

International Rocket Engineering Competition



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Utah State University

The Competition

Worldwide Competition!

The International Rocket Engineering Competition (IREC) challenges teams to design, build, and launch a high-powered rocket to a target altitude of 10,000 feet while recovering all components. Our team must integrate propulsion, avionics, recovery, and payload systems within strict safety, budget, and design constraints, demonstrating proficiency and innovation in rocketry.

Requirement	Target	Threshold
Altitude	10,000 ft ± 50 ft	10,000 ft ± 200 ft
Acceptable Damage	No Damage	Minor Damage, Flight Capable
Payload	Deploys and Completes Mission	Deploys
Thrust-to-Weight	9:1	5:1

Carbon Fiber Filament Winding

Carbon Fiber Tube Manufacturing



- Use a CNC Filament Winder to wind helical and hoop tubes.
- Cured tubes in industrial oven over 8 hrs.

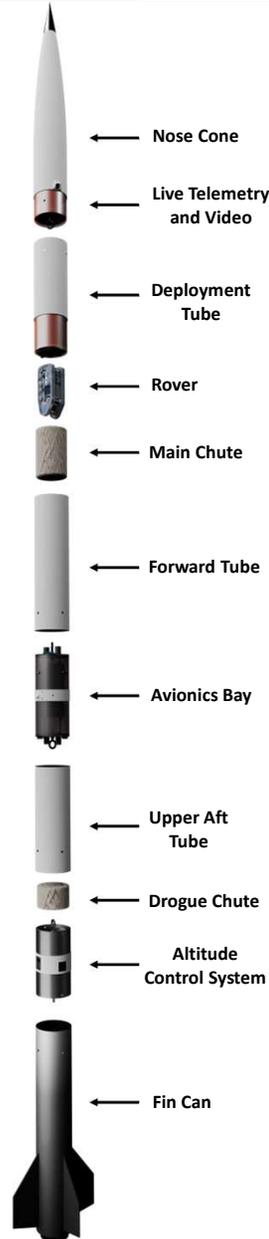
• Directional Strength Tuning - Carbon fiber filament wind patterns enable tailored structural strength along specific axes.

Custom Carbon Fiber Airframe



- High Strength-to-Weight Ratio: Carbon fiber composites provide exceptional strength while keeping the rocket lightweight, critical for achieving high altitude.
- Carbon Fiber Frame offers high rigidity.

Sky Streaker Design

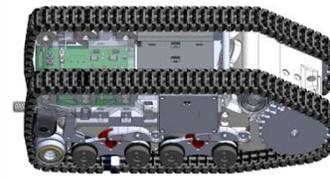


Live Telemetry and Video

- Purpose:** Stream 1080p video at 100 fps and telemetry data to custom ground station.
- Integrated Ground Visualization:** Ardupilot overlays telemetry on live video, enhancing in-flight monitoring and recovery precision.



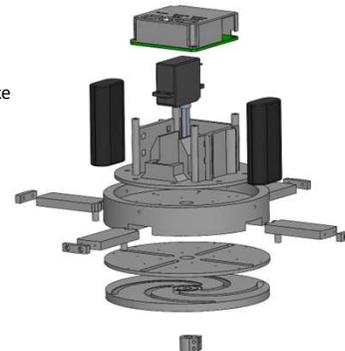
Payload-Rover



- Purpose:** Deploy data cubes and set up communication network
- Adaptable:** Rover employs tracked suspension to overcome terrain obstacles

Altitude Control System (ACS)

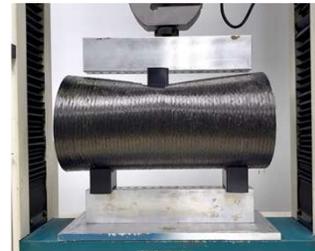
- Purpose:** Servo-driven airbrake system for real-time apogee control.
- Fast & Precise:** Spiral cam deploys airbrakes in 0.15s for responsive altitude correction.
- Flight-Tested Control:** PI algorithm tuned in custom simulator ensures accurate apogee targeting.



Simulation and Testing

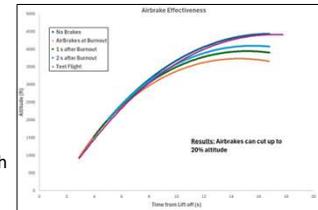
Airframe Bending Test

- Used a three-point bending setup on a 50,000 lb capacity tensile testing machine.
- Airframe successfully withstood a bending moment exceeding **250 lb-ft** without structural failure.



Airbrake Simulation

- Simulated airbrake performance using a custom-built aerodynamic model with Runge-Kutta 4th order (RK4) aerodynamic to verify airbrakes efficiency. Based on test flight data, at peak efficiency, airbrakes can reduce apogee by **20%**!



Conclusion



Expected Results

- Three successful launches of a full-scale rocket this spring have demonstrated that Sky Streaker will be able to meet all IREC competition and customer threshold requirements.

Lessons Learned

- A clear understanding of the full rocket system and each team member's role is essential for success.
- Holding consistent weekly team meetings to review rocket systems, assign tasks, and track progress yields the best results.

Future Work

- Conduct weave pattern and composite optimization research to reduce weight without compromising structure.