

CBASS: THE DESIGN AND ARCHITECTURE OF A THREE DEGREE OF FREEDOM NEAR-FRICTIONLESS TESTBED FOR GROUND VALIDATION OF CUBESAT OPERATIONS

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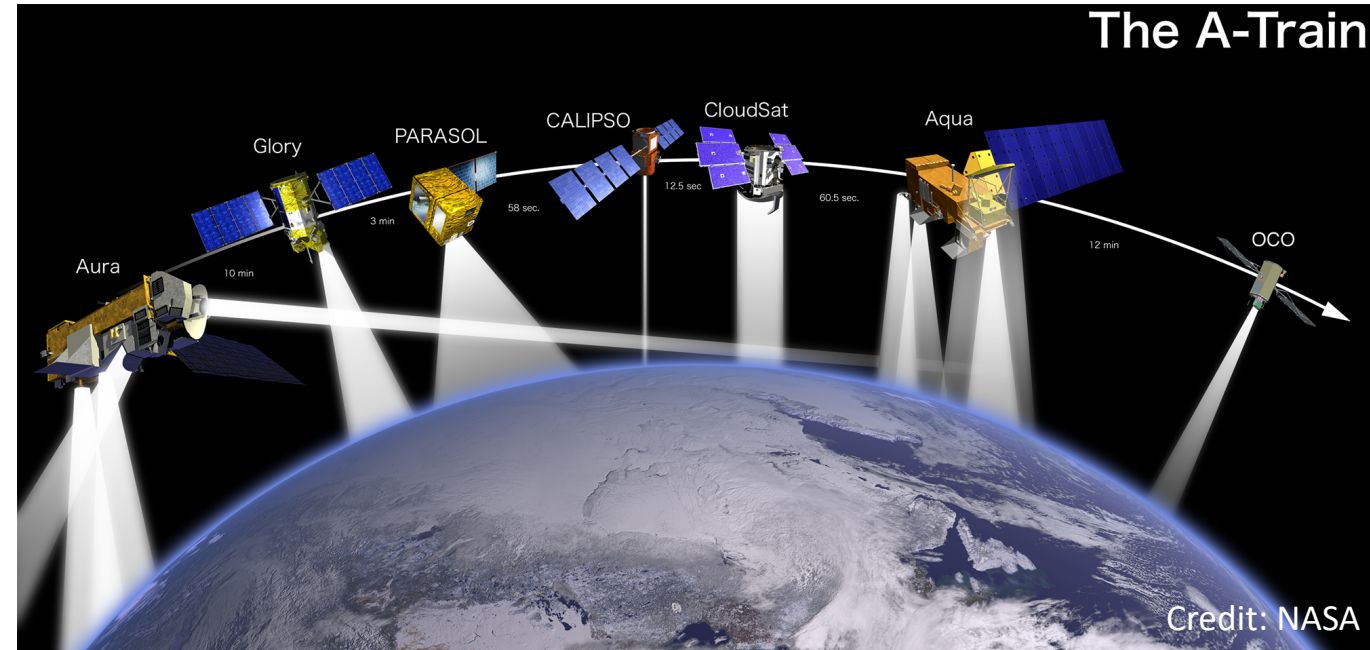
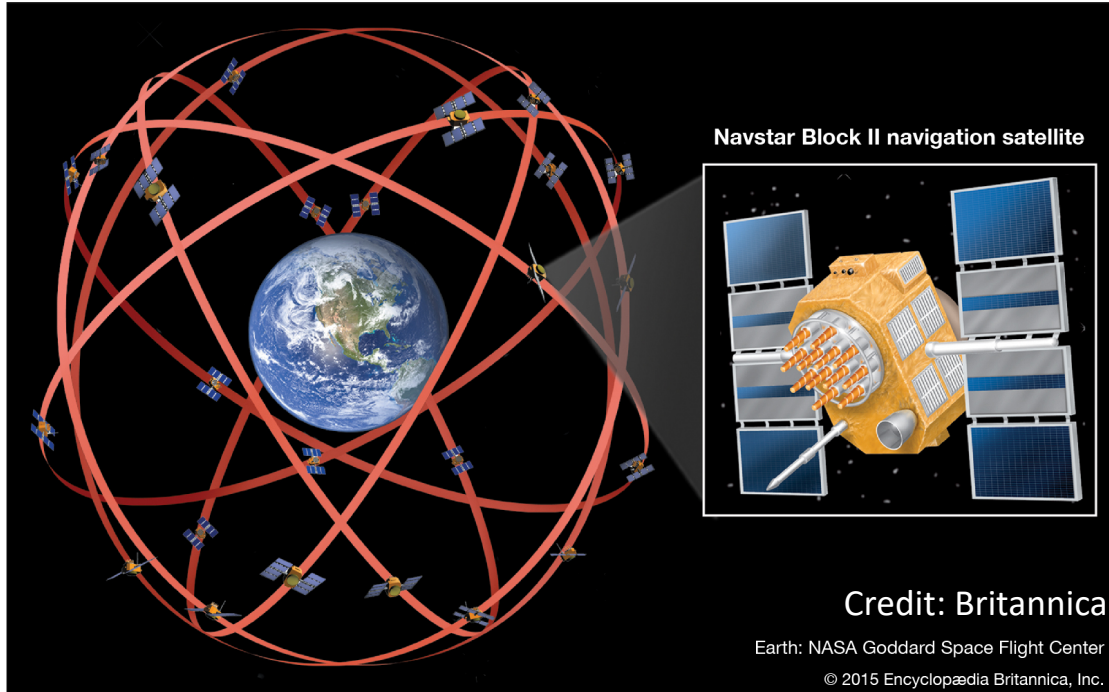
34th Annual Small Satellite Conference

Pre-Conference Workshop Session IV: Advanced Concepts II

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Shift in Satellite Morphology

Constellations



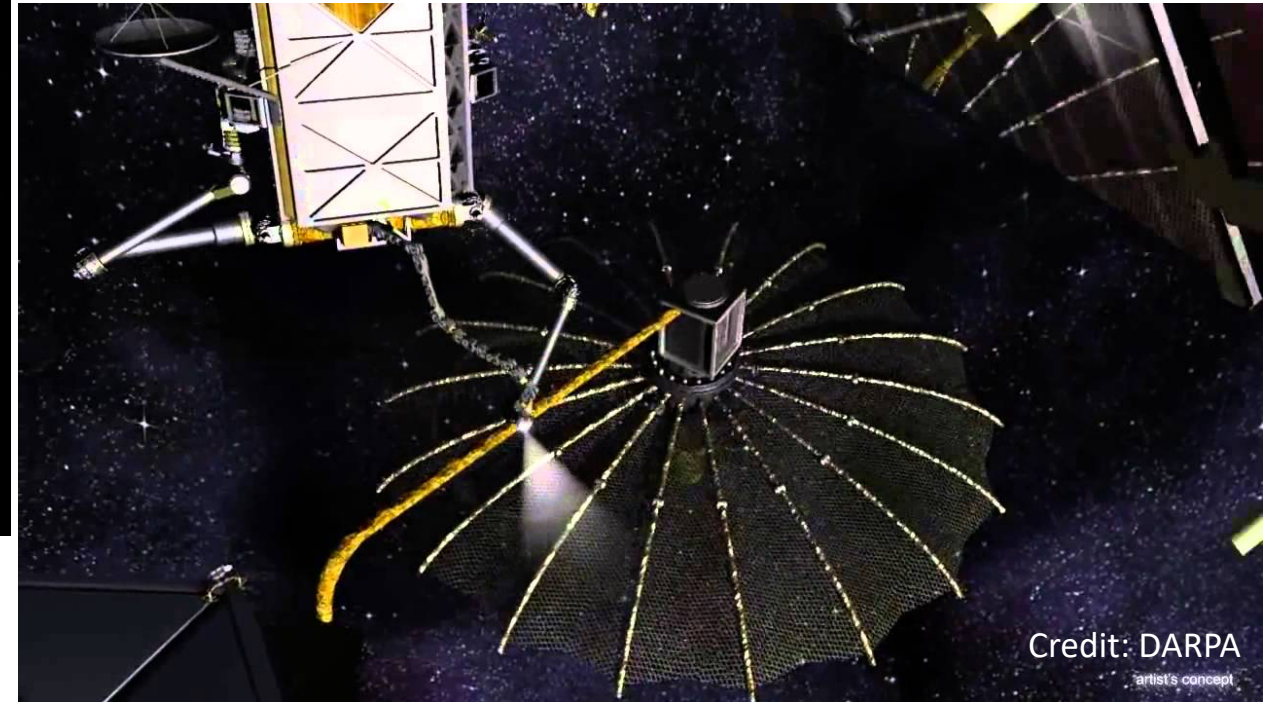
Shift in Satellite Morphology

The New Vision: Manufacturing and Aggregation



Credit: Made In Space

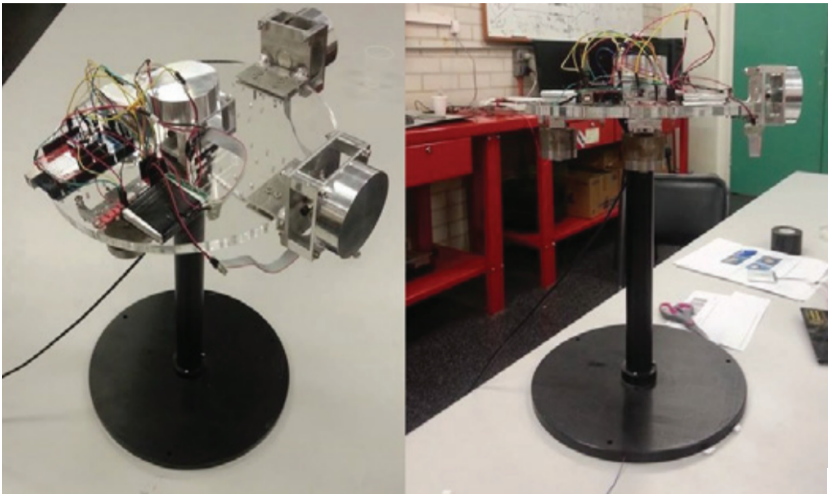
Made In Space's Archinaut



Credit: DARPA
artist's concept

DARPA's Phoenix Satellite Servicing

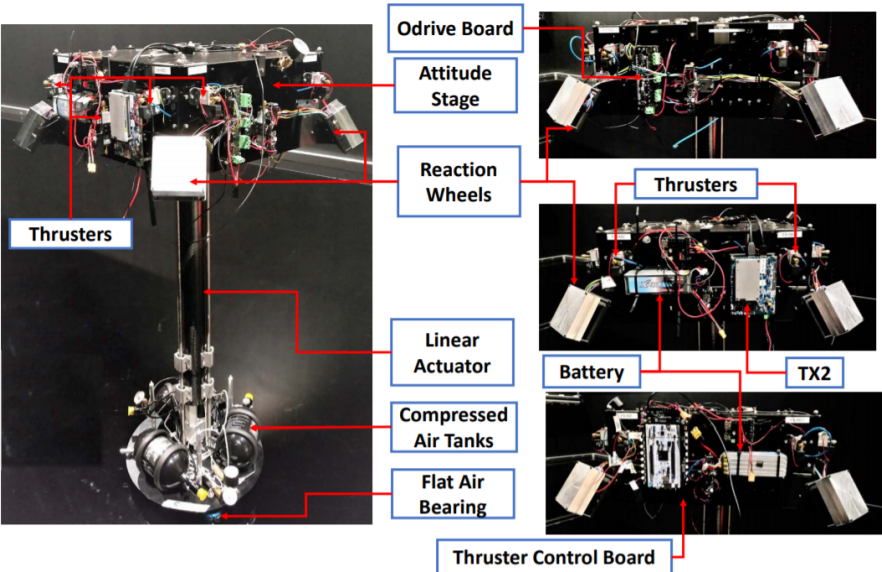
Ground Testing Platform Variations



Air bearing table from the Spacionics Laboratory [1]

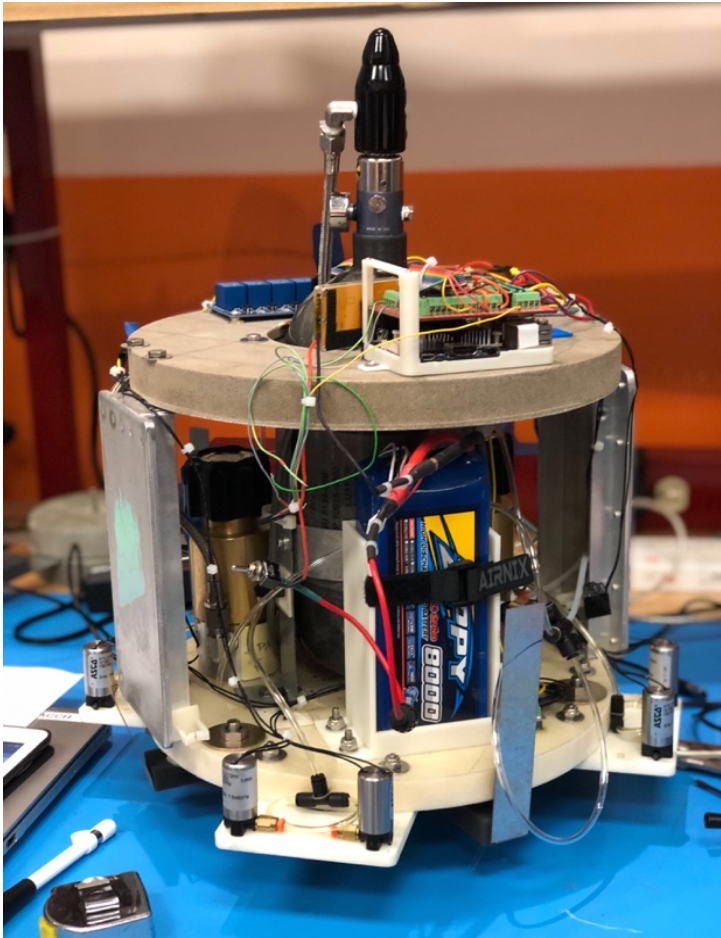
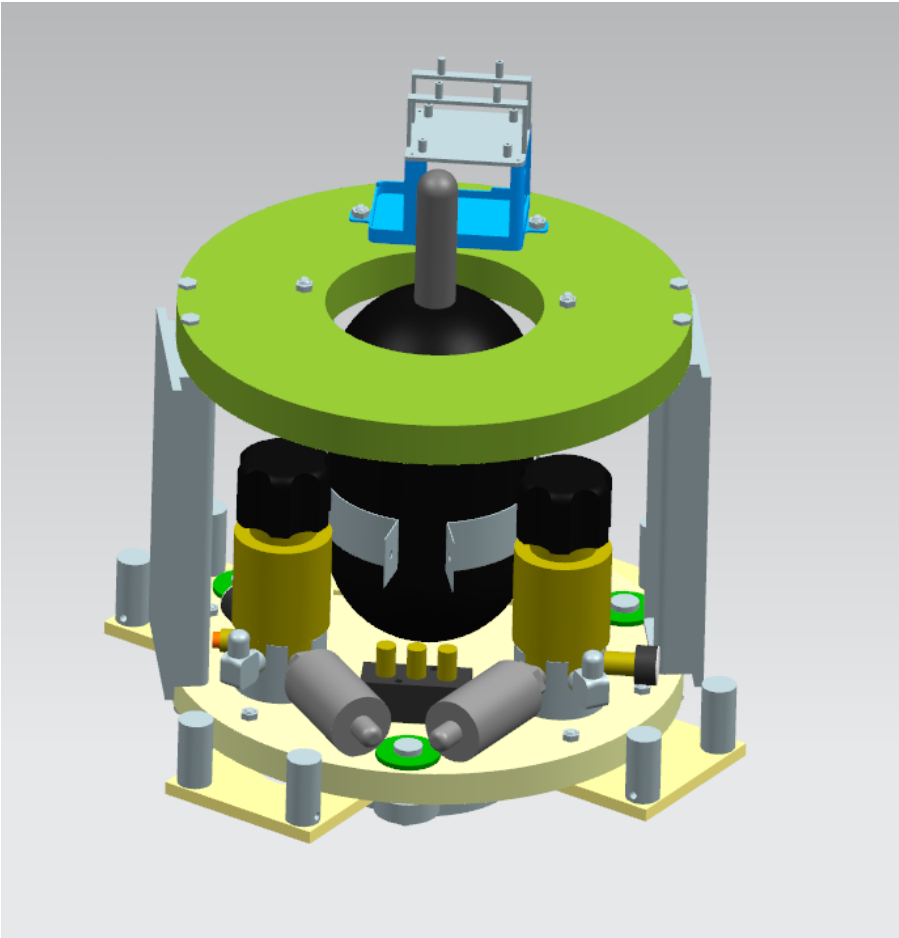


Vehicles in the Micro-satellite Dynamic Test Facility [3]

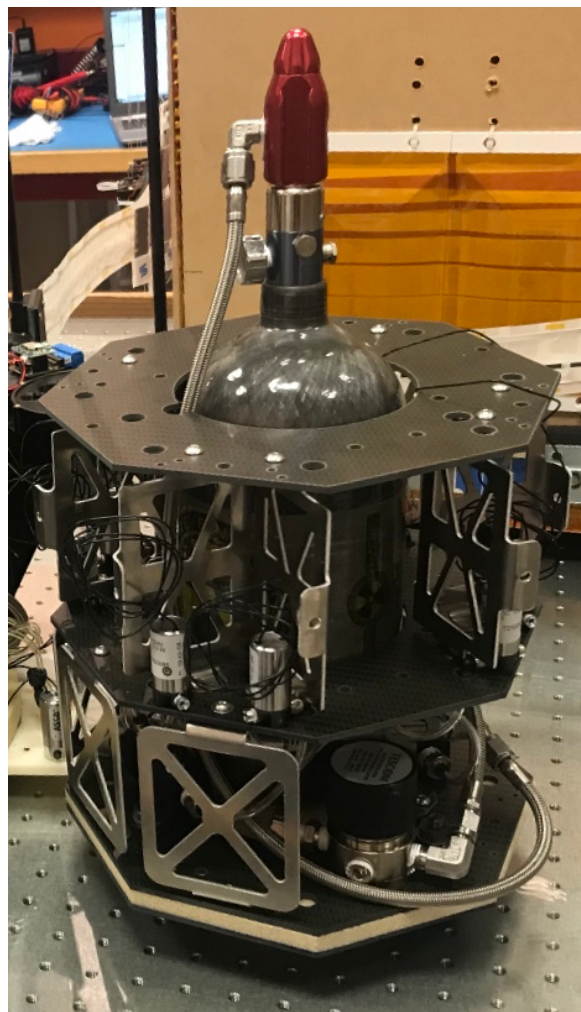
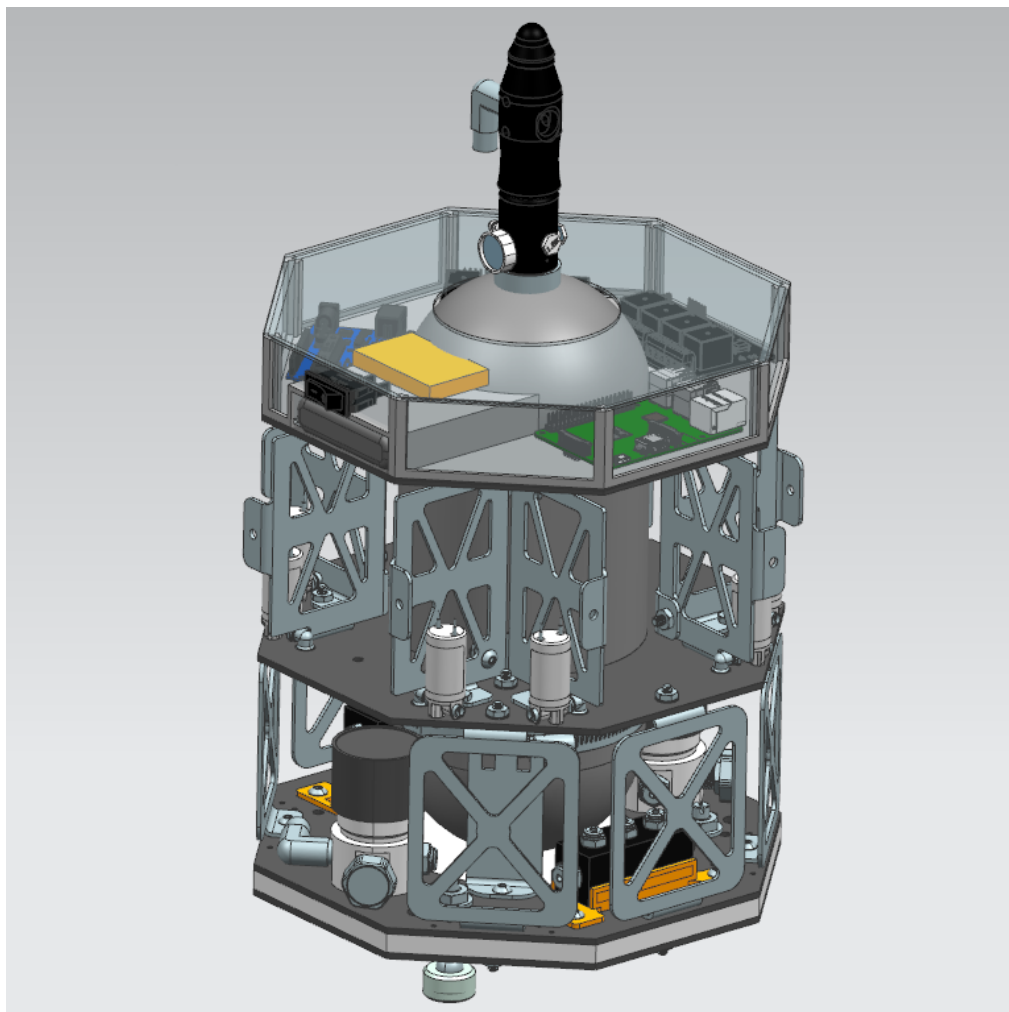


M-STAR dynamics simulator [2]

USC SERC's Generation I GTP



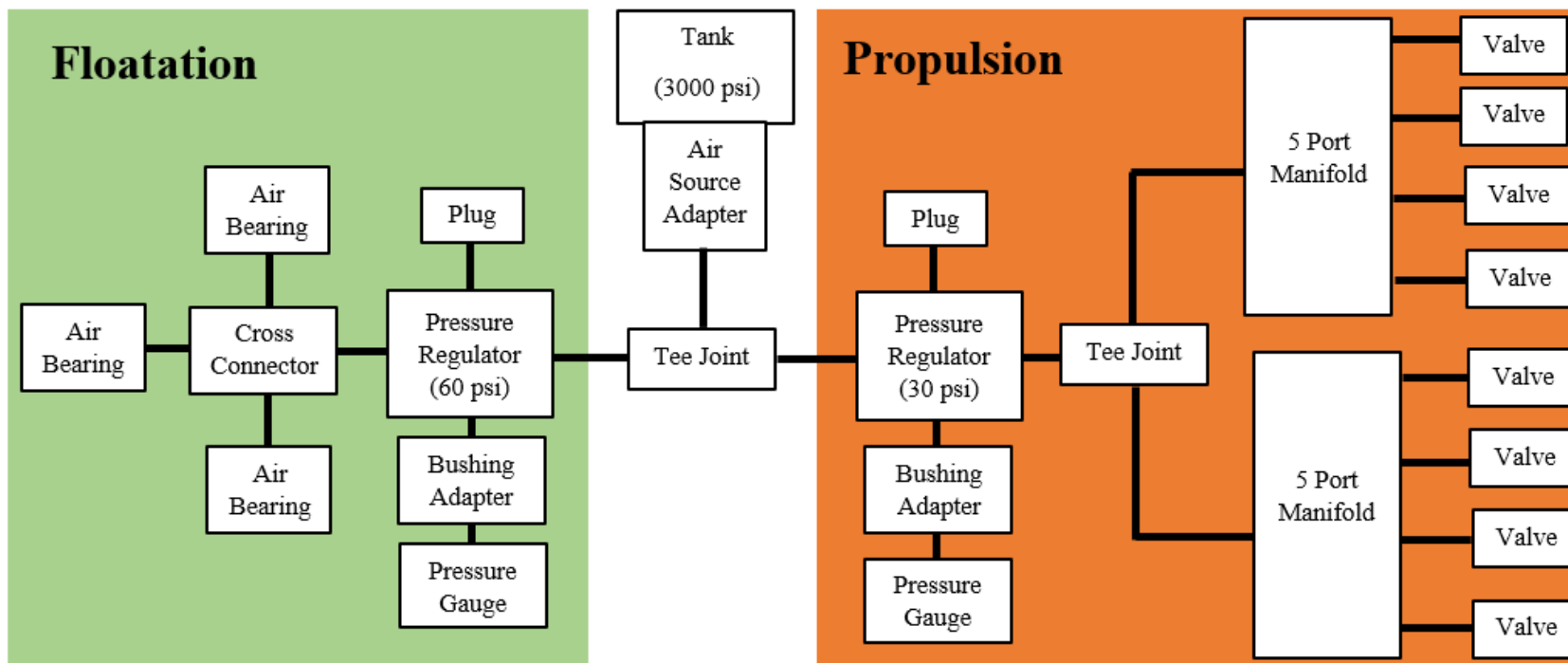
USC SERC's Generation II GTP



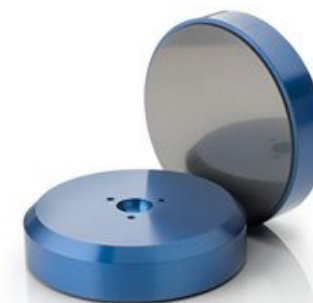
Features of Gen II include...

- Propulsion and floatation via a common cold gas supply
- A semi-regular tessellation aggregation pattern
- Increased adaptability for use with multiple projects
- Reduced weight using composite materials
- Isolated control box

Propulsion and Floatation



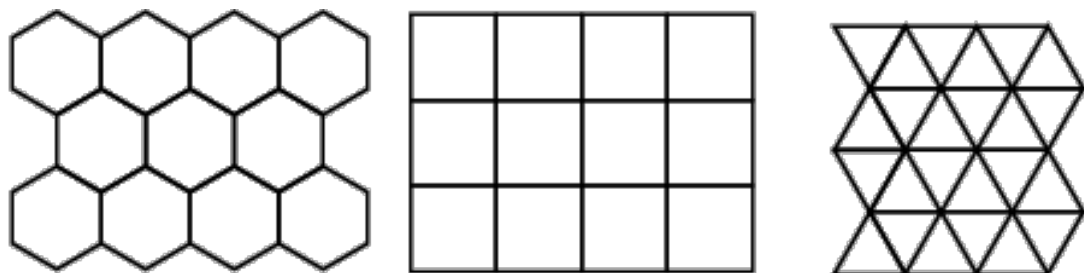
ASCO Solenoid Valves



New Way Air Bearings

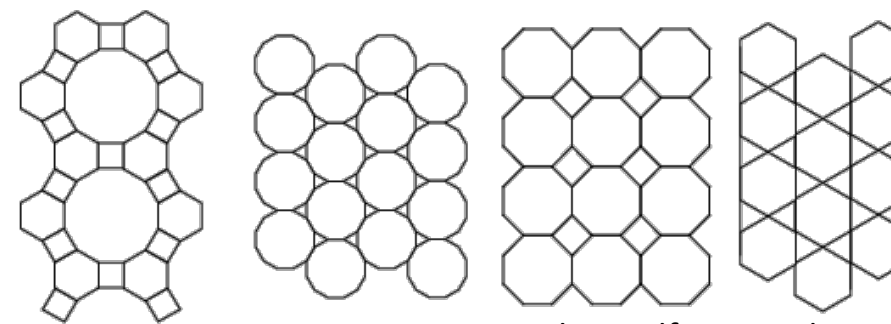
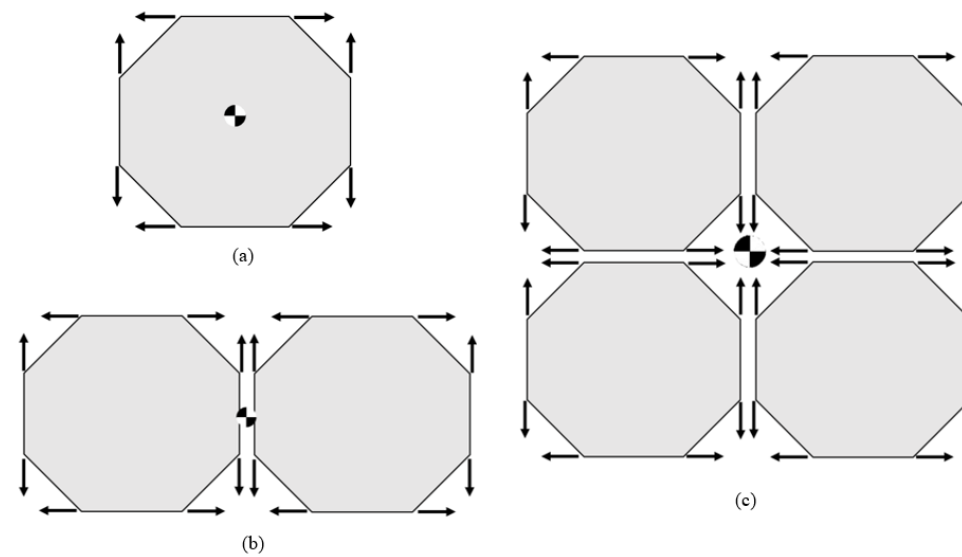
Regular vs. Semi-Regular Tessellation Behavior

Regular Tessellations



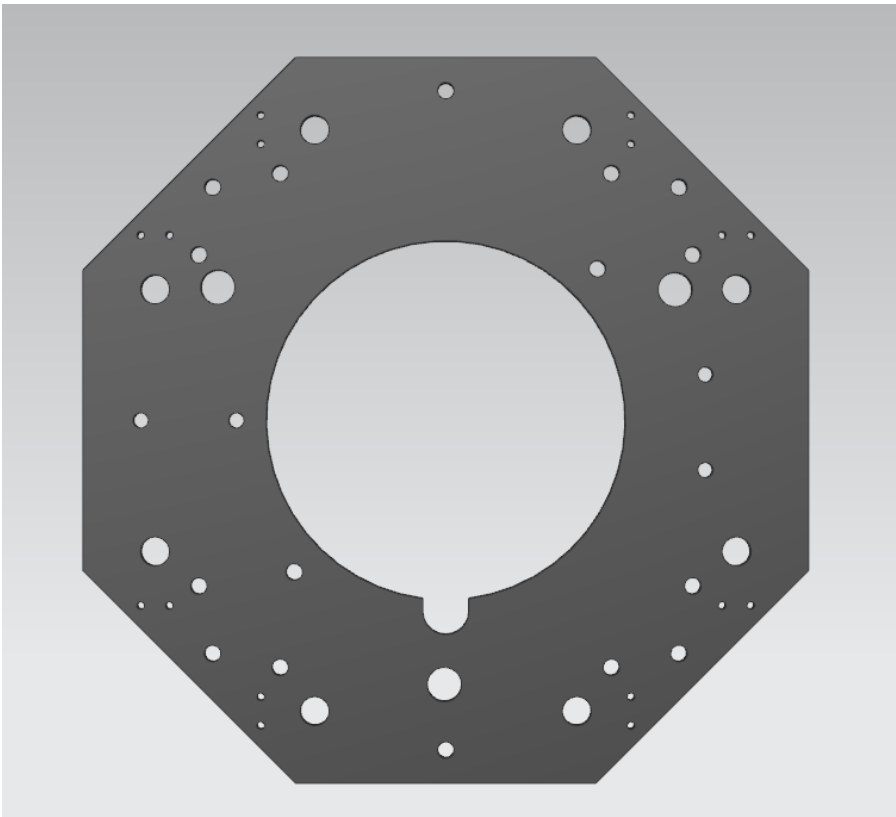
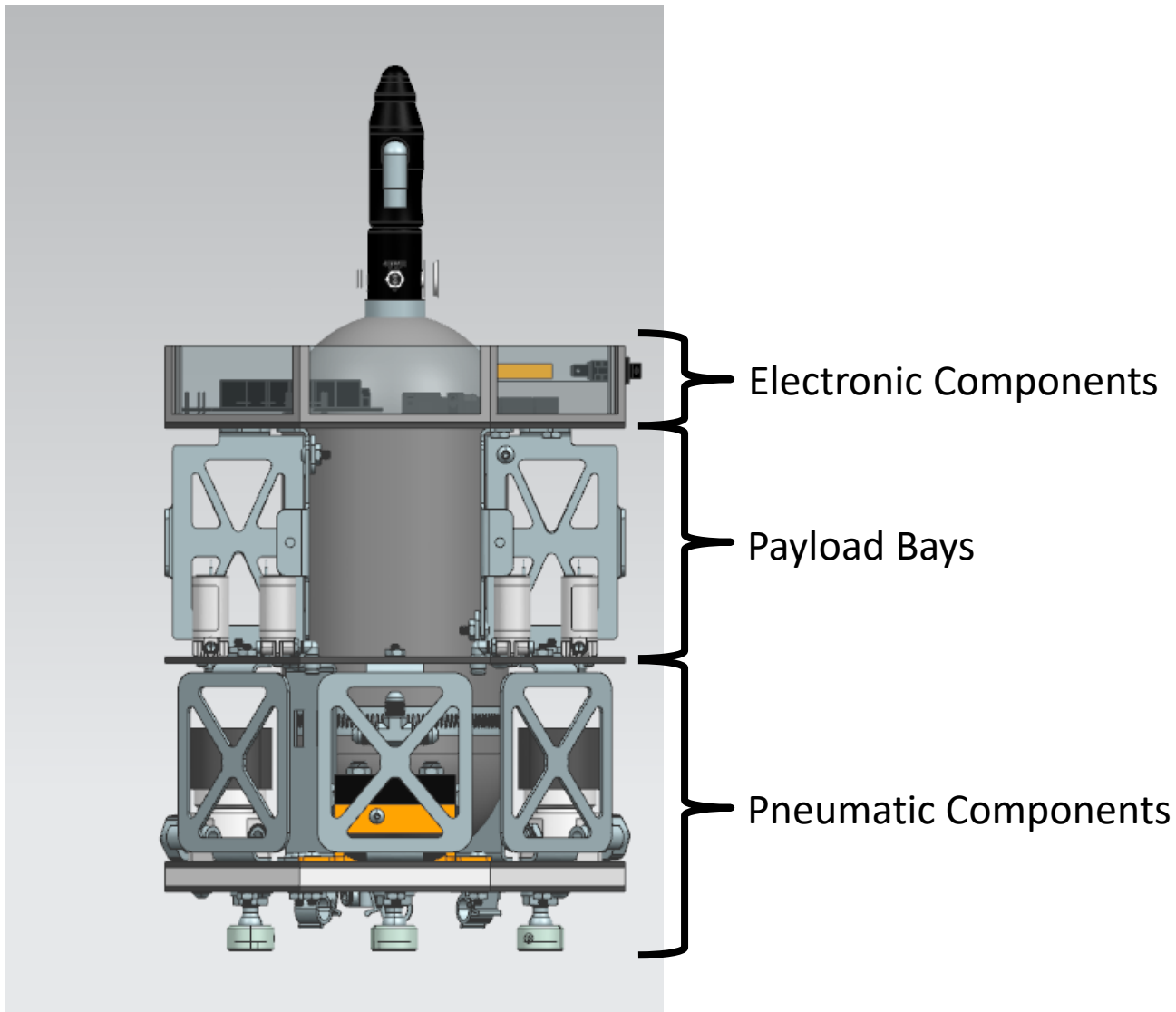
Credit: Wolfram MathWorld

Semi-Regular Tessellations

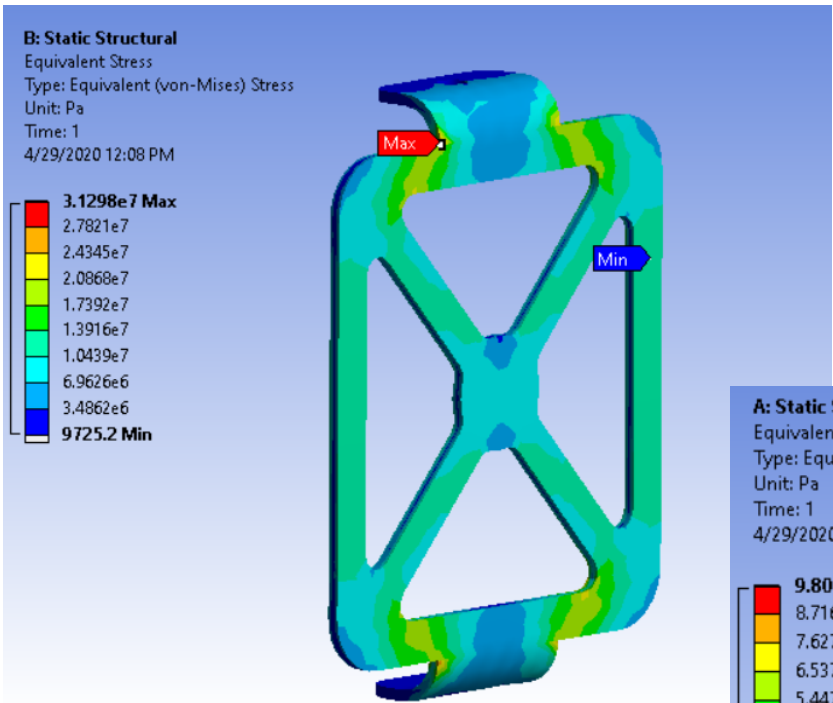


Credit: Wolfram MathWorld

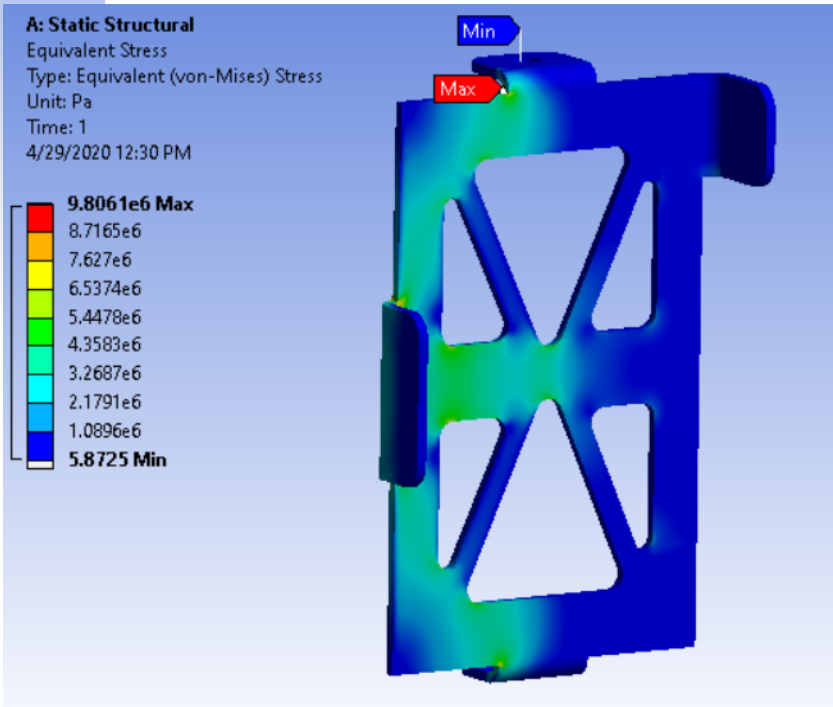
Increased Adaptability



Reduced Weight

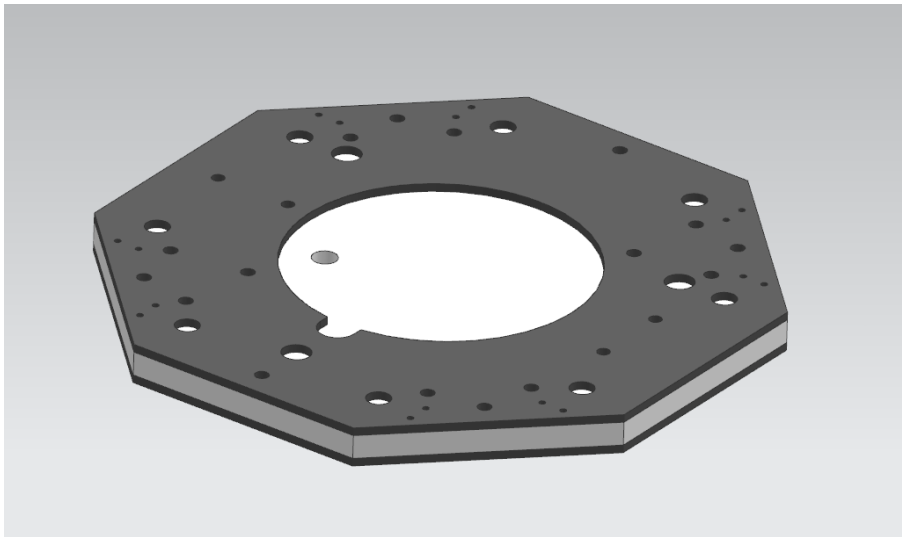


Structural analysis of Al6061-T6 side walls



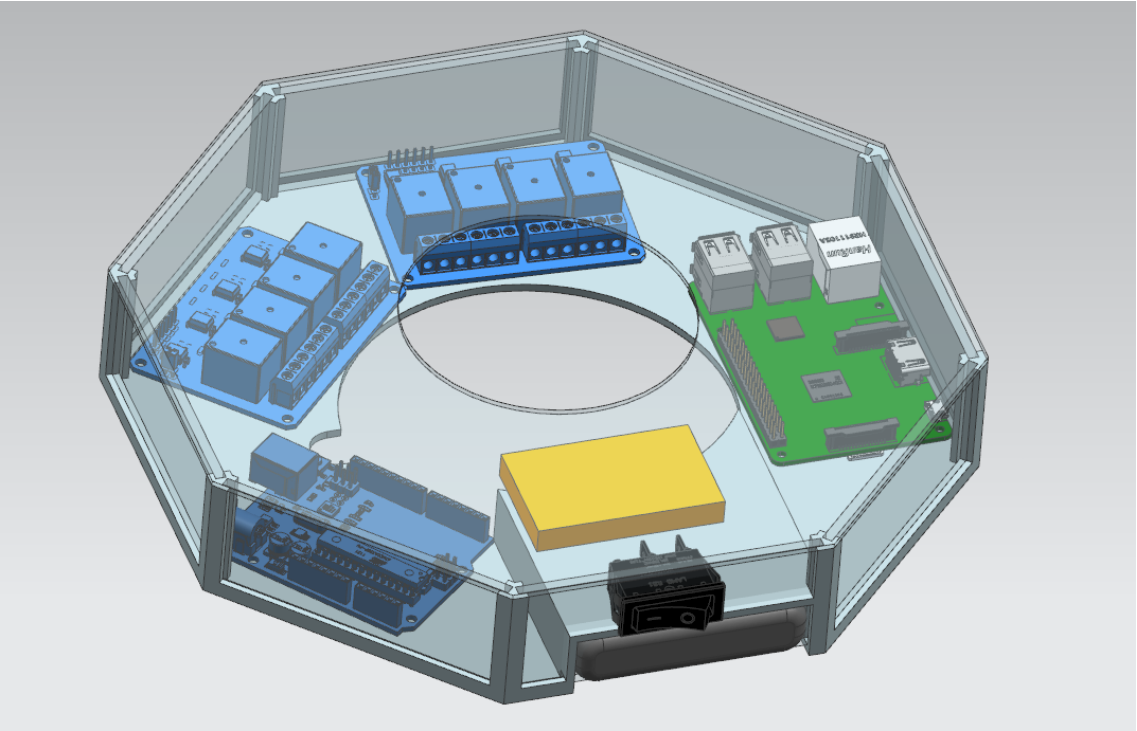
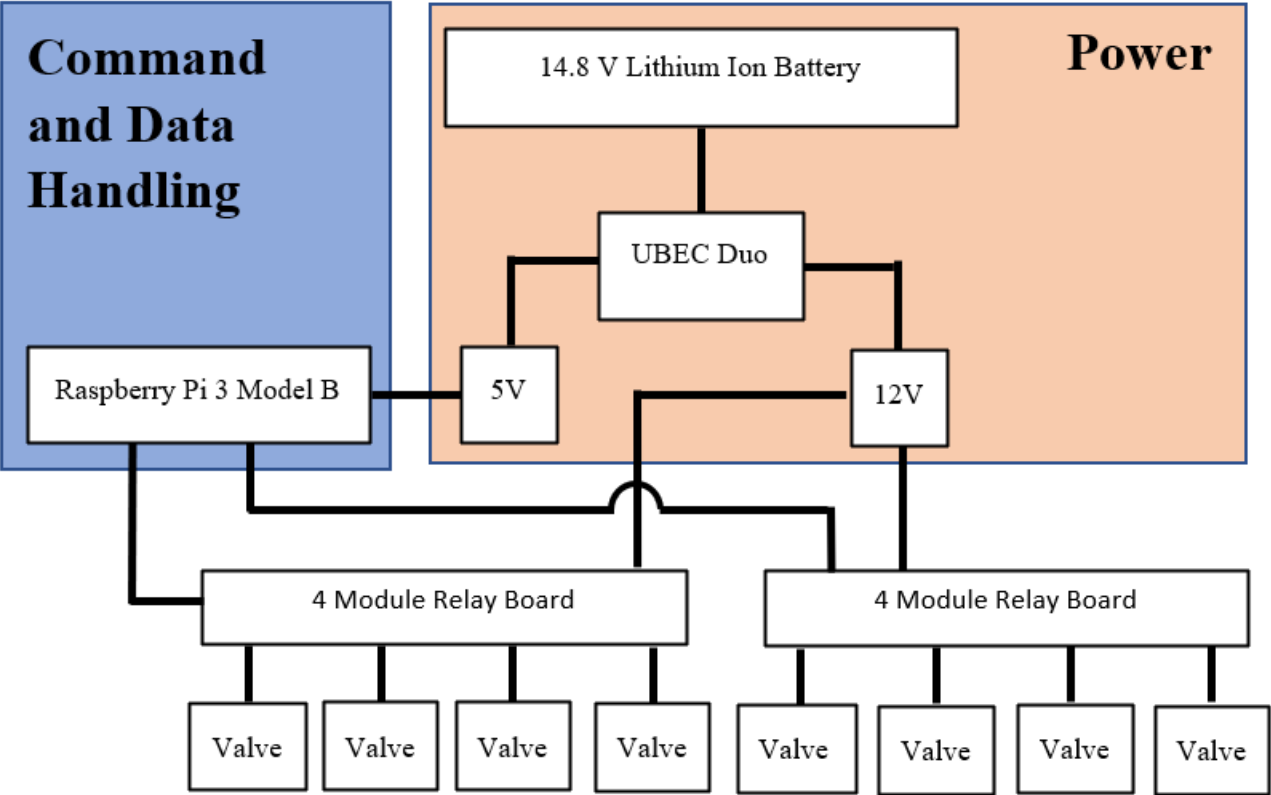
1/8" plain weave carbon fiber

3/8" 4lb density foam

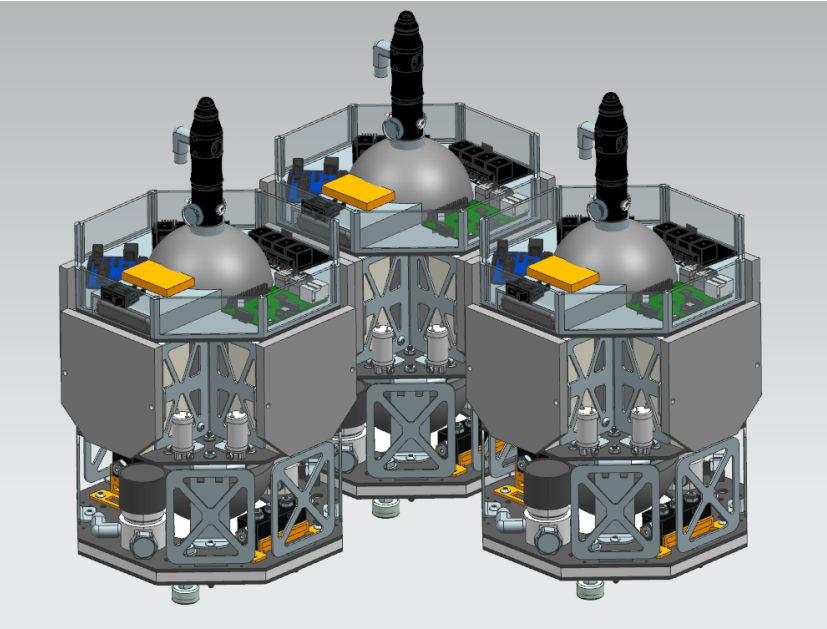


Composite sandwich base plate

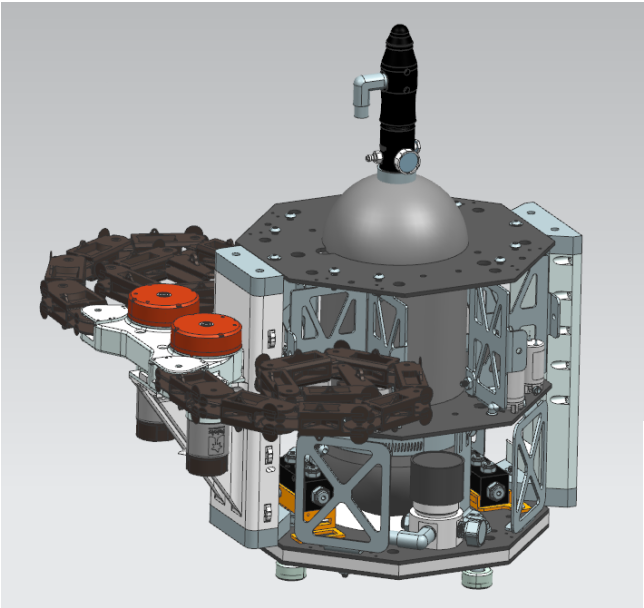
Isolated Control Box



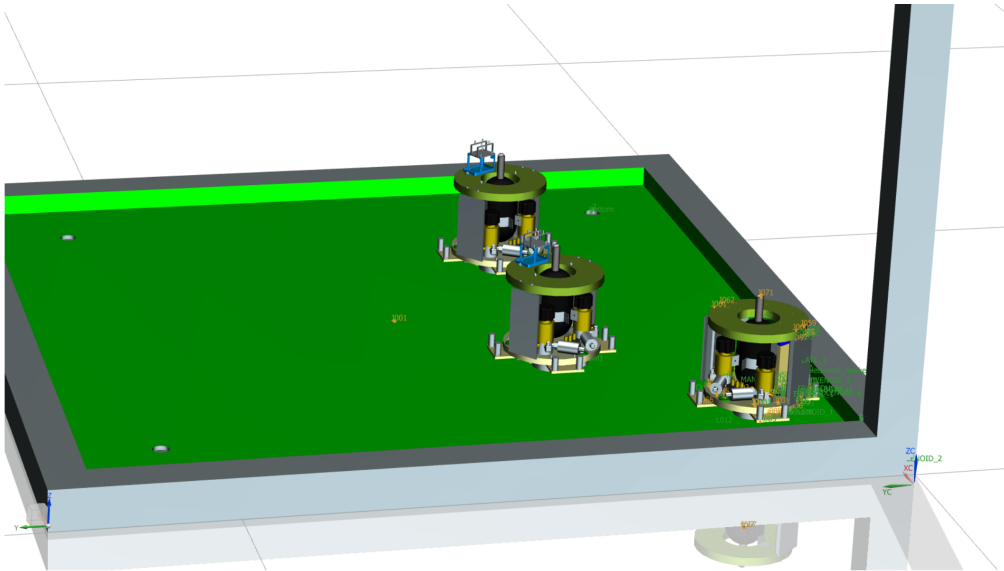
Applications at SERC and Future Work



Gen II modified for CBASS



Gen II modified for REACCH



Gen I platforms used in NX Simulink Motion for Swarm RPO [4]

- [1] Kwan, T., Lee, K. M. B., Yan, J., Wu, X. (2015). An air bearing table for satellite attitude control simulation. In *2015 IEEE 10th Conference on Industrial Electronics and Applications*, 1420-1425. 10.1109/ICIEA.2015.7334330.
- [2] Nakka, Y., Foust, R., Lupu, E., Elliott, D., Crowell, I., Chung, S., Hadaegh, F. (2018). Six Degree-of-Freedom Spacecraft Dynamics Simulator for Formation Control Research. In *AAS/AIAA Astrodynamics Specialist Conference*.
- [3] Bezouska, W., Aherne, M., Barrett, T., Schultz, S. (2009). Demonstration of Technologies for Autonomous Micro-Satellite Assembly. In *AIAA SPACE 2009 Conference & Exposition*, 10.2514/6.2009-6504.
- [4] Rughani, R., Villafañá, L., Barnhart, D. (2019). Swarm RPO and Docking Simulation on a 3DOF Air Bearing Platform. In *70th International Astronautical Congress*, IAC-19-D1.2.9.