Week 5 Project Summary – James Davies

# Fundamentals

First few weeks spent learning the fundamentals about gyroscopic mechanics and the electronics that will be used throughout this project. Produced detailed notes about modelling a simple gyroscope to gain a better understanding of the induced precession system that would be used for the project.

Also created a set of notes about the useful electronics and components that are to be used; including Arduinos, MOSFET’s, etc. During this note taking I also performed simple experiments to validate and test the theory. Pictures and Videos of these are on GitHub and my lab book.

# Circuit Design

After reading about last year’s project and the problems it encountered, I decided to create two main circuits for my angle controls system.

One for the control the servos RPM and the motor rpm connected to the two flywheels. This is constructed from the Genuino 101, a MOSFET, a voltage regulator, resistors and capacitors. This can be seen in figure 11 in my lab book.

The second circuit is for the measurements of the system. Currently using an Arduino UNO, a MPU6050 board and a SD card reader, this system records the data into a new CSV file for every test run. This can be seen in figure 12 of my lab book.

# Measurement Sketch

With the measurement system built, I then created an Arduino sketch to operate the hardware to measure the current angle (with offsets) and record it to the SD card. The sketch, shown in figure 12 in my lab book, makes use of the several pre-built libraries including: IC2dev, MPU6050, Wire, SPI, and SD.

The sample size can be changed easily at the start of the sketch, with each measurement taken every 0.5ms. The sketch also features the functionality to dynamically name the files from the number of previous measurements taken (which are stored on the SD card).

# Flywheel Design

To perform the torques required from the test rig I am creating, I am also redesigning the flywheels. A small change I have done to the system is to have the zero position of the two flywheels 90 degrees apart. This produced the desired effect of a linear torque from the two flywheels, rather than a torque reducing with cos(θ) in each. This is vital if I am to achieve my goal of producing not only a stable system but one that a control lean can be produced.

Measurements have been taken to find the maximum dimensions of the flywheel to maximise the moment of inertia of the new flywheels. To find the order of magnitude of torques that will be needed to be produced from the flywheels, I have taken mass and size measurement of the rig and modelled it. This has allowed me to produce an equation (equation 10) to find the mass of the flywheel required. Once the mass is found the dimensions and material of the flywheel can be decided. Current work is finding the angular velocity of the servos under load, so this mass can be found as a function of the angular velocity of the flywheel.

The values for the new flywheel are been found with the aim of producing a maximum lean angle of 35 degrees of the bike system. I am pushing forward with two designs currently, with the intension of discussing with the technicians that will be manufacturing them, for fast production times. Hopefully this will allow for more testing time of the system.

# Plan

1. Resolve the non-constant angular velocity of the servos due to weight disparities, by adding mass to one side (for now, another motor later).
2. Using equation 10, find a suitable mass/angular velocity for the new flywheels.
3. Produced measurements and material needed for the flywheels
4. Create a CAD design of the wheels.
5. Fit and balance the Flywheels.
6. Investigate and produce predictions or RPM losses during servo rotations.
7. Design a sketch to control the servos and flywheels RPM dynamically
8. Start with PID corrections
9. By the end of first term, have a stable balance inside the frame.