We aim to design an off-center spinning mass underactuated controller to steer flying objects. A quadcopter with a rotating arm attached to it is used to demonstrate the principle of such controller. By in depth analysis of the system dynamics and results of this project, we wanted to develop a similar model applicable for rocket control systems.

In 10 weeks of time, we did

1. Mathematical analysis

* Aim to develop state evolution equation of our system
* Use Newton’s Second Law and represent orientation in quaternion
* Matlab implementation of the plant

1. Simulation
   * Considering variables such as spinning mass, thrust force and pitching angle.
2. Motor Design
   * Analyzed the dynamics of the Spinning Mass actuator
   * Studied different types of motors and explored the pros and cons with respect to our project
   * Created two mathematical models for controlling position and speed of a DC motor.
3. Practical Implementation
   * Prepared a prototype for demonstration purposes

We aimed to design an off-center spinning mass under actuated controller to steer an airborne vehicle. Due to budget limitations, we chose a quadcopter modified with a rotating arm for the purpose of demonstrating the principle of such a controller. We wanted to replicate the dynamics of most vertical take-off and landing vehicles. We achieved the following:

- Mathematical Analysis

o State evolution equation of system

o Quaternion based orientation

o MATLAB implementation of plant

- Simulation

o Considered variables such as mass, actuator, thrust, and angles.

- Motor Design

o Actuator Dynamics

o Trade-offs between various motors

o Mathematical control models for both speed and position

- Practical Implementation

o Drone + Arm prototype for demo