Executive Summary

The UCI Rocket Project requires the fins component on the Preliminary Test Rocket in order to achieve a successful launch in spring of 2021. The UCI RP Fin Design and Integration team has researched and designed a structurally sound fin that will be secured mounted to the strut of the rocket. The primary objectives of the project includes secure attachment of the fins, a minimal to ‘no movement’ flight experience, and a lightweight fin that would not not hinder the mission objective of the rocket.

Project Goals

- Fins mounting withstands a lifting pressure of 71 kPa
- Flutter velocity should stay 15-20% greater than instantaneous velocity
- Maximum weight of each fin should be 3kg
- Manufacturing covers 3-5 days
- Position of center of pressure needs to be 1.5 caliber aft of center of gravity location
- Fins withstand maximum flight temperature and stagnation pressure of 120 Celsius and 1.72E5 Pascal, respectively

Fin Structure Design

- Fins will have an airfoil profile with a clipped delta plan form
- Fins will be made out of a low density foam
- 2 carbon fiber spars will inserted into the foam for structural integrity
- One spar will run normal to the rocket while the other will run at an angle to the rocket
- A3D printed ‘leading edge’ will replace the foam at the leading edge to protect it from high stagnation pressure
- Initially will have a ‘no movement’ flight experience, and a lightweight fin that would not hinder the mission objective of the rocket.

Fin Mounting Method

- End of both spars will line up at the flat surface of each fin
- Skin of the rocket will have a cut for each fin’s location prior to its attachment on the rocket
- Composite wrap method will be implemented using a fiberglass cloth and resin
- Wet cloth will be wrapped around the entire fin with the corresponding strut
- Once resin is cured after 2 hours, the rocket’s skin will be installed by sliding down to fit the location of fins
- Tip to tip layup of carbon fiber will be applied to all of the fins

Fin Structure Analysis

- A prototype of the fins will be made for testing
- A 3-point-bend testing on the fins following ASTM D7250 and ASTM C273 standard using an Instron machine
- The procedure will give us the shear modulus of our fins which we can then use to verify our flutter velocity requirements

Future Improvements

- Adherement: Additional research and analysis is needed to provide a firm conclusion on composite wrap and fiberglass strength to support fin mounting
- Fiberglass Wrap: High stagnation pressures in flight can cause fiberglass fracture
- Further case studies need to be performed regarding fiberglass wrap performance at high speeds

Acknowledgements / References

The UCI RP Fin Design and Integration Team would like to acknowledge the guidance of the team’s advisor Professor Mark Walter, as well as the Launch Vehicle co-leads of UCI Rocket Project, Arthur Weng and Cliff (Ching-Hao) Yu.

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Team Formation / Prior Work

Task Management
- Risk Analysis
- Fabrication
- Design
- Manufacturing
- Integration
- Research
- Monitoring

Kernels
- 1. Fins
- 2. Spars
- 3. Fins alignment
- 4. LE
- 5. Spars to strut adherement
- 6. fiberglass wrap (stagnation pressure)

Fin Attachment Method:
- Fin attachment without skin installation
- Fin attachment after skin installation