



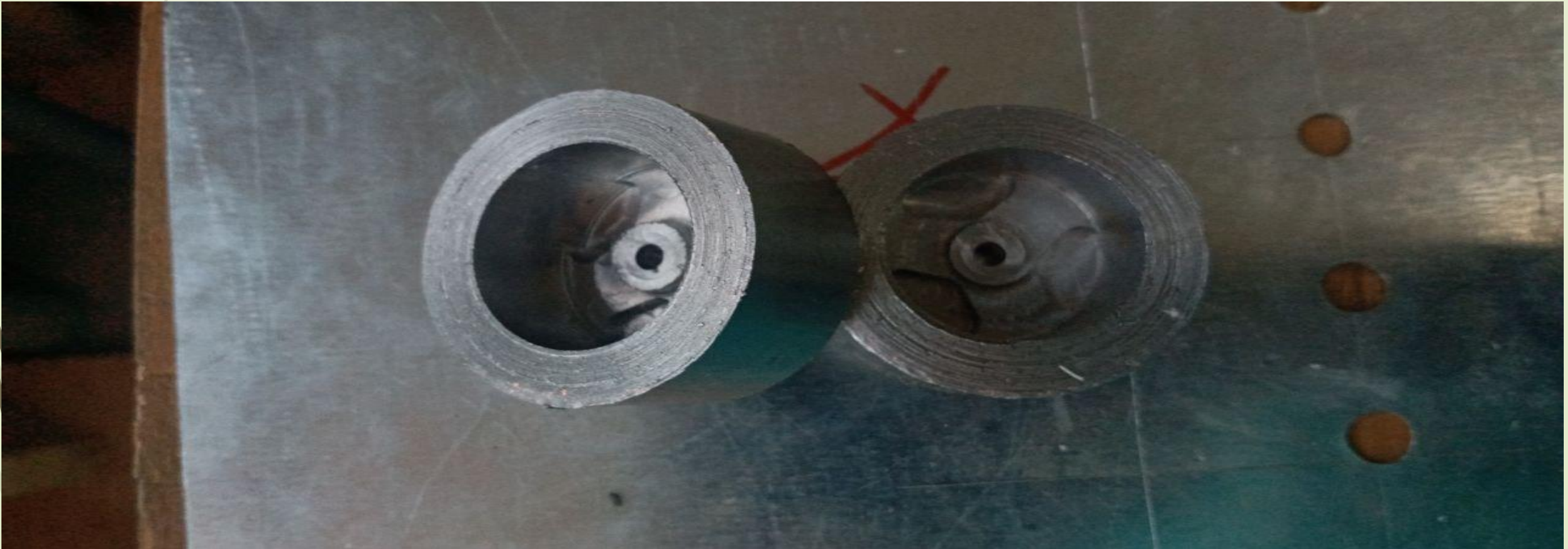
NAKUJA PROJECT PROGRESS REPORT INTERNSHIP 2022 WEEK 7

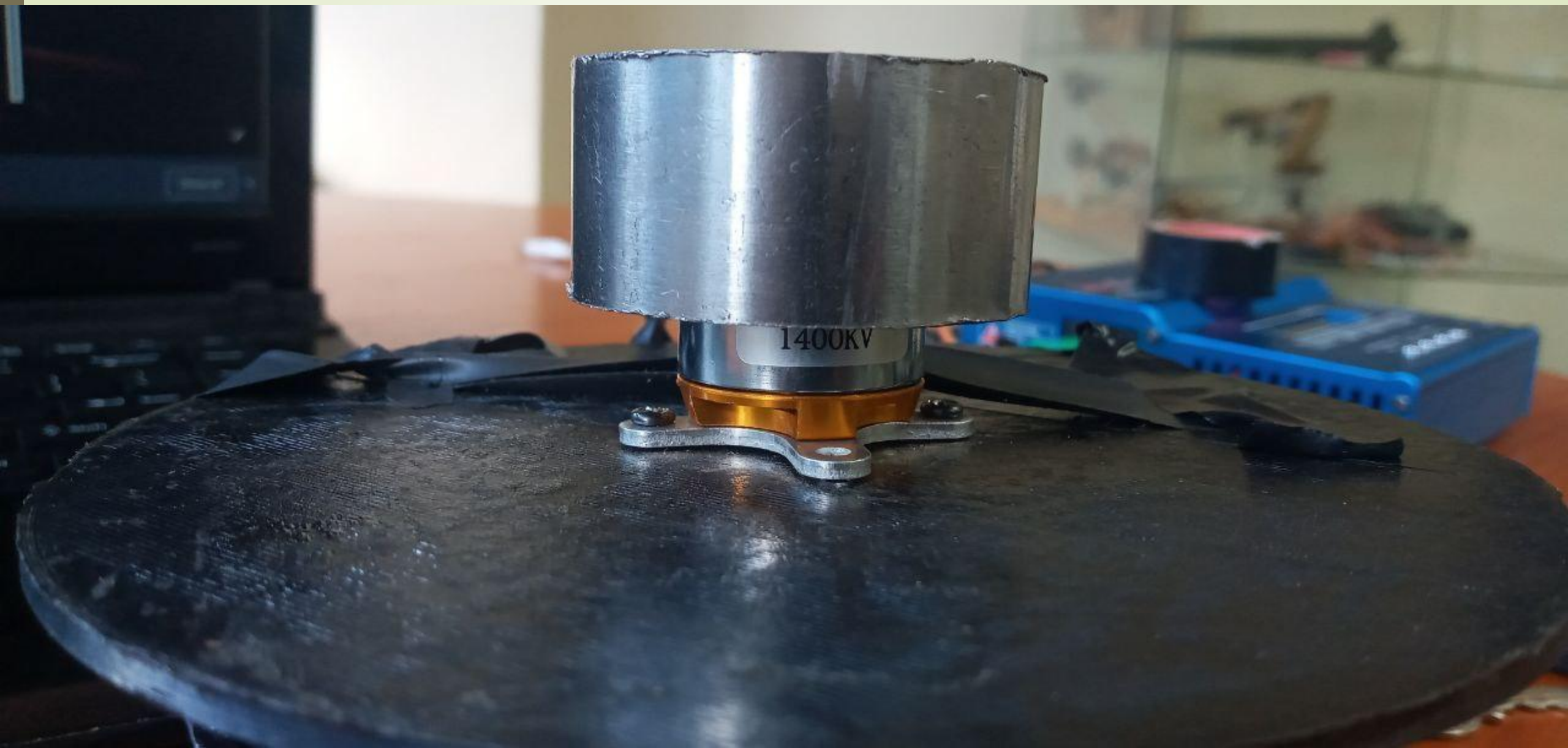
FLIGHT CONTROL

DERRICK KIRIMI

TASKS LAST WEEK

- Reaction wheel fabrication





MPU6050 library reselection

- Getting data from the MPU6050:
- We have used and viewed source code for a number of libraries:
 - Jarzebski/Arduino-MPU6050
 - MPU6050_tockn
 - Adafruit MPU6050 Sensor Library

Problems and inadequacies were encountered as these differ in:

- Method of gyroscope calibration and offset determination
- Accelerometer gravity compensation
- Method of reading values from the accelerometer and gyroscopes
- Processing of raw data through smoothing and low pass filters
- Application of filters, Kalman filter or complementary like Madgwick/Mahony to fuse gyroscope readings
- Dealing with gimbal lock by application of quaternions rather than euler angles usage.
- Dealing with the cases where roll goes past +/-180
 - Our Choice. Utilises the DMP and a FIFO buffer.
- <https://github.com/jrowberg/i2cdevlib/tree/master/Arduino/I2Cdev>
- [i2cdevlib/Arduino/MPU6050 at master · jrowberg/i2cdevlib \(github.com\)](https://github.com/jrowberg/i2cdevlib/tree/master/Arduino/MPU6050)

[#26] Kalman filter improvement (application to apogee detection)

- Future possible alternatives to the Kalman filter are:
- Unscented Kalman filter(uses Sigma points rather than linearization, computationally expensive)
- Extended Kalman Filter (uses Jacobi first order linearization. Computation of Jacobi's can be done before by hand or with Symbolic maths, numerical methods are computationally intensive.
- Multiplicative Extended Kalman Filter.

The MEKF is an important modification of the Kalman Filter that makes it applicable to orientation estimation.

- Manifold Extended Kalman Filter

https://www.researchgate.net/publication/330128000_Kalman_Filtering_for_Attitude_Estimation_with_Quaternions_and_Concepts_from_Manifold_Theory

“Then, the MEKF with the RP chart and without applying the “chart update” is our best attitude estimator according to the adopted performance metric. This algorithm resembles the conventional “Multiplicative Extended Kalman Filter”, but we have obtained the MEKF without having to redefine any aspect of the classic Kalman filter”



TASKS THIS WEEK

- Finish reaction wheel fabrication.
Facing, tapping and filing.
- [#102] Fabrication of the safety cage.
- [#101] Fabrication of the reaction wheel mounting case.
- [#25] Test reaction Wheel on test bench with current firmware.
- [#29] Log operation data.
- Creating interfaces to hide implementation details, make for easier following, debugging and library changes.