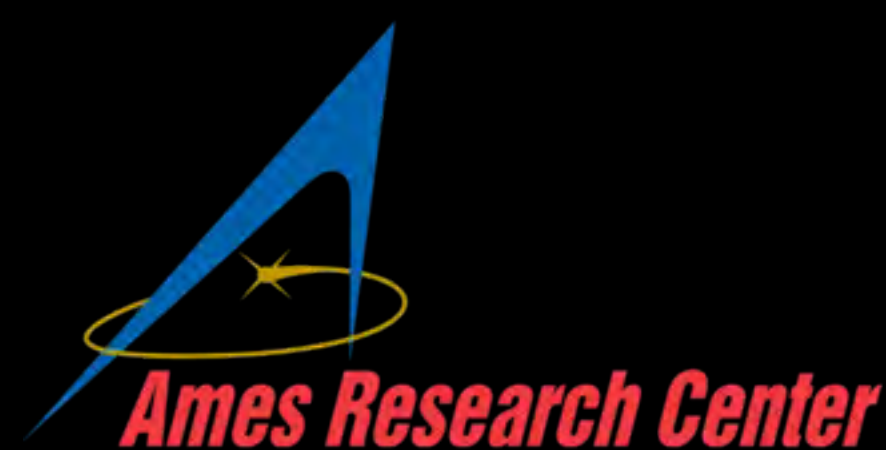
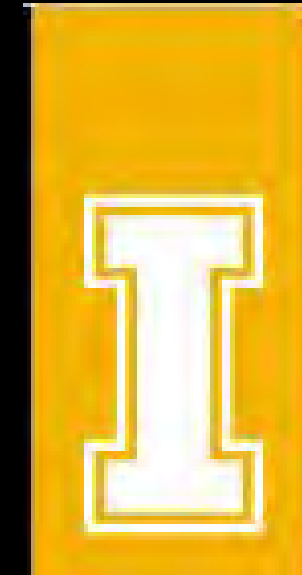




Low-Cost Satellite Attitude Determination and Control System



Team TARDIGRADES

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Background

- ADCS – Attitude Determination and Control System
- Used to determine the orientation of the satellite and adjust/tilt it in response to inputs.
- Commercial units are expensive but individual components can be combined much more cheaply

Objective

To identify and assemble components to create an ADCS unit ready for vibration testing

Design Requirements

All components of the ADCS must:

- be able to withstand vacuum
- operate at less than 8.2 V
- fit within 1 U (10x10 cm)

Value Proposition

The ability to point the satellite is integral for use of cameras, telescopes, and communication equipment.

Using lower-cost components makes the technology more accessible to groups like students, who wouldn't normally be able to afford it.

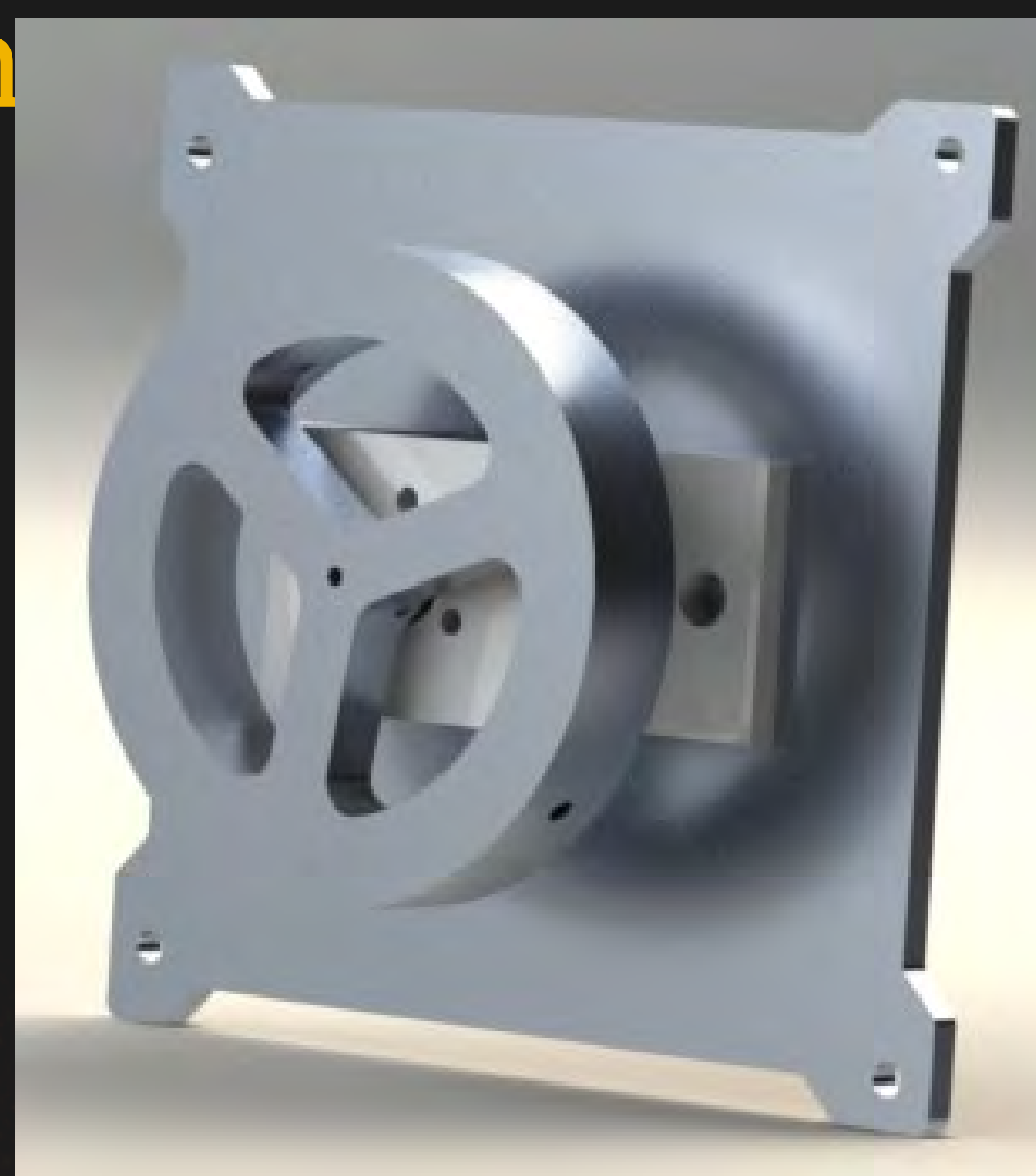
Mechanical Design

Conceptual Development:

- Chose to focus on reaction wheels out of all ADCS components
- Chose spoked instead of solid due to moment of inertia

Final Design:

- Driven by Maxon 351006 brushless motor
- Wheel and base plate constructed from aluminum
- Motor mount and cover are 3D printed



Moment of Inertia (g*mm ²)	26122.27
Maximum Angular Momentum of Satellite	
X (rev/min)	0.8018

Validation

Flywheel

- 3D print test stand and motor mount allowing uniaxial rotation
- Allows testing of motor-flywheel assembly and observation of counter-rotation of the plate



Controls

- Verified that board is capable of spinning the motor in the correct direction and speed
- Check that it is supplying correct voltage to all component of the board

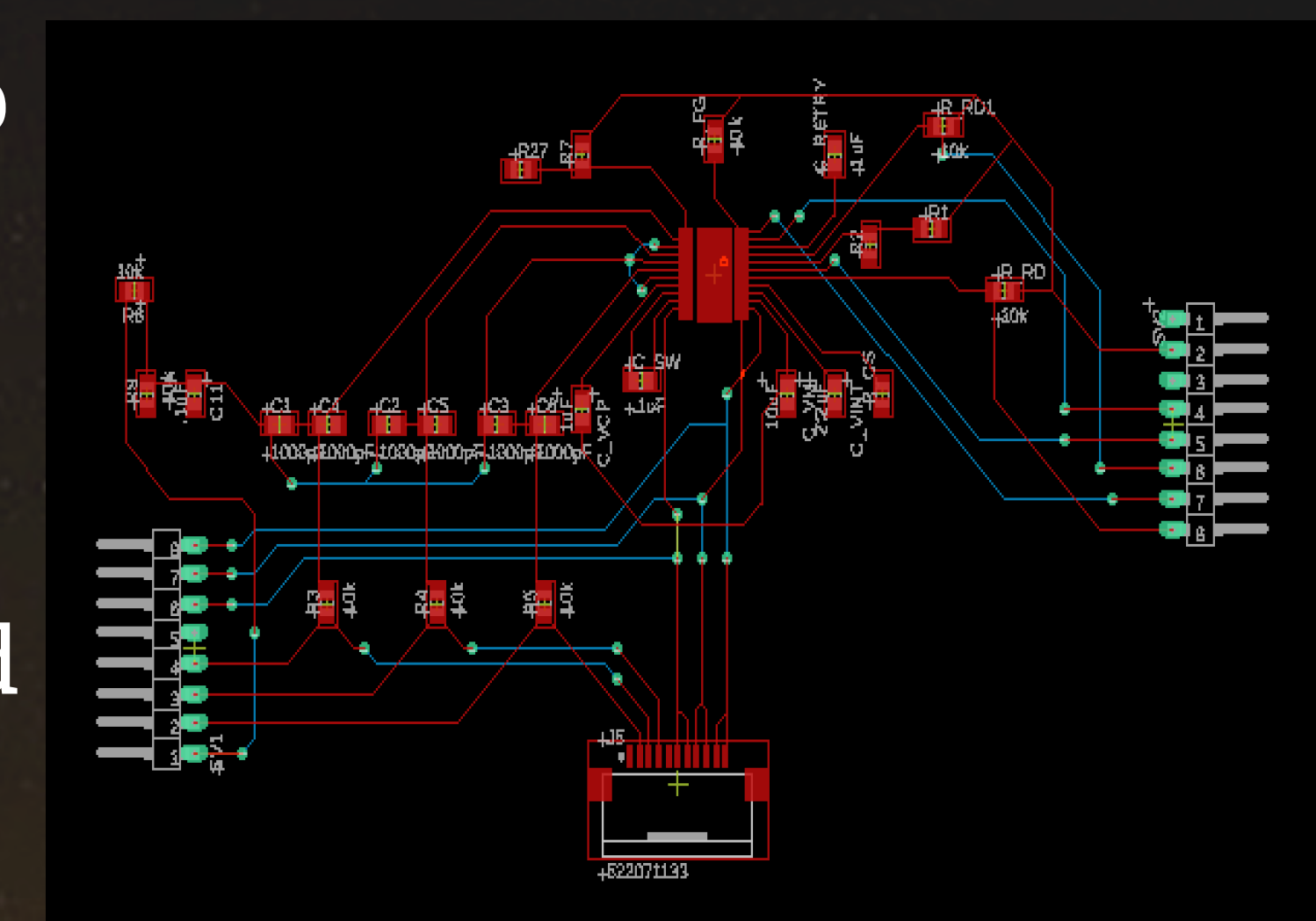
Electrical Design

Conceptual Development:

- Focused on creating a schematic comprised of the motor driver, IMU, SAMD21, and power converter, and a PCB design for the motor driver

Final Design:

- Motor driver built in conjunction with DRV10970 brushless DC motor driver chip
- Used LM53635-Q1 power converter to supply power to the IMU and processor
- ICM-20948 IMU used to measure the rotational acceleration



Recommendations

Mechanical

- Increase compactness of design
- Integrate magnetometers and torque rods
- Adjust wheel geometry based on desired rotation

Electrical

- Integrate motor driver PCB design with power converter, SAMD21, and IMU PCB design
- Consolidate PCB design to fit on the mounting plate

Special Thanks

- NASA ARC: Marcus Murbach, Avery Brock, and Samuel Zuniga
- Lead Instructor: Dr. Feng Li
- Mentor: Jacob Brower
- Idaho Space Grant Consortium

