Lab Section: T 3-5

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**Lab 5 – Active Gimbal Control– Dual-Axis Gimbal**

**Prelab**

Text, letter

Description automatically generated

**Experiment #1**

*Record your Gimbal #.*

*#7*

**Experiment #2**

1. *Roll axis:*

*(a) Damping ratio and natural frequency of P control with Kp = 10 (or some other value) and impulse response plot.*

**

*0.07*

*9.40*

*(b) Kp and Kd of PD controller.*

*40.21+4.12s*

1. *Pitch axis:*

*(a) Damping ratio and natural frequency of P control with Kp = 5 (or some other value) and impulse response plot.*

*(graph)*

**

*0.08*

*10.69*

*(b) Kp and Kd of PD controller.*

*31.11+3.15s*

*Explain why pitch and roll axes have different controller gains.*

*The moment of inertia in roll is greater than that of pitch.*

1. *Implement both PD controllers. Insert a closed-loop step response plot of both pitch and roll responses when driven by a square wave. Use d\_error\_1 and d\_error\_2 for this task.*

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**Experiment #3**

1. *Insert a plot showing d\_error\_2, filt\_d\_error\_2, and roll\_rate for the roll axis when subject to a square wave input. Comment on the three signals. Use alpha = 0.5 for the low-pass filter.*

**

***\*\*\* Use pitch\_rate and roll\_rate for D control actions for the following tasks.***

1. *Insert a closed-loop step response plot of both pitch and roll responses when driven by a square wave. Use pitch\_rate and roll\_rate for this task. Compare the responses to the ones in Exp. #2.3 above, and comment on the responses.*

**

*The response is a lot smoother, a little faster, and without any oscillations.*

1. *Include a plot showing roll response when subject to a 1 Hz sine wave input. Make comments on the behavior of the gimbal based on your observations.*

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*The gimbal appears to be consistently rocking.*

**★Additional Task ★**

1. *Estimated spring constant and oscillation frequency of the mass-spring setup.*
2. *Demonstrate your tracking system to a staff member.*