Dynamic Systems and Controls

Lab 11

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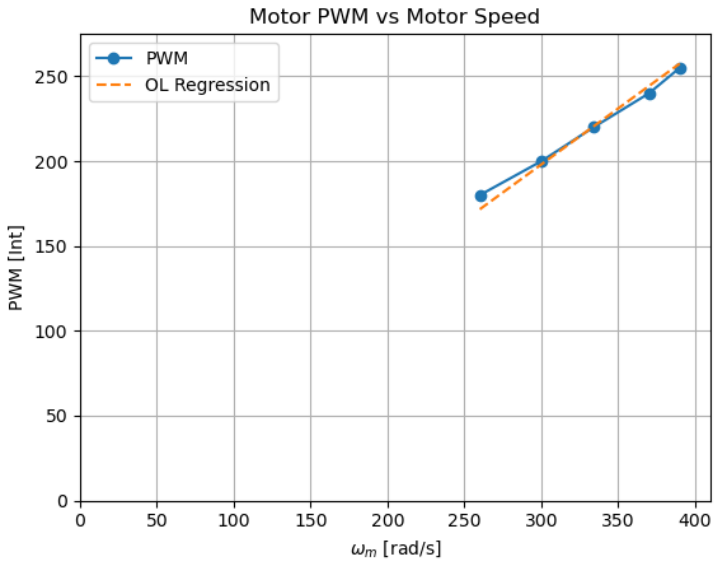
Part 1

1. With 5 data points on PWM vs output speed in rad/s, the linear regression in orange below gives us the open loop gain.



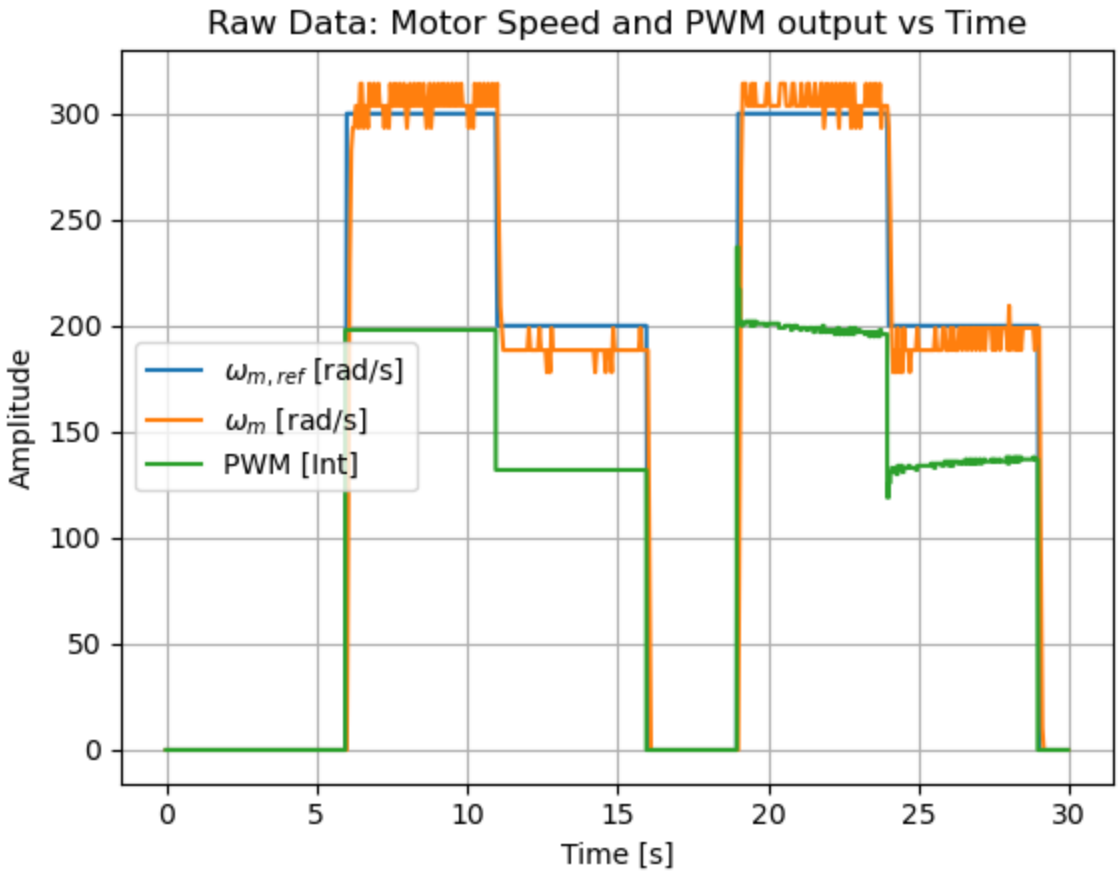
2.

```
$ python PMDC_OLgain_DataAnalysis.py
OL Gain [PWM/(rad/s)]: 0.6602634388952191
OL intercept [PWM]: 0.0
OL Gain R^2: 0.9728964464240755
```

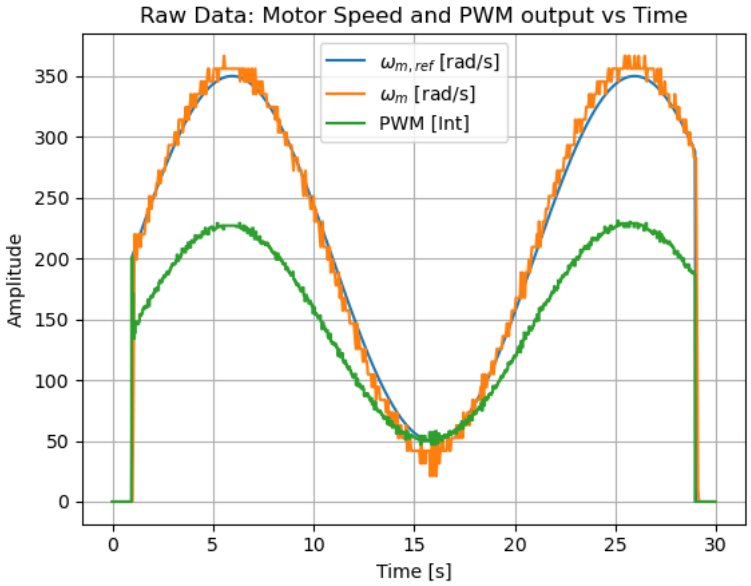
Wm ref (rad/s)	Wm exp (rad/s)	PWM output (int)	Wm error (rad/s)	Percent Error (%)
220	200	145	20	9%
270	260	178	10	3.7%
340	335	225	4	1.1%

Part 2

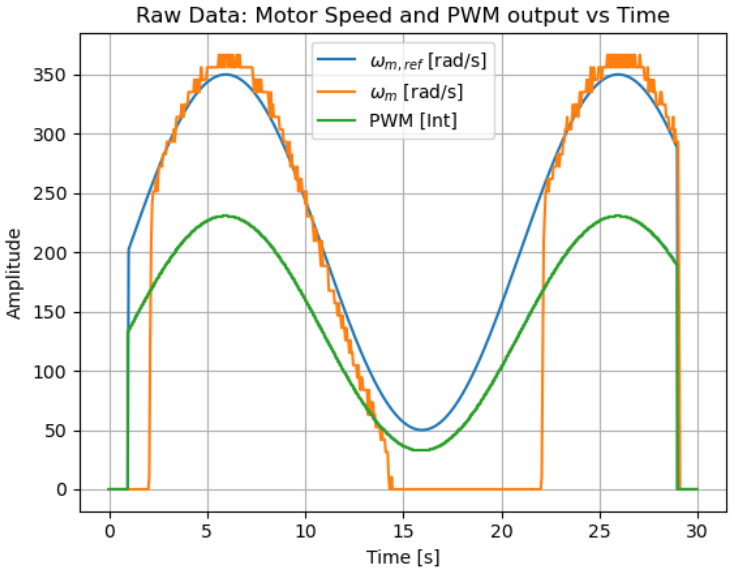
1. Step reference



Sinusoidal reference closed loop



Sinusoidal reference open loop



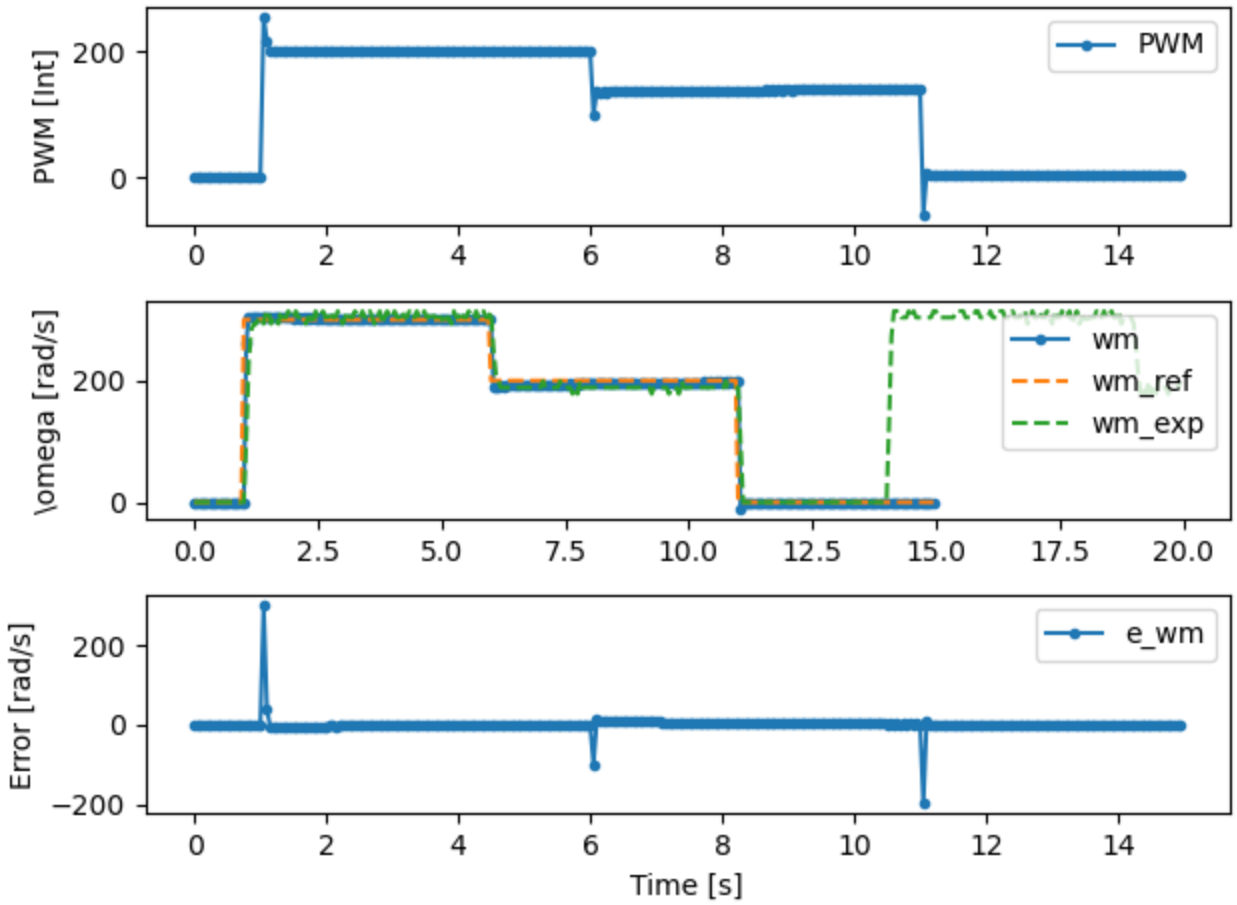
2. Gain values

```
# OL Gain
OLgain = 0.6603 # [PWM/(rad/s)]

# Closed loop gains
Kp = 0.3    # Determine units
Ki = 0.3    # Determine units
Kd = 0.001  # Determine units
```

I increased Kp first until I was able to reach the desired value. I then increased Ki & Kd until I was able to decrease my steady state error and reduce & improve response time. Kp (PWM*s/rad), Ki (PWM/rad), Kd (PWM*s^2/rad).

3. Simulation



Rise Time:
Experimental-0.180s
Simulated-0.093s
Percent Overshoot:
Experimental-5%
Simulated-3%
Settling Time:
Experimental-0.5s
Simulated-0.2s