DALHOUSIE UNIVERSITY
FACULTY OF ENGINEERING

Zaid Al Rayyes – Daniel Campbell
Andrew Montgomery – Matthew Montgomery

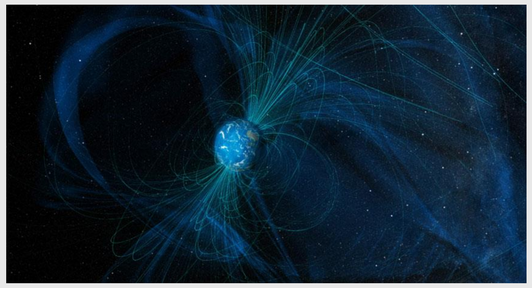
Dr. Robert Bauer - Dalhousie University
Faculty of Mechanical Engineering

Department of Mechanical Engineering

CubeSat Satellite Attitude Control Testbed

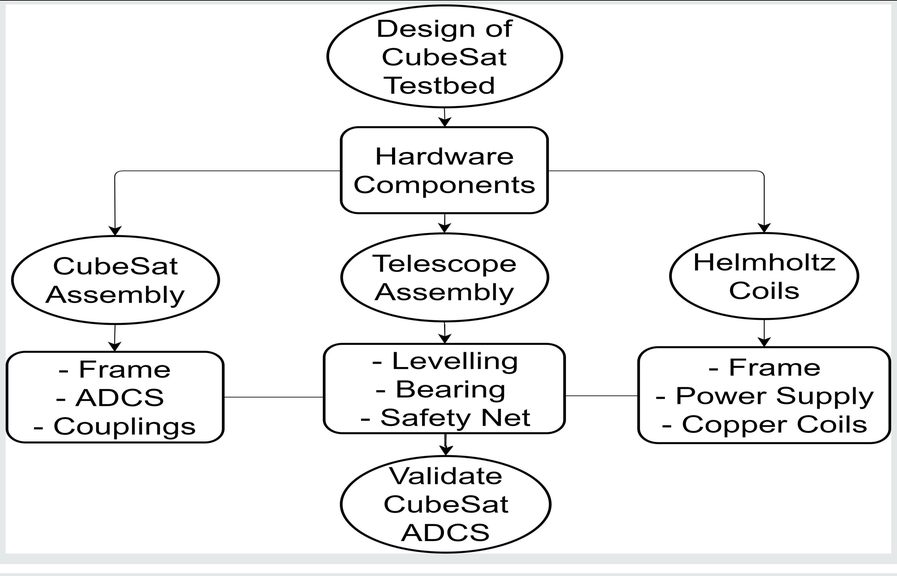
Background

- Team 19 has designed a testbed that will test the LORIS' Attitude Determination and Control Systems (ADCS) before it is placed in orbit.
- Accurate attitude determination and control are critical aspects of CubeSat design and testing, yet are difficult to achieve.
- The monitoring of Earth's magnetic field permits accurate and reliable attitude determination and control.



- The Helmholtz Cage uses electromagnetic induction to control the magnetic field strength within its enclosed space, therefore mimic Earth's magnetic field.
- Attitude control systems are tested by placing the CubeSat on a low friction bearing and allowing them to rotate in-plane in response to the field.

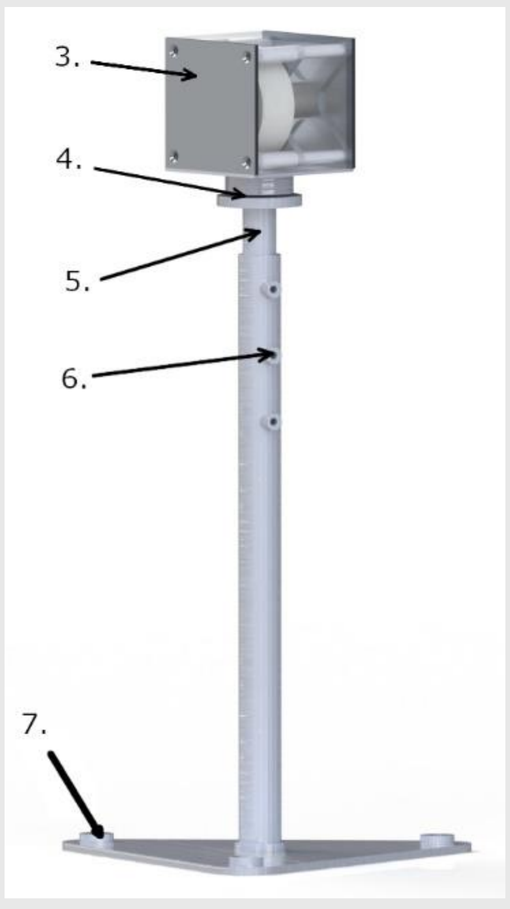
Design Process



References

- Conover, Emily. "Bizarre metals may help unlock mysteries of how Earths magnetic field forms." Science News 7 Nov 2018 https://www.sciencenews.org/article/bizarre-metals-mystery-how-earth-magnetic-field-forms. Web.

Details of Design

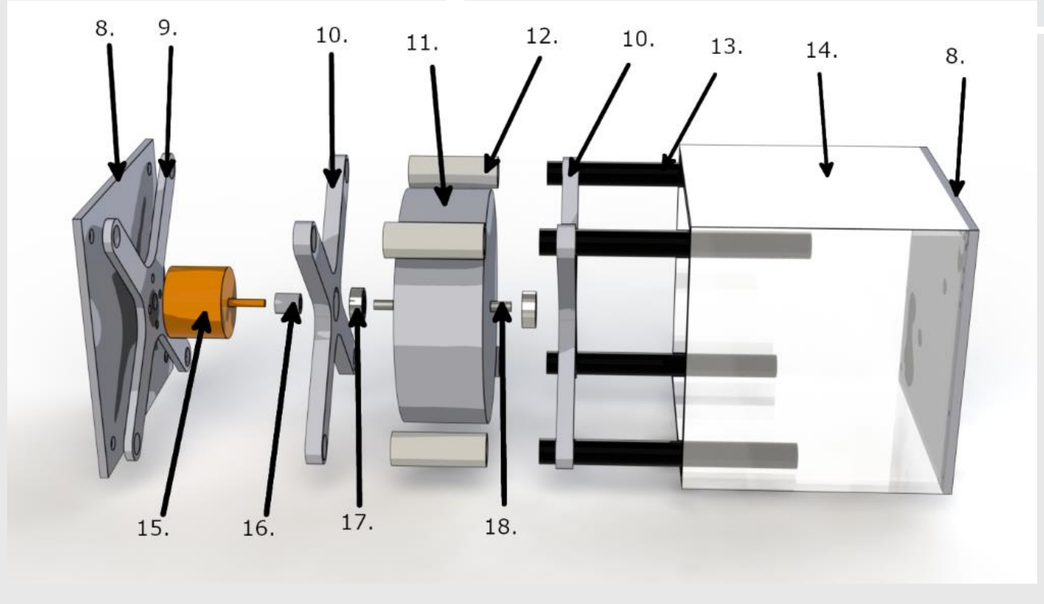


Testbed Structure

1. Magnetic Coil Frame
2. Coil Support Structure
3. CubeSat Testing Assembly
4. Low Friction Bearing Housing
5. Telescoping Tube
6. Machine Screw Partitions for Fixing Telescoping Assembly
7. Baseplate with Leveling Screw Partitions

CubeSat Assembly

8. CubeSat End Plate
9. Motor Mounting Plate
10. Flywheel Mounting Plate
11. Flywheel/Reaction Wheel
12. Flywheel Mounting Plate Spacers
13. Frame Rails
14. Cast Acrylic Shield
15. Brushless Motor
16. Motor-Flywheel Coupler
17. Flywheel Axle Bearing
18. Flywheel Axle



Conclusion

The test satellite was able to control its attitude based on the magnetic input from the testbed. This shows that other CubeSats should be able to sense the testbeds magnetic field and react to it as they would in space. In this sense, the project was successful. This project proved to be a constant learning process, about project management, electronics, computer science and control algorithms.

Future Work

A more accurate simulation of a complete low-earth orbit would be possible with a 3-axis cage.

The prototype Cube Satellite takes readings at approximately 100 Hz. More accurate measurements could be made using a more sophisticated magnetometer.

There are several options for improvement of the bearing, such as air bearings and ceramic bearings.

Bearings with sufficiently low friction may permit the use of magnetorquers in the cage.

The testbed and CubeSat will stay at Dalhousie for further testing.

Acknowledgements

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