CubeSat Reaction Wheel Attitude Control Platform

9/26 Meeting

EMBRY-RIDDLE Aeronautical University

EasyControls.org

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General Updates/Reminders

- Ignite Funds released!!

- **GitHub** will be our primary repo:
  - Make account if you don't have one yet
  - Will house code, weekly meeting slides, relevant documentation
  - **Justin Hartland > CubeSatAttitudeControlPlatform**

- Action item Excel sheet is live and posted on Discord for reference

Current Project Goal

- Produce functioning attitude controller by **9/25**
  - 1 DoF for now
- Ignite Grant Paper submission by **9/30**
- Move on to ACTIV while CubeSat continues development
  - CubeSat required to test ACTIV

[Ryan] Attitude Estimation

Progress completed this past week

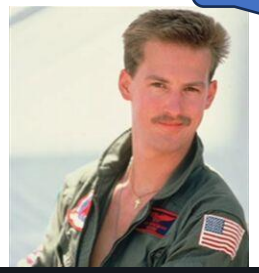
- Worked on yaw drift problem for LSM9DS1 sensor
  - Implemented QUEST (Quaternion Estimator) for sensor
  - Quest function only returns an object I have no idea how to work with
    - Last minute edit WE HAVE QUATERNIONS!!!
  - Still need to adjust sensor data to provide needed information (DCM, Euler angles, whatever)

Goals for next week

- Full implementation of attitude determinator without yaw drift to PID controller

Anticipated challenges

- May need to adjust approach to a Madgwick filter (for accuracy)
- My brains all mushy



$$L(\mathbf{A}) = \frac{1}{2}\sum_{i=1}^{n} |\hat{\mathbf{W}}_i - \mathbf{A}\hat{\mathbf{V}}_i|^2$$

$$g(\mathbf{A}) = 1 - L(\mathbf{A}) = \sum_{i=1}^{n} a_i \, \hat{\mathbf{W}}_i^T \mathbf{A} \hat{\mathbf{V}}_i$$

$$\bar{\mathbf{q}} = \begin{bmatrix} \mathbf{Q} \\ q \end{bmatrix} = \begin{bmatrix} \hat{\mathbf{X}} \sin\frac{\theta}{2} \\ \cos\frac{\theta}{2} \end{bmatrix}$$

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[Justin] Apply PID controller to system

Progress completed this past week

-Printed new iteration of CubeSat (much more structurally stable)

-Preliminary PID applied; result is good not great

->50%

Goals for next week

-Write paper for Ignite

-Continue PID controller development

-Submit first purchase order (ODrives are of primary interest)

Anticipated challenges

-Yaw drift is still a problem

  -Either I am not correctly implementing the magnetometer, or the libraries are faulty

-Tuning the motor and PID constants (Zeiger-Nicolas)

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[Ella] Electrical System in the Cube

Progress completed this past week

-Designed layout for Battery and #

-Highlight based on: Complete

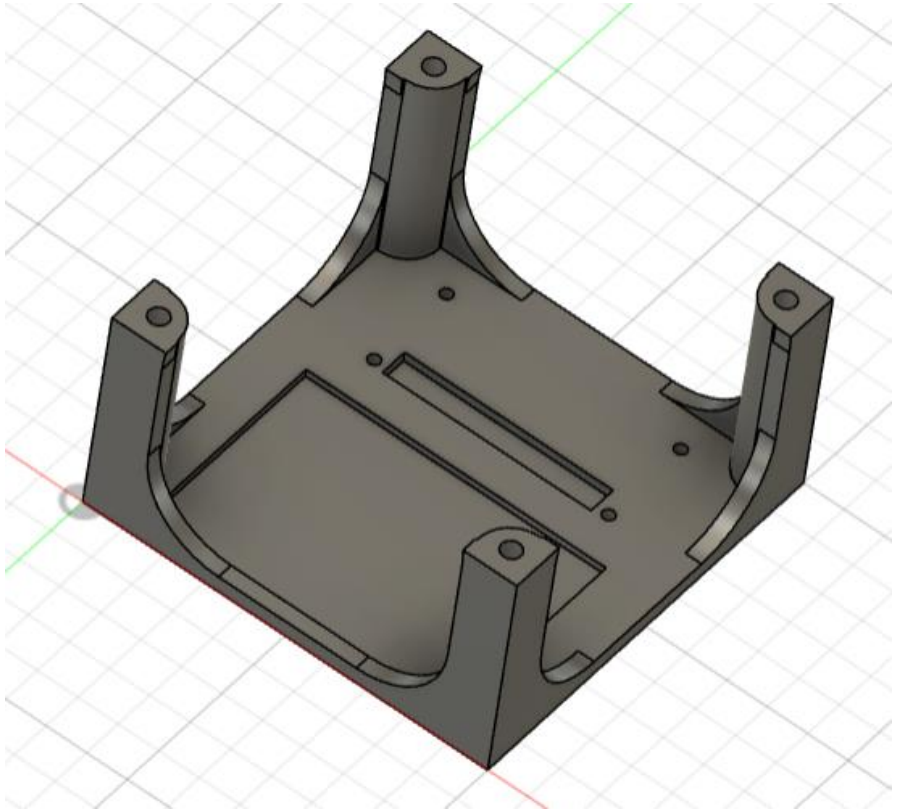
Goals for next week

-Print the new design and add it to the whole system

-Change threaded insert hole diameter

Anticipated challenges

-None



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[Vishal] + [New Inverted Pendulum]

Progress completed this past week

-Working on new pin connection between the stand and pendulum

-Using a ball bearing

-Slot fit between Pendulum arm and ball bearing

- Included spaces between ball bearing and hinges

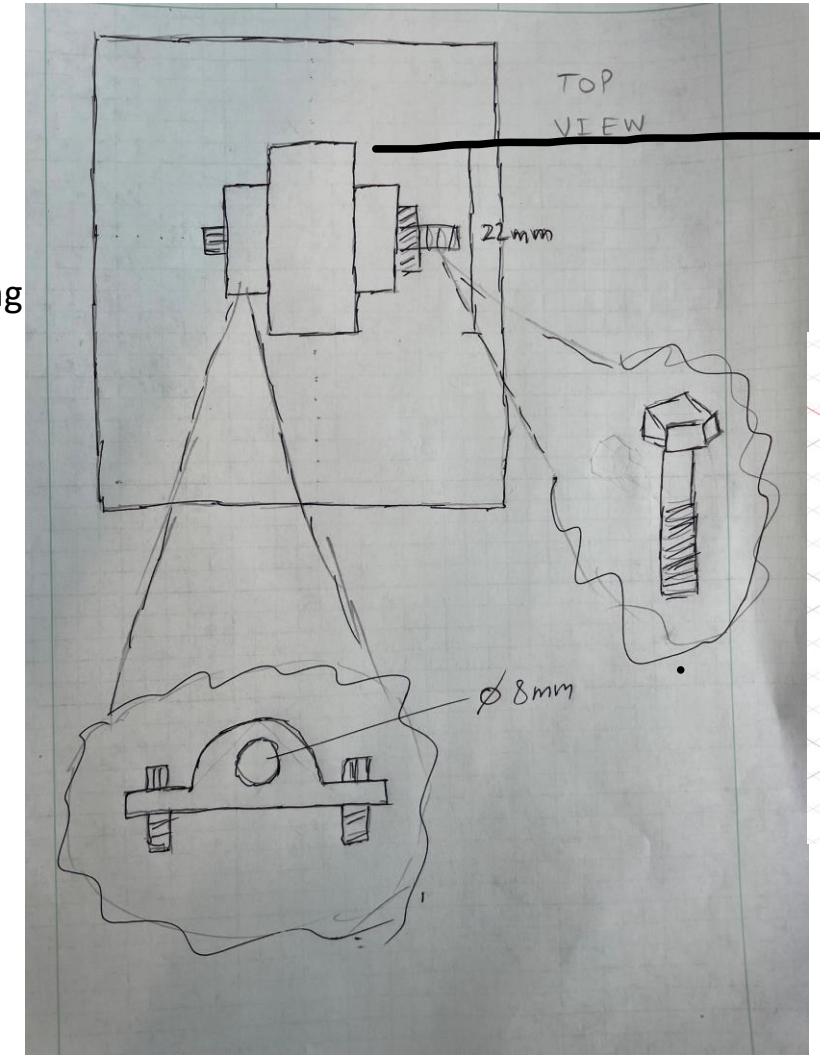
-Highlight based on: 60%

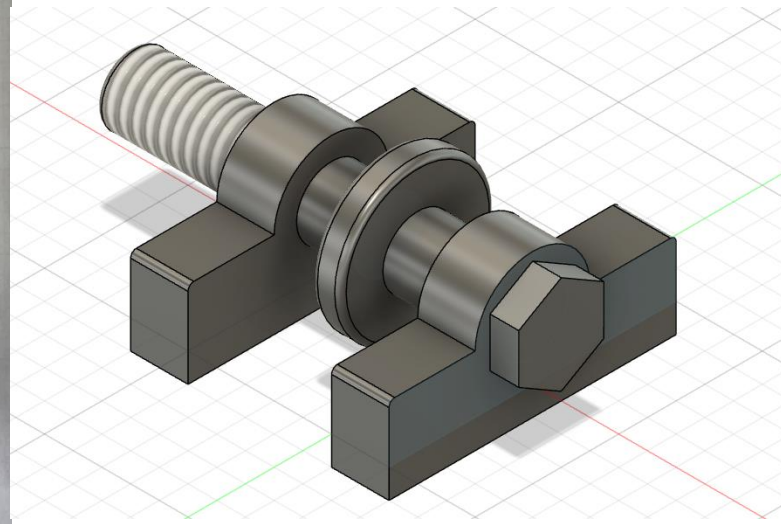
Goals for next week

- Improved CAD model with Pendulum attached
- Proper dimensions

Anticipated challenges

- Class conflicts
- Completed model





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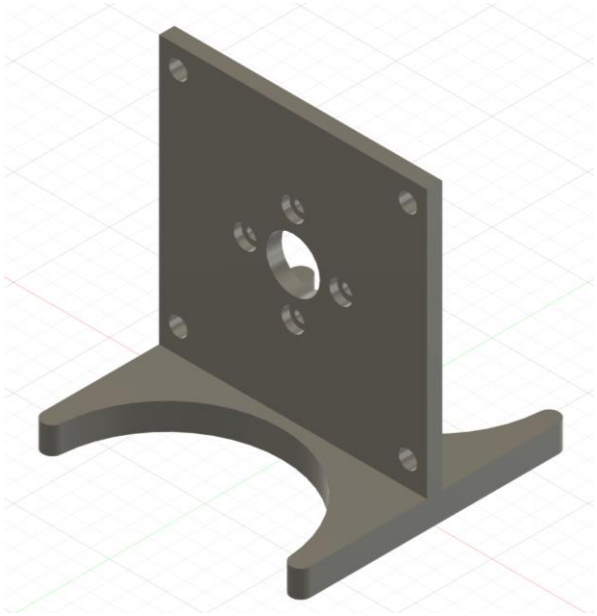
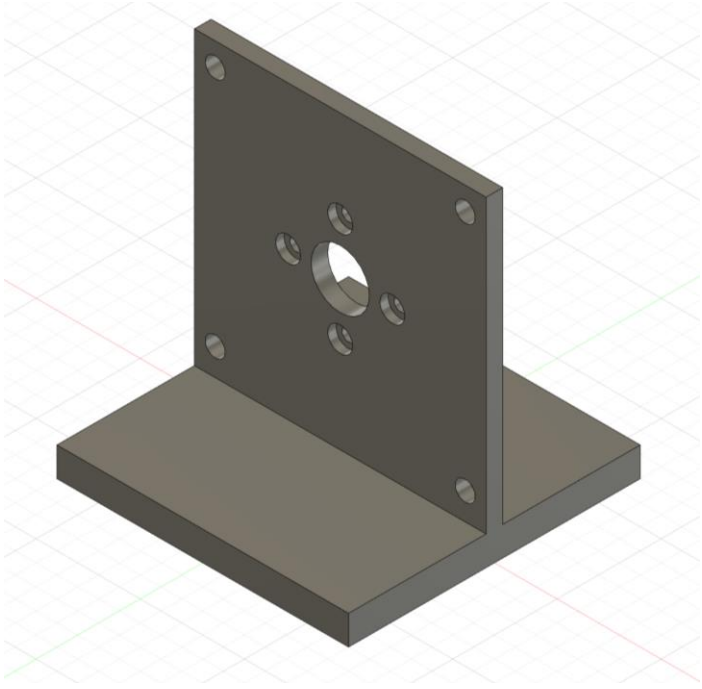
[Isaac] Daisy Chaining O-Drives





Progress completed this past week

-Finished CAD for daisy-chaining set-up

-->two designs for double velcro if necessary

-Recommended CAN

-Recommended CAN Code

Goals for next week

-Complete ideas/CAD Model for 2DOF

Anticipated challenges

-iterations to fit all into the smallest space

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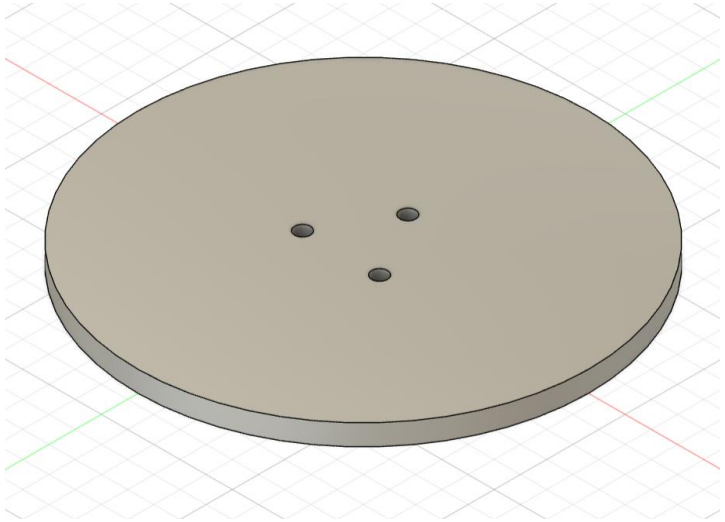
[Jacob] + [Increase Reaction Wheel's MOI]

Progress completed this past week

-Decided to machine a reaction wheel from a solid hunk of metal (attempt stainless steel, aluminum would be twice as heavy and only increase MOI by 6% compared to 3d-Print with bolts). Attempted to meet with the supposed charming Bill, but was not successful.



Goals for next week

-Hopefully have wheel machined and ready for testing

Anticipated challenges

-We're on Billy time now.

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Dylan + Electronics

Progress completed this past week

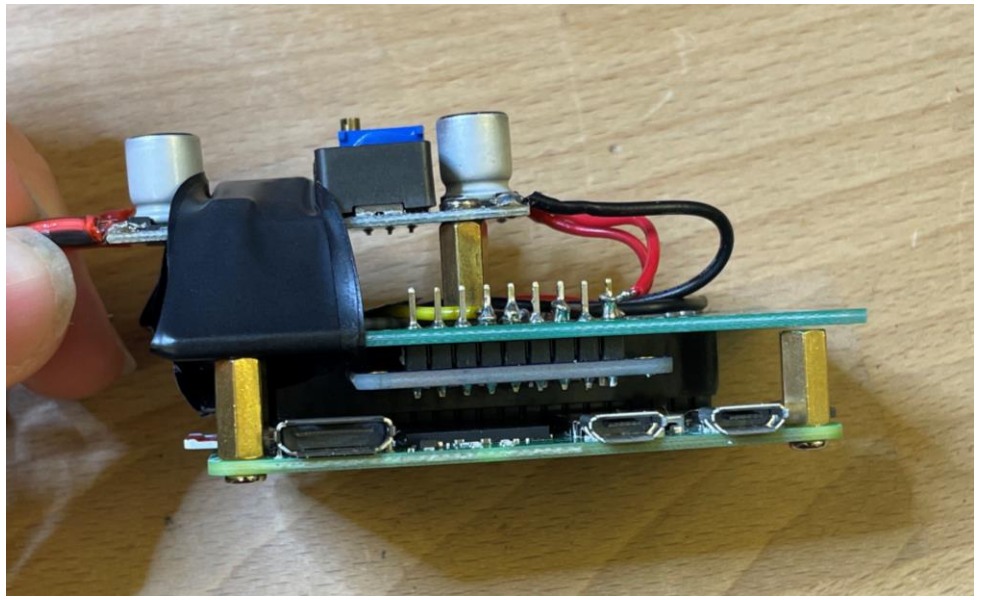
- Researched BMS ICs for custom Battery Management Board (allow to monitor voltage of each cell of the battery)
- Helped Justin 3D print and Assemble new 1 DOF CubeSat Test Bed

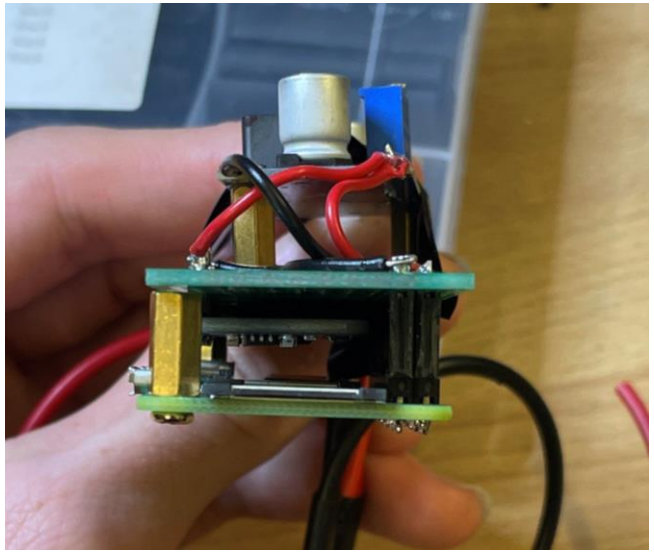
Goals for next week

- Finalize IC selection for BMS

Anticipated challenges

-N/A





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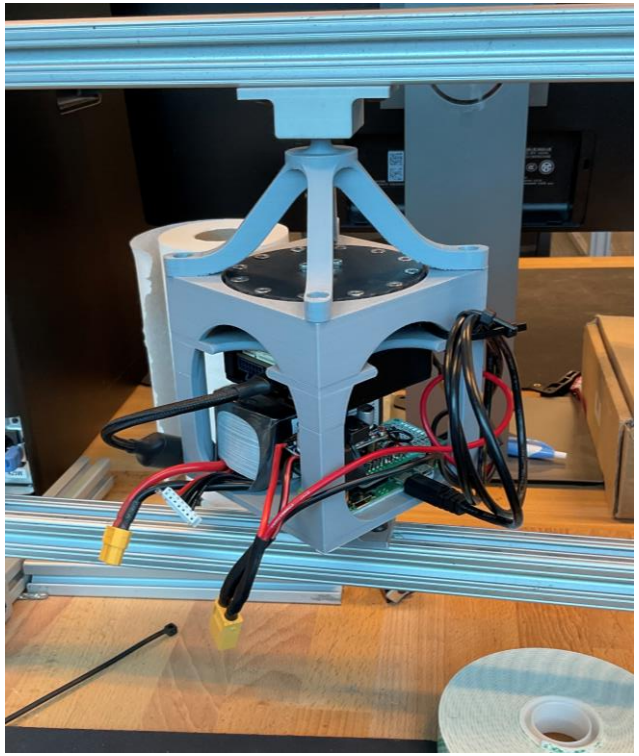
Various tasks for upcoming week

- Hardware
  1) Integrate electrical system into CubeSat bus (Ella)
  2) Assemble 2 DoF + configs and consider CoM compensation (Isaac)
  3) Assemble multi-motor control testbeds

- Electrical
  1) Solidify ODrive daisy-chain strategy for 2 DoF + (Isaac)
     - Compile list of required electronics and provide example code prior to purchase
  2) Include voltmeter to current electrical system, PCB (Dylan)

- Software
  1) Compile resources for expanding into 2 DoF +
  2) Resolve yaw drift issue
  3) MatPlotLib to plot PID controller

Visual System Updates



[Assignee] + [Task Title]

Progress completed this past week

-[Discuss progress]

-Highlight based on: Complete, >50%, <50%

Goals for next week

-[Discuss goals]

Anticipated challenges

-[discuss challenges, request assistance if needed]

[Relevant photos if needed]

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