



FISH & CHIPS

FeatherCraft Integrated Structural Housing &
Computer, Hardware Interface Processing Suite

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Customer: Michael Brown

Advisor: Joe Tanner

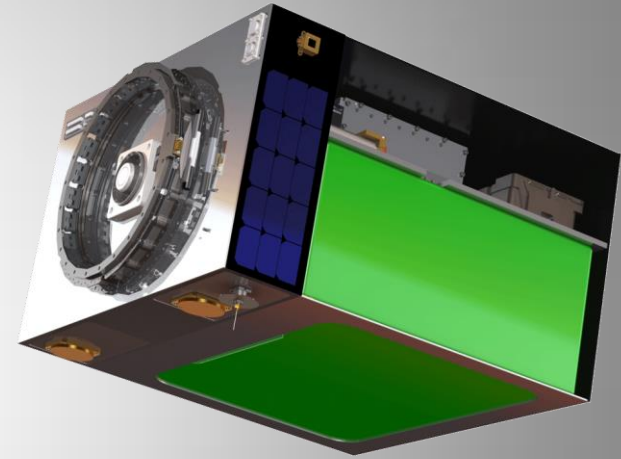


OVERVIEW



Project Motivation:

- Commercialization of International Space Station provides a launch opportunity not only to cubesats but larger **100 kg spacecraft**
- Spacecraft are launched on ISS cargo resupply missions, allowing for internal soft-stowed configuration and less stress on structure in launch environment
- Surrey Satellite Technology US plans to offer the FeatherCraft system as a cost-effective platform for **payloads of 45 kg or less.**



Surrey's FeatherCraft Illustration



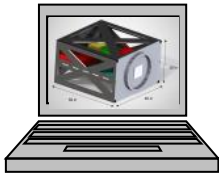
Project Statement:

The **5 kg FeatherCraft structure** shall provide support for a **100 kg total mass** commercial spacecraft with reduced structural manufacturing time and materials cost, and enable the spacecraft to **survive launch** to and **deployment from the ISS**.

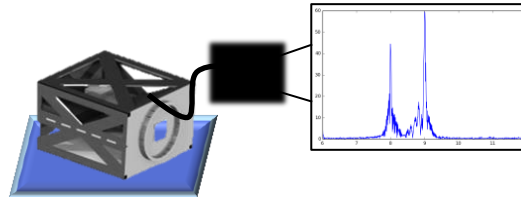
CON OPS:



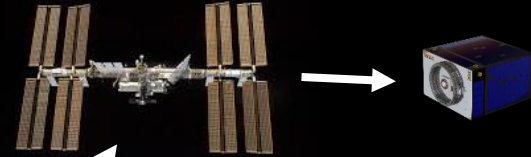
1. Design structure to meet all requirements, manufacture STM, design and create DAQ system



2. Perform vibration test and analyze accelerometer data

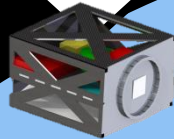


6. Interface with the Kaber Deployment System and deploy from the JEM airlock

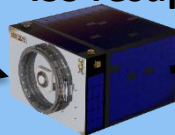


7. Possible Orbit Raising Maneuver and 5 year mission lifetime

3. Final assembly & integration with avionics and other bus components



4. Integrate with payload and ISS resupply vessel



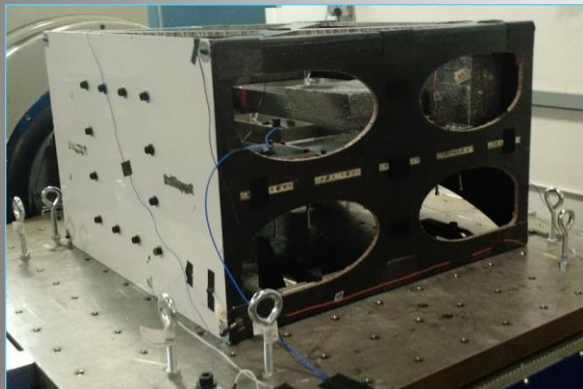
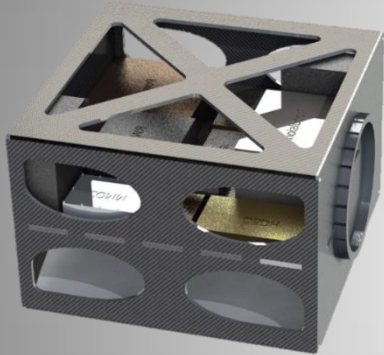
5. Launch to ISS



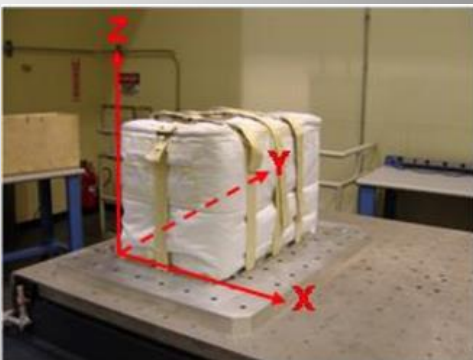


ISS Launch Configuration:

Structure



Foam Wrap
Reduces
Vibration Loads



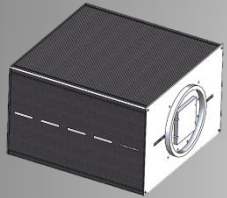


STRUCTURE

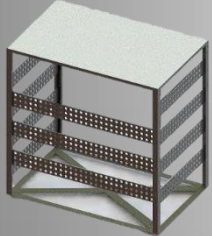


Design Evolution:

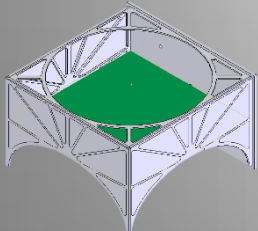
Initial Concepts:



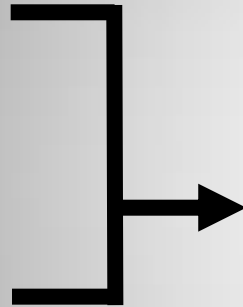
Composite Panels



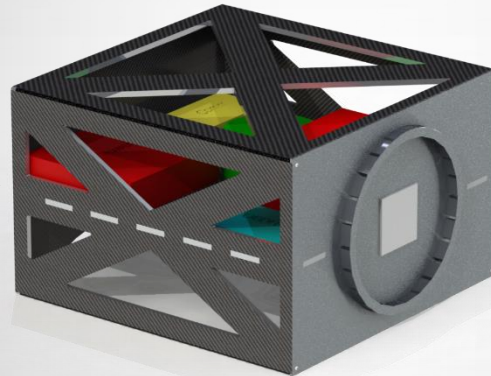
Skeleton Structure



Light-Weighted



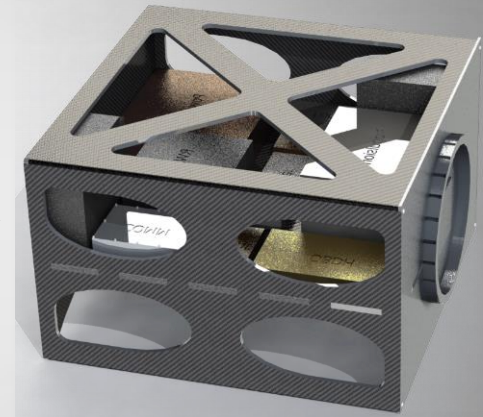
Preliminary Design:



Light-weighted composite panels with internal columns for stiffness



Final Design:



Weight relief radii optimized to reduce stress concentrations



Structural Test Model (STM):

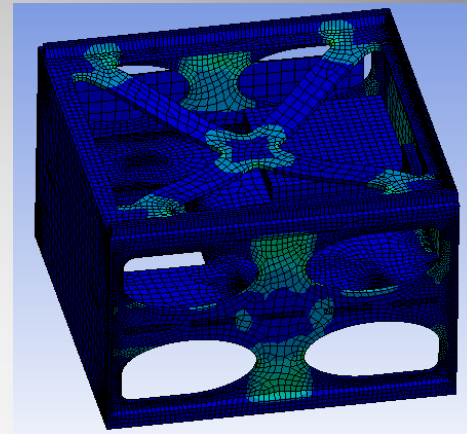


- Carbon fiber with aluminum honeycomb sandwich panels
- Four carbon fiber columns bolted on two sides creates the frame
- Panels adhered with space-grade epoxy
- 2 weeks of assembly (~100 man-hours)

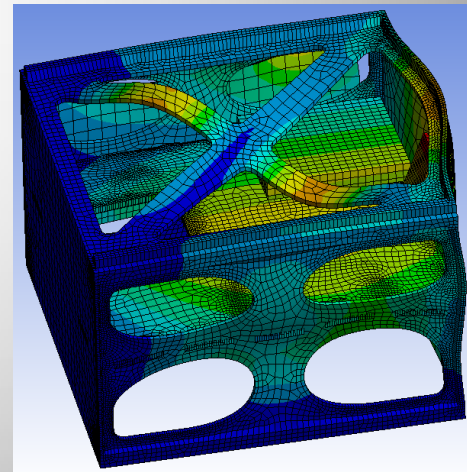
Required Mass:	< 5 kg
Predicted Mass:	4.48 kg
Actual Mass:	4.16 kg

Modeling - ANSYS:

- Developed for panel survival and design
- Two models developed
 - One designed for an arbitrary payload
 - One for detailed predictions of test model
- Two analysis cases
 - Will structure survive launch vibration loads?
 - What are its natural modes?



Material Stress Locations
Under Load



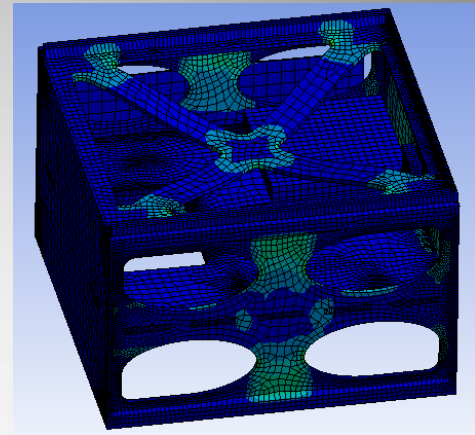
Example Mode



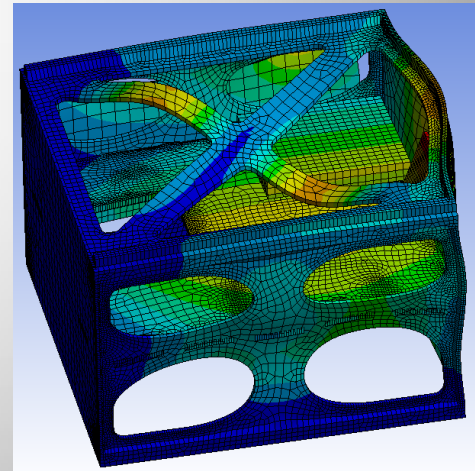
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**Design Margin:
55% above 1.9 FOS**



Material Stress Locations
Under Load



Example Mode



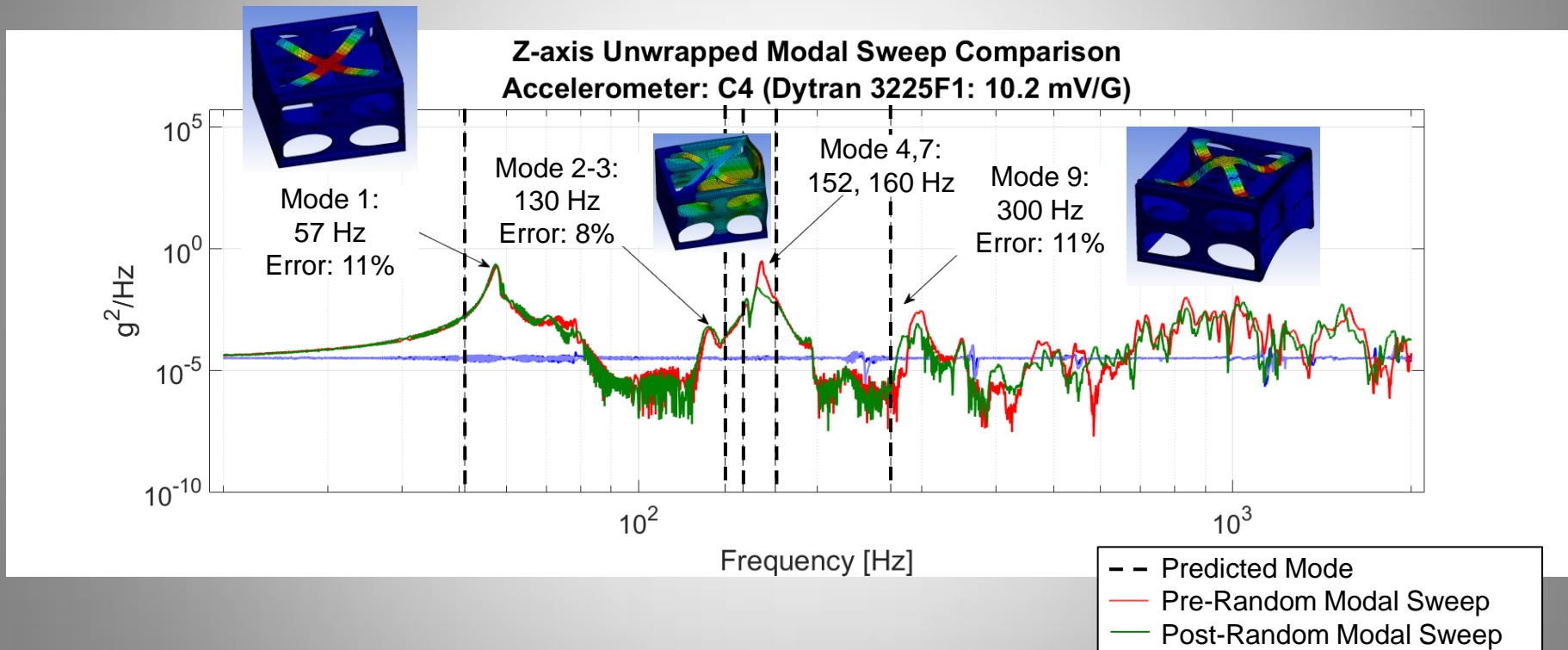
Testing:



STM SURVIVED!



Results: Z-Axis (Most Critical)

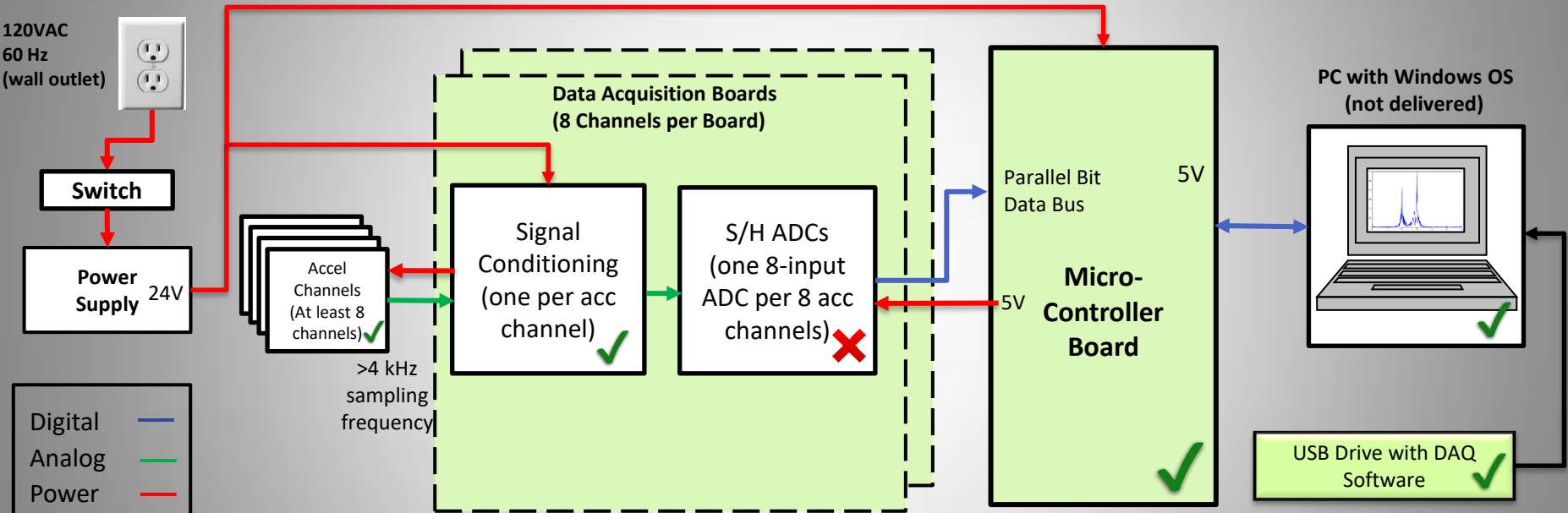




DAQ



DAQ Hardware FBD:



- Digital — Blue line
- Analog — Green line
- Power — Red line
- Software — Black line
- Acquired — White box
- Designed — Light Green box

Functional ✓

Not Functional ✗



CONCLUSION



Conclusion:

The FeatherCraft structure design meets all customer requirements and has **TRL value of 4-5**

Improvements:

- Improve structure for space environment
 - Thermal subsystem
 - Vacuum testing
- Reduce manufacturing/assembly time of structure
 - Reduce part count
 - Streamline adhesive process
 - Minimize panel mass to a lower margin
- Consider other options for DAQ to decrease manufacturing complexity





Acknowledgements:

