instead of rad/s

4.



(a) Square Wave Input

(b) Response angular velocity (rad/s) with no filter

Figure 1: Square Wave Input and Response

5.

The encoder uses discrete pulses to measure the angle of the disc. When taking the derivative of these incremental (step-like) measurements, high frequencies are introduced. This is because the derivative of a step function is a dirac delta, which introduces high frequencies. These high frequency oscillations appear as noise in the angular velocity signal.

The step-like nature of the encode can be seen in Fig. 2.

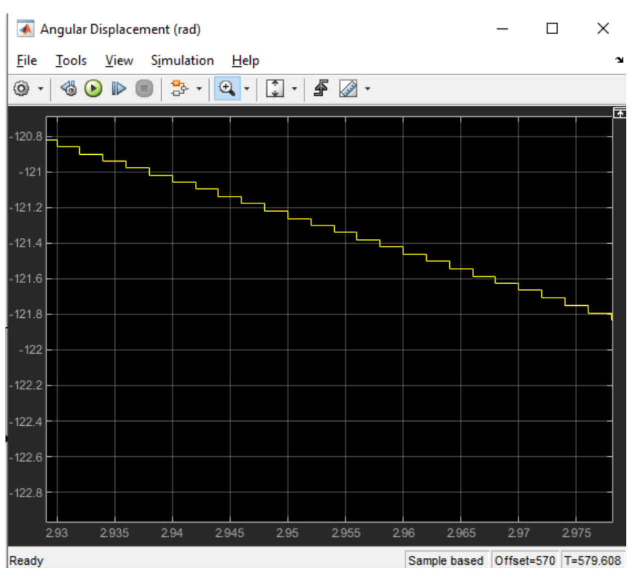


Figure 2: Angular Position (rad) with no filter

6.

A `Transfer Fcn` block with `num:[100]` and `den:[1 100]` was used.

7.

Yes, it looks noisy still. Much of the perturbations have been removed, but there are still some.

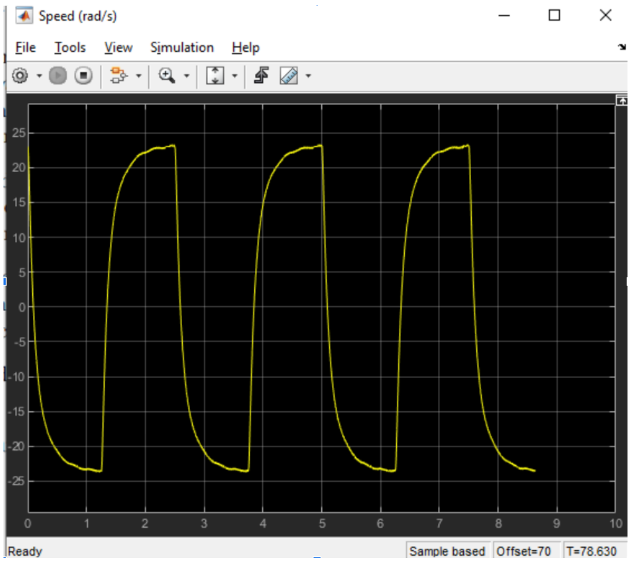
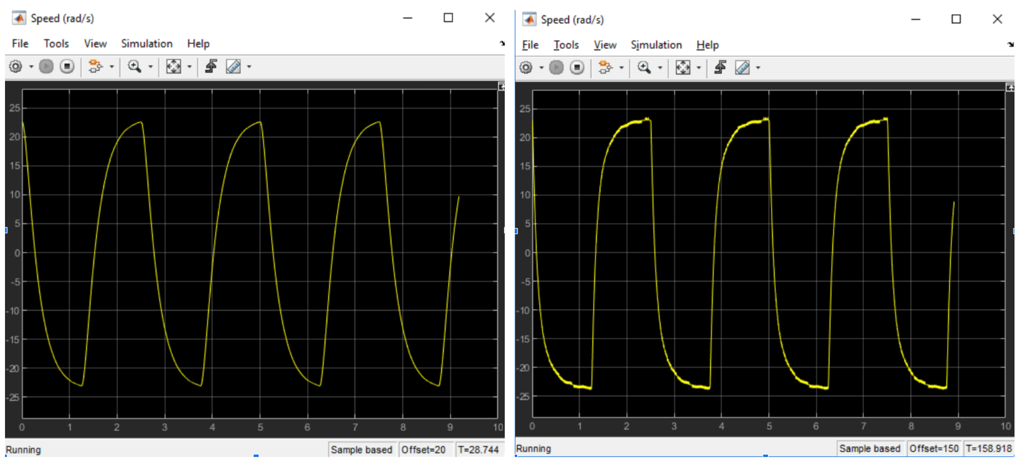


Figure 3: Response angular velocity (rad/s) with 100 rad/s filter

8.

For $\omega_f = 5$ rad/s, the signal is quite clean and smooth as seen in Fig. 4a.

For $\omega_f = 200$ rad/s, the signal is very noisy as seen in Fig. 4b.



(a) Response angular velocity (rad/s) with 5 rad/s filter

(b) Response angular velocity (rad/s) with 200 rad/s filter

Figure 4: Square Wave Input and Response with Different Filters