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Lift Measurement System



LiDAR installation



Embedded computation nodes

Results

Volume measurement of
<1% error, >99% accuracy
at 20Hz sampling rate.
AIAA SciTech 2023
Conference paper.

Skills

C++, Poisson surface
reconstruction, Monte Carlo
integration, FAA software
requirements, embedded
Linux, UDP networking.

Requirement
Develop system to measure
lift of a gas cell.

Methodology
Use a 3D LiDAR sensor
to sample cell geometry
and perform numerical
integration.

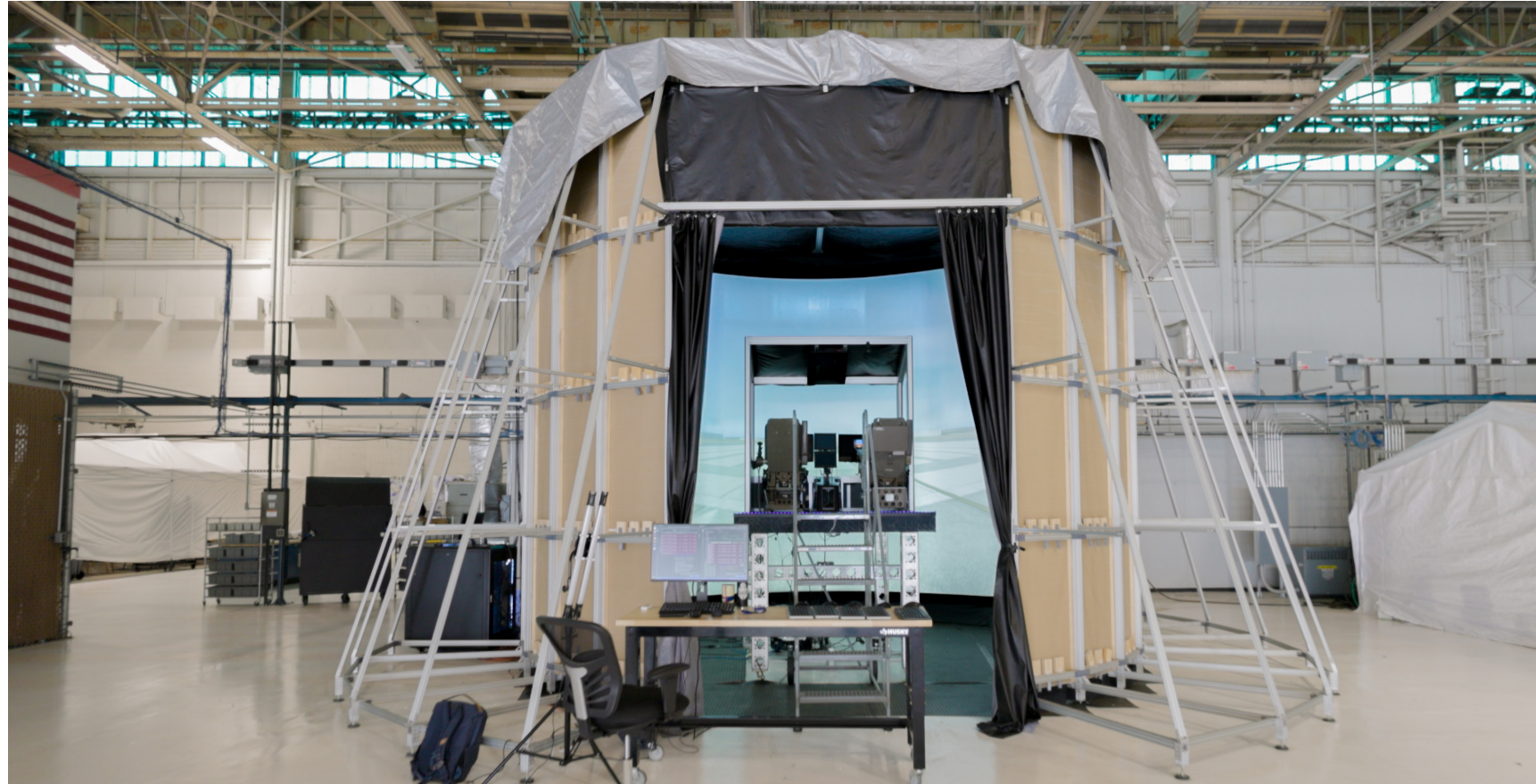


Manufacturing LIDAR sleeves

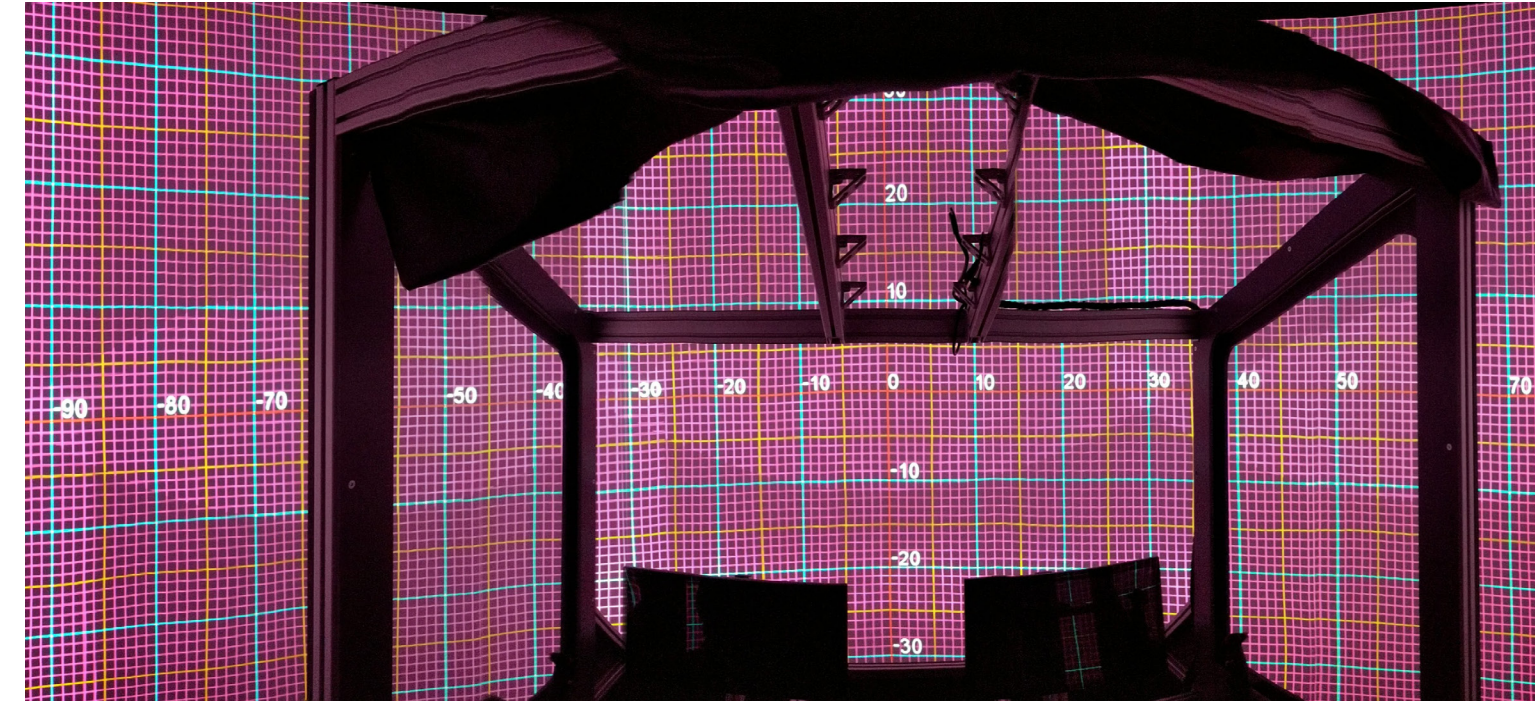


Gas cell

Airship Simulator



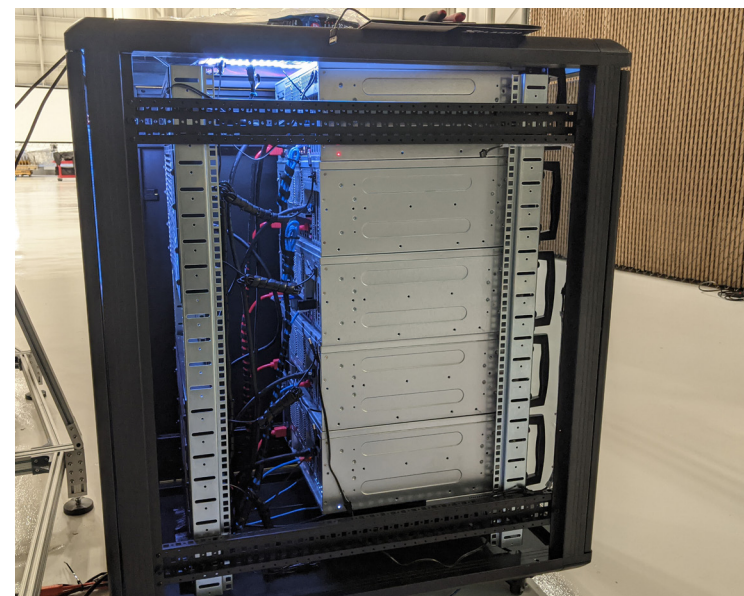
Simulator V02.00 - 10ft tall, 315 degree surround



Meshing all ten projectors into one image

Requirement
Construct an immersive airship simulator for testing of GNC plant and controller.

Skills
Computer networking, Teensy, C++, Python, computer hardware, flight testing, GNC, projector warping, pilot training.

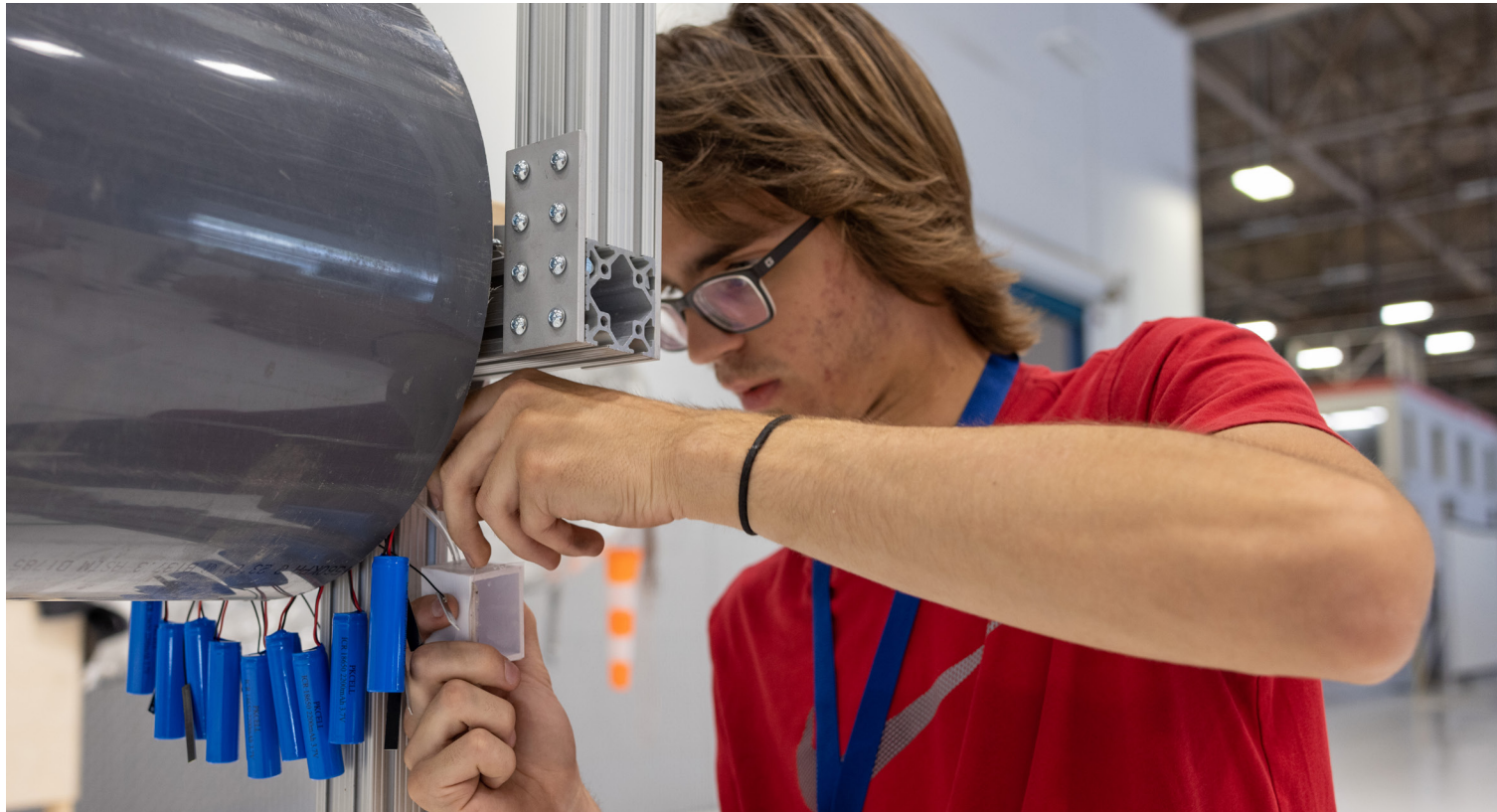


Simulation PCs

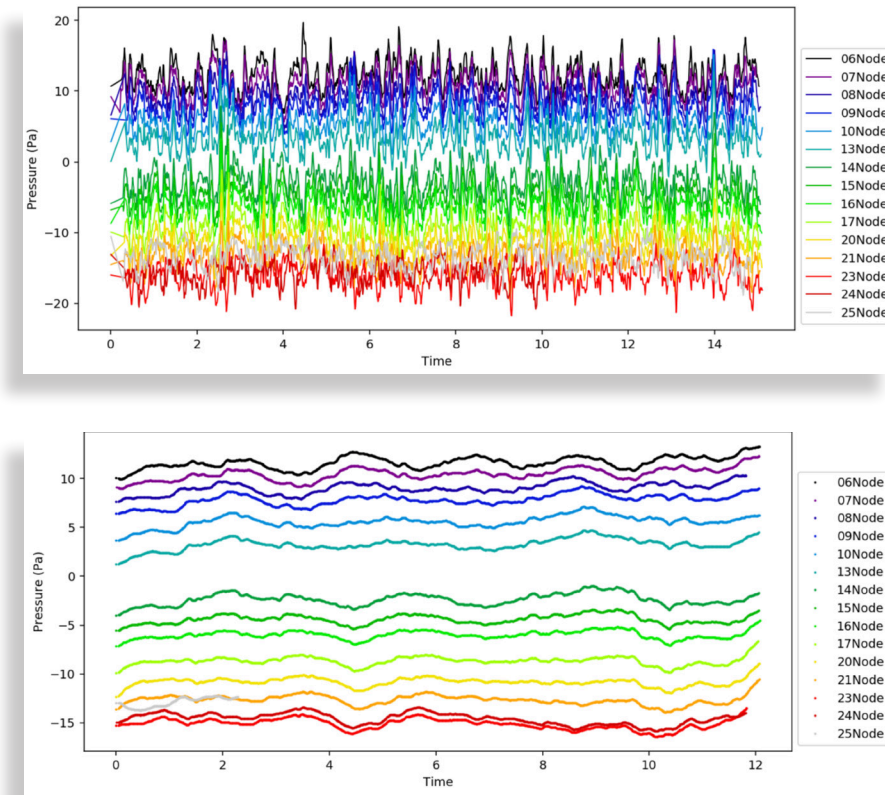


Simulator V01.00

Airship Gust Testing



Pressure sensor setup for scaled test



Results

Successfully correlated theoretical and experimental results of pressure distributions satisfying FAA requirements.

Skills

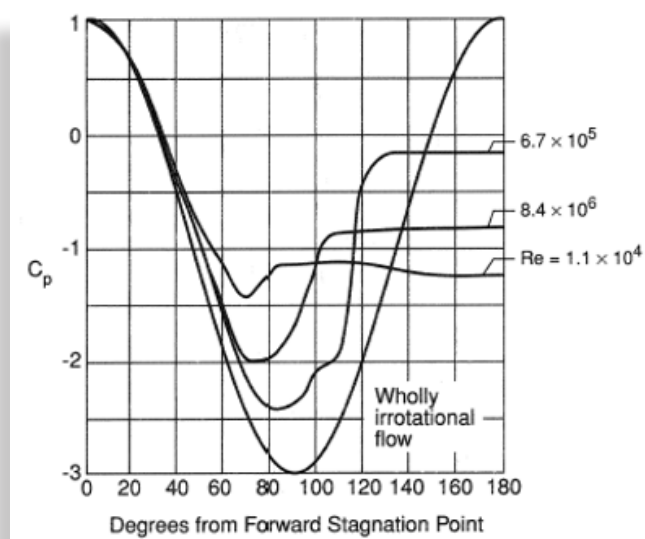
Fluid dynamics, Python, Google Cloud Platform, ParticleIO, Fourier analysis, digital signal processing.

Goal

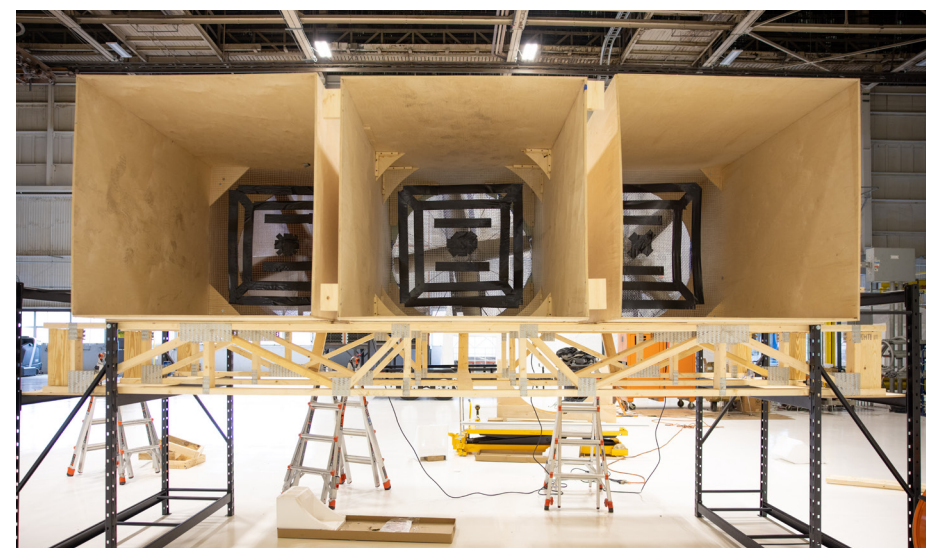
Study the effect of strong wind gusts to determine if airship frame can withstand pressure loads.

Methodology

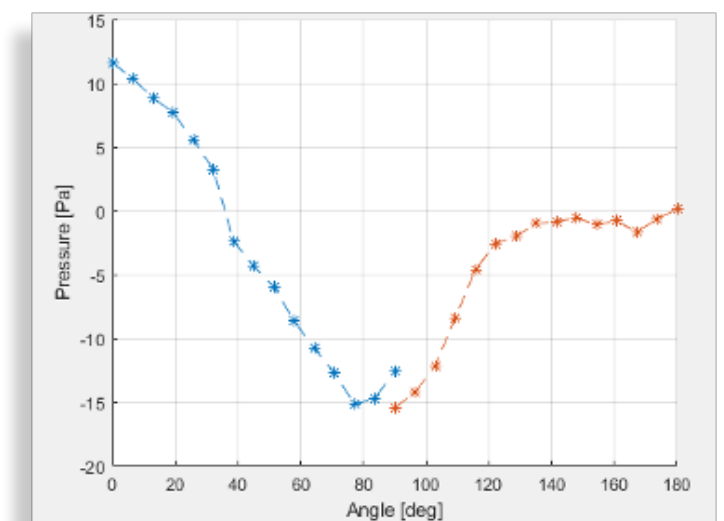
A custom wind tunnel was constructed. An array of custom wireless pressure sensors were implemented and used to measure the pressure distribution.



Theoretical coefficient of pressure curves

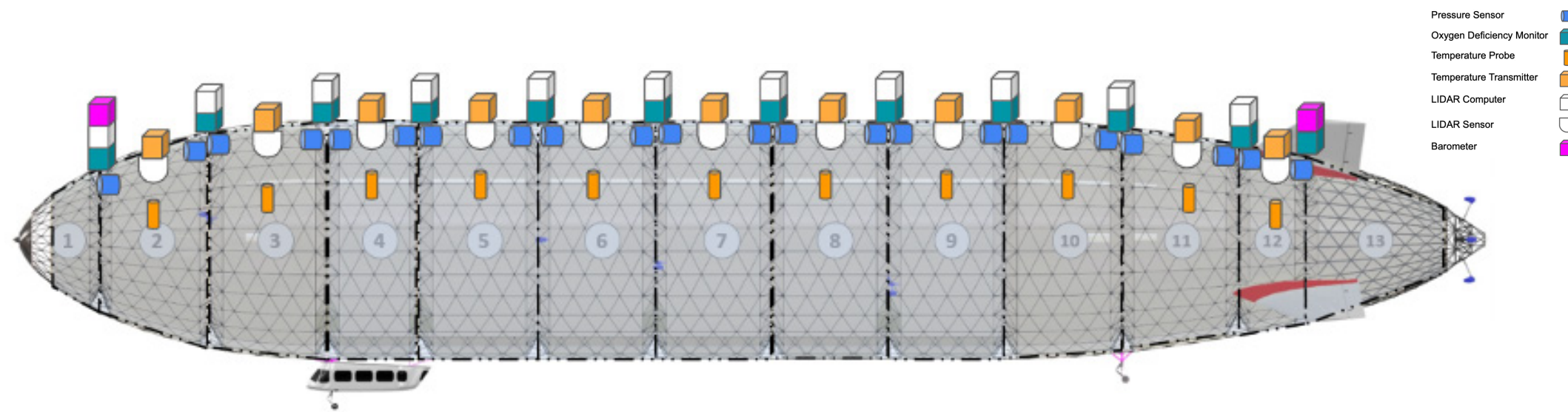


Gust generator construction



Obtained pressure curve

Airship Monitoring Software



Methodology

A C++ GUI was written. The GUI interfaces with 8 DAQs and 11 LiDAR sensors in real time. Program was multi-threaded for maximum responsiveness. Data from all sensors is logged.

Skills

C++, data acquisition, networking, Linux.

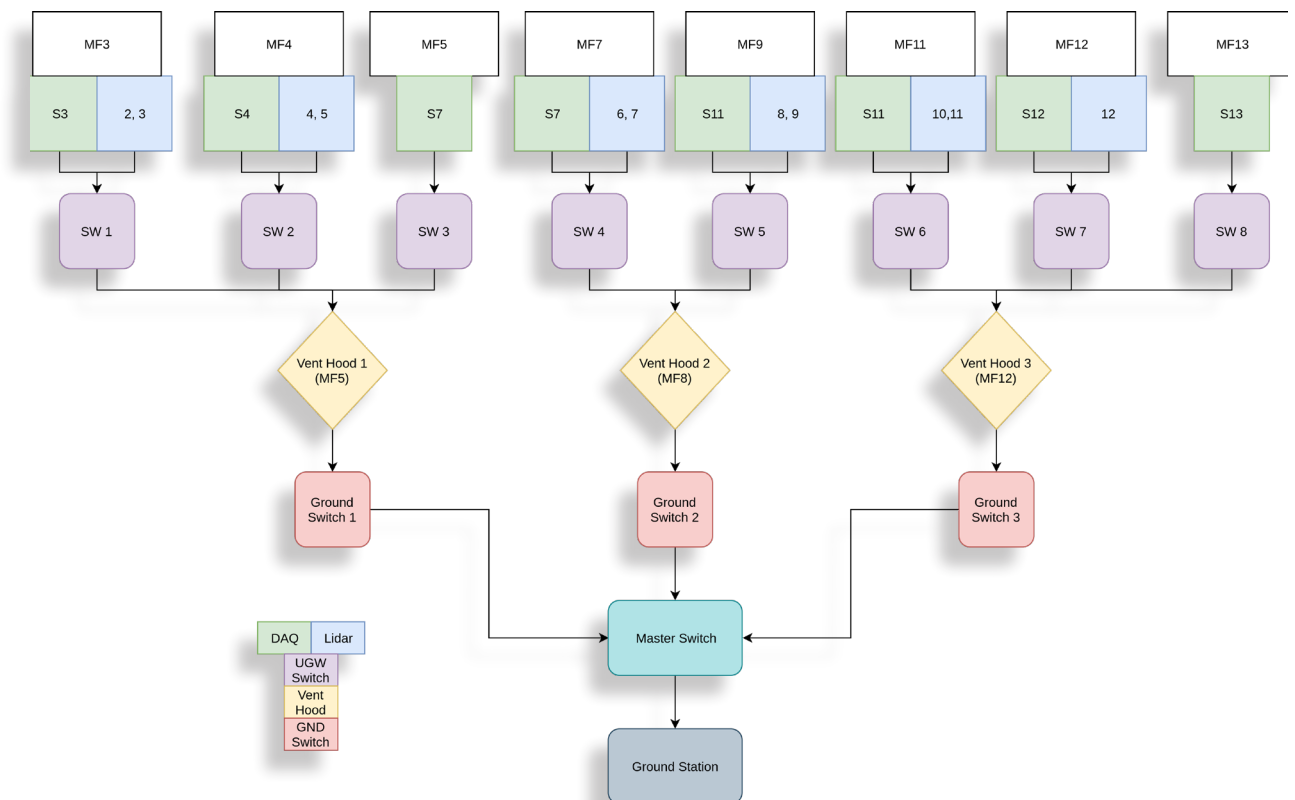
Airship monitoring software



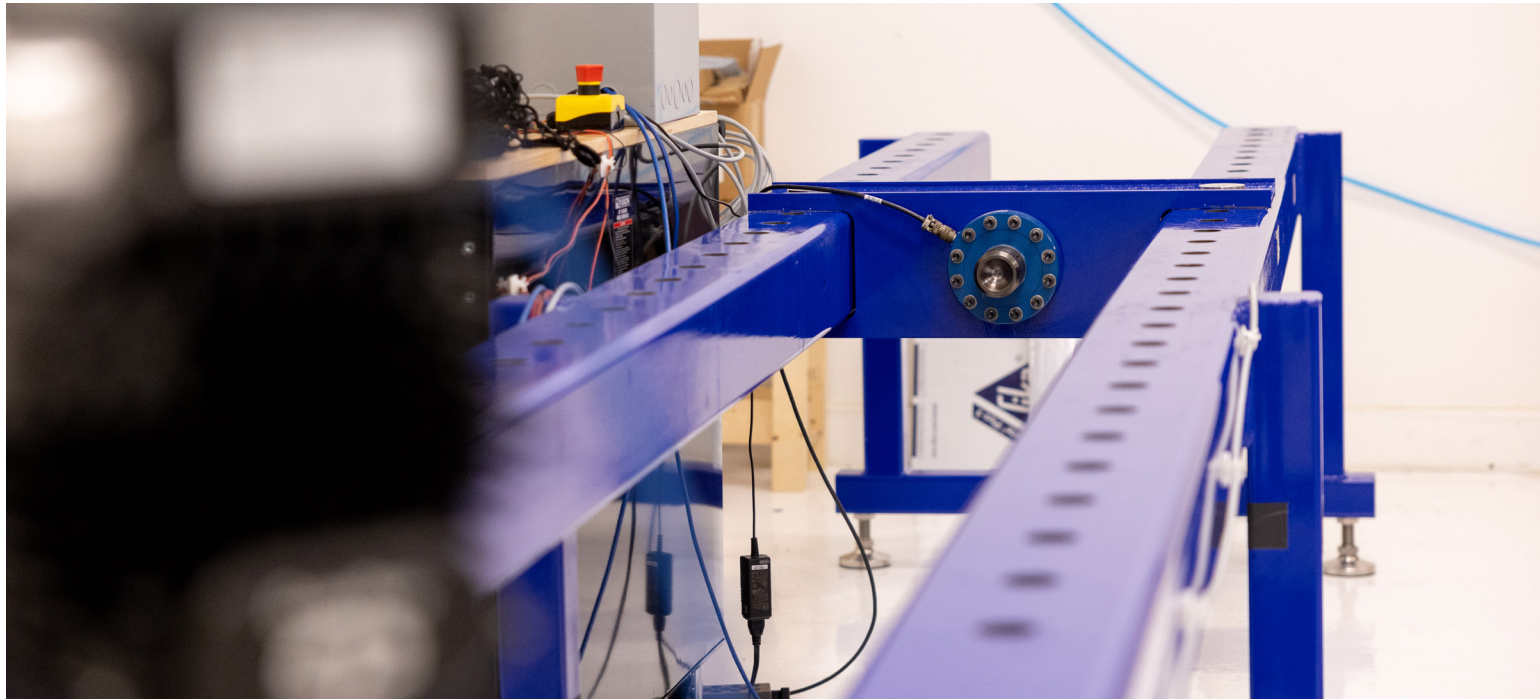
Requirement
Display critical sensor information with zero delay to airship operators. In particular, oxygen levels must be carefully monitored and displayed in real time.



Installed sensors



Mechatronics

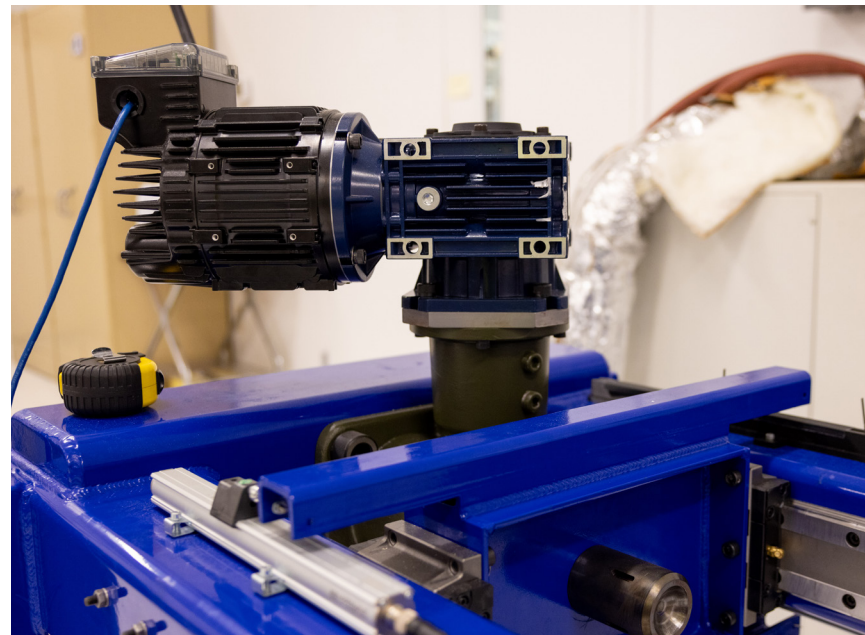


Mechanical Test Frame

Designed lab grade test frame with 725W AC servo motor, Integrated LabView VI, and C++ PID motor controller.

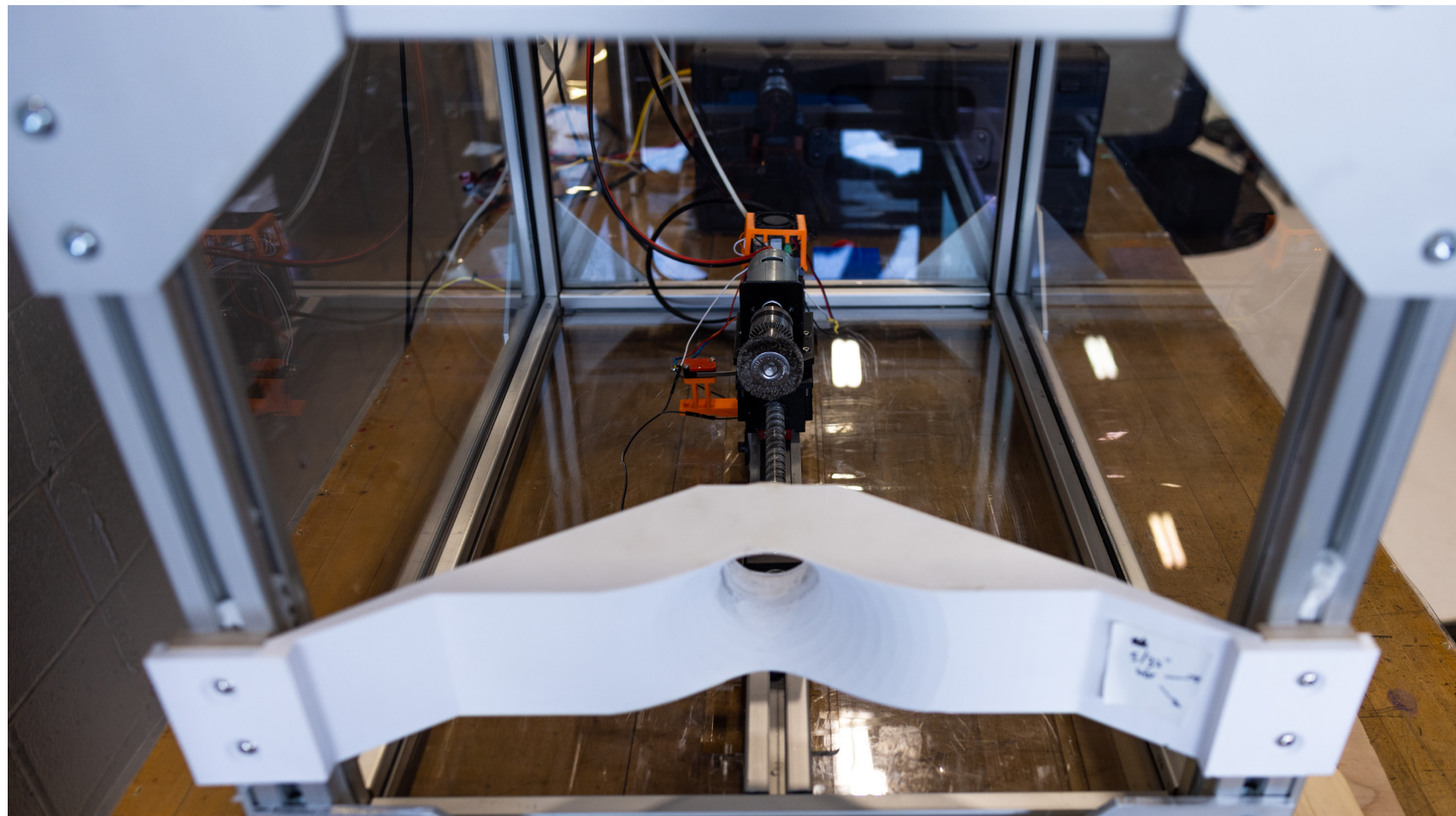
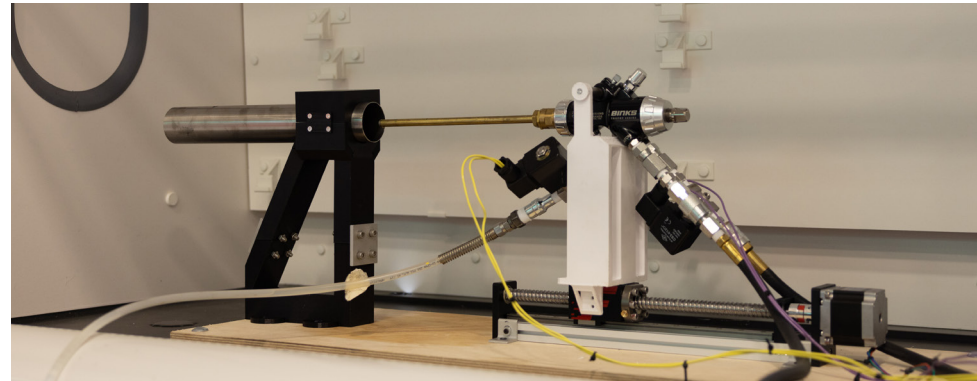
Manufacturing

Designed assembly line type process for in-house Titanium surface treatment. Includes chemical etching and abrasion of Titanium hubs.



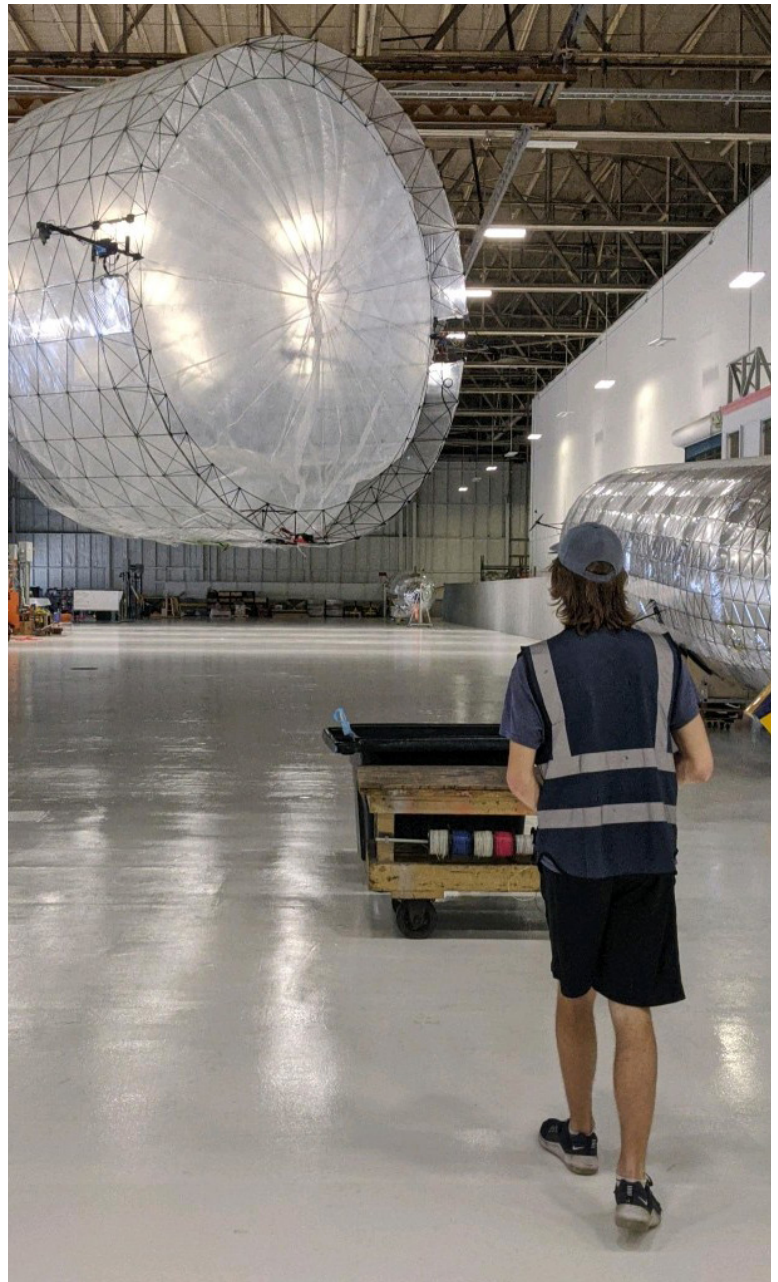
AC servo motor and drivetrain

Primer atomizer on ball screw, driven by stepper motor



Abrasion brush on ball screw driven by stepper motor

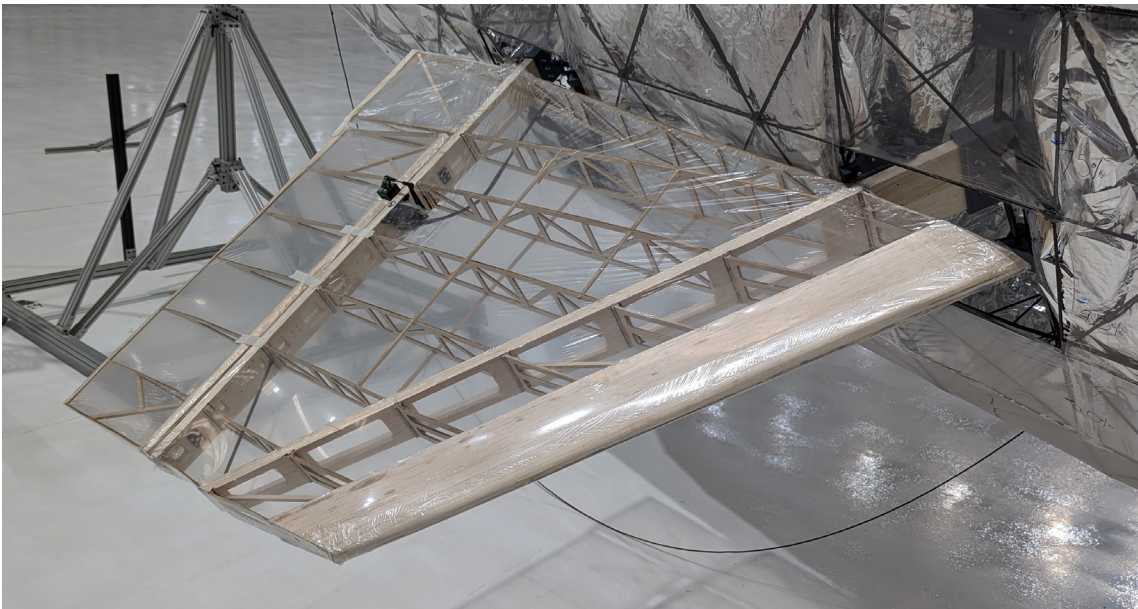
Scale Airship Flight Tests



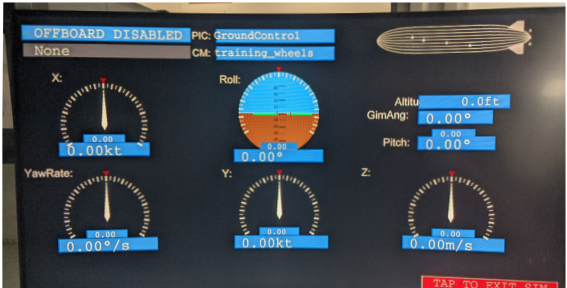
Flying the "burrito"

Flight Test Engineer

Wrote software to collect and display telemetry data during model airship flights for GNC debugging. Performed repairs and maintenance for model airship such as helium inflation. Constructed balsa wood fins. Piloted model airship during flight tests.



Installed balsa wood fin



Custom Python GUI for flight tests

