1.

a. degree accuracy=360/2248= 0.16 degree/count

b. duty cycle=(3/99)*100=3.03%

c. Counting the number of count at a given time to determine the frequency.

At 25% duty cycle, the encoder count's frequency is about 1600Hz, at which the frequency of encoder task is about 3200Hz.

At 75% duty cycle, the frequency of encoder counts is about 5200Hz, at wich the frequency of encoder task is about 10400Hz.

d. The “off” and “on” position starts at 15Hz of the PWM signal(with %30 duty cycle)

2.

Following the steps from manual, at Kp=0.4 and Kd=0.2, I got a relative good trajectory plot.

3.

Picking up three different gains:

The low gains are Kp=0.1 and Kd=0.06

The high gains are Kp=1.2 and Kd=0.4

The ideal gains are Kp=0.4 and Kd=0.2

Observation:

For 2 full rotations, the change of Kp and Kd cause a larger difference for the speed and oscillation. For 5 degree rotation, it was relatively less sensitive.

For low gains of Kp and Kd, the speed is slow while with a small oscillation.

For high gains of Kp and Kd, the speed is high but there was a large oscillation.

For ideal gains of Kp and Kd, the speed is relative fast and the oscillation is relative small.

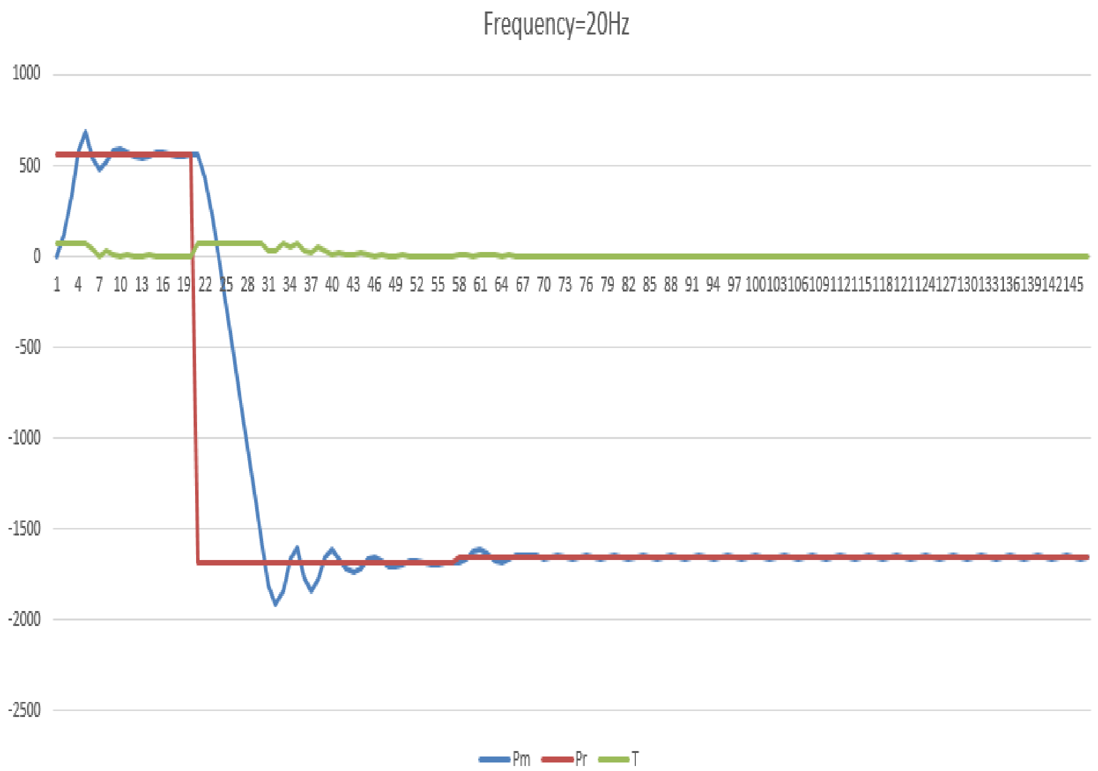
When slowing the controller frequency to 5Hz (from 50Hz).

Observation: The oscillation became much larger than the original frequency (50Hz), this is because the system became slower to react with the change of rotating direction.

4. For 50Hz

For 40Hz

For 20Hz



Observed behavior:

As the rate became slower, the oscillation becomes larger and it made the system harder to settle the motor down. This is because the controller's ISR was entered slower than that of normal condition, so it caused the system slower to "react" with the change of the rotating direction.