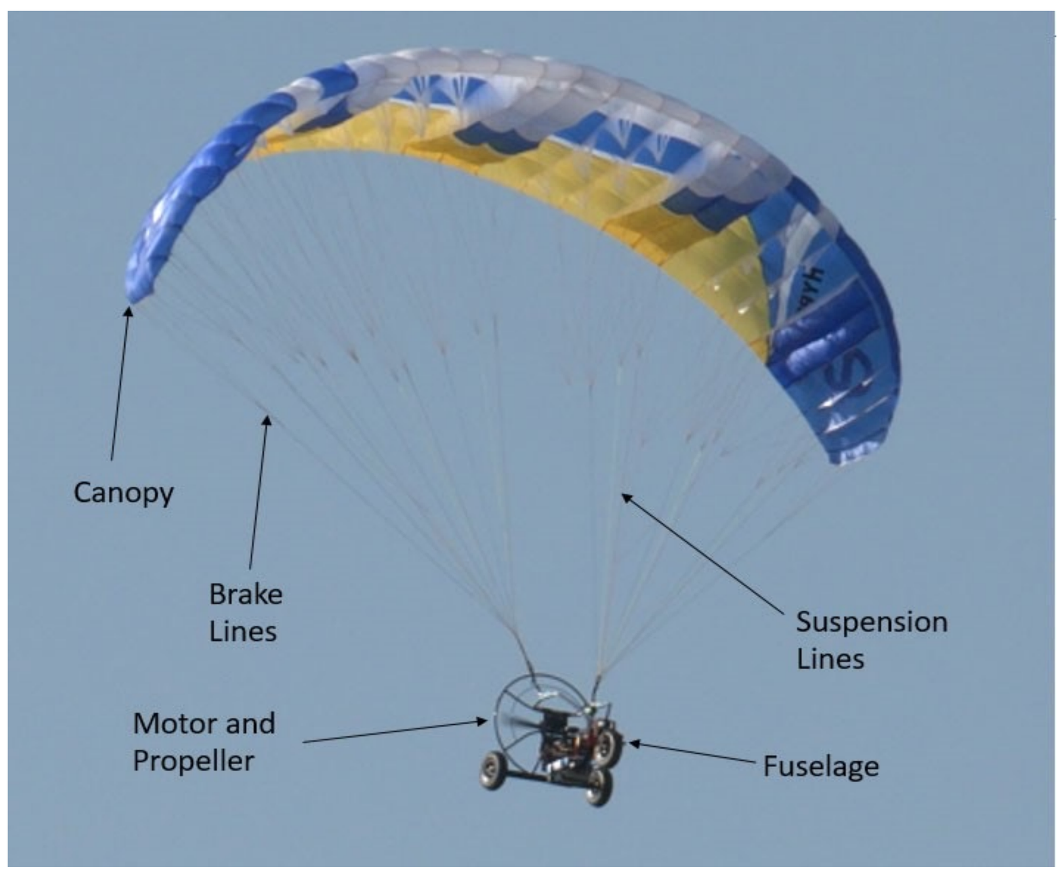
Aero-propulsive characterization of Paramotor sUAS

Alex Haefner, Mechanical Engineering – Penn State Applied Research Lab

Advisor: Julia Cole, Fluid Dynamics and Acoustics Office, Penn State Applied Research Lab

Introduction

This poster summarizes the work documented by the authors in Ref 1.

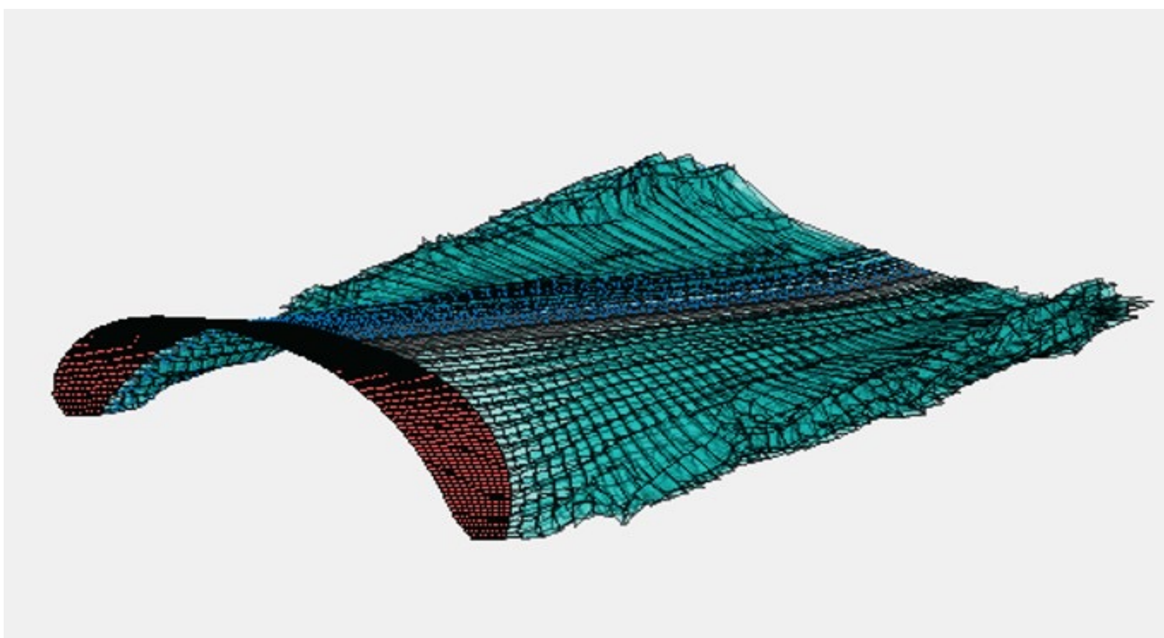


Paramotor Characteristics:

- Parafoil canopy
- Fuselage with propeller thrust system
- Brake lines for yaw control
- Single speed (function of wingloading) [2]
- Pendulum stability
- High payload capacity
- Short takeoff [5]

Motivation:

- Little flight test data exists in literature
- Apply models as a design space aid
- Capture aerodynamic behavior for predictions

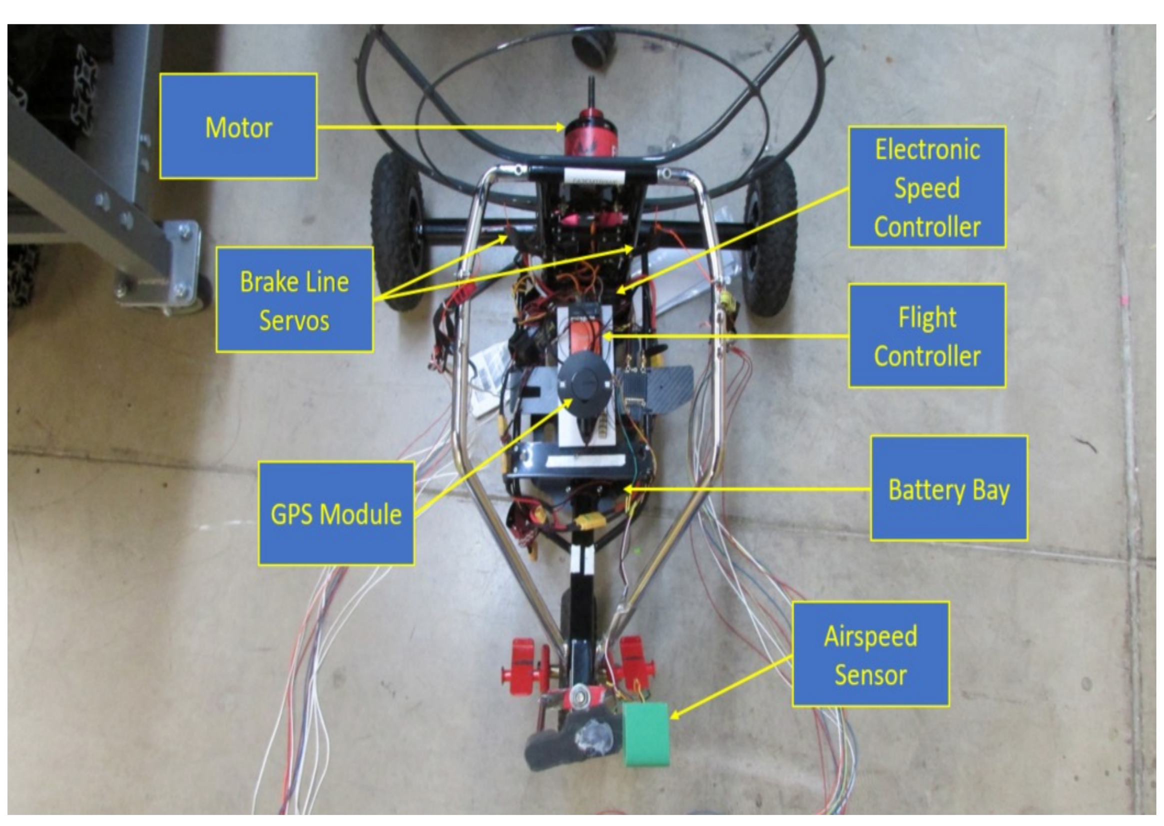


Objectives

Research addressed four primary questions about sAUS Paramotors:

1. What unique challenges are there when flight testing paramotor sUAS?
2. How accurate are traditional fixed wing modelling techniques at capturing paramotor behavior and how can they be adapted to understand vehicle dynamics?
3. How does paramotor performance change with wing loading? What does this mean for potential applications of paramotor sUAS?
4. What is the mission space for this paramotor in terms of endurance and payload and how can we use models to find this space for other paramotors?

Methodology



Flight Testing:

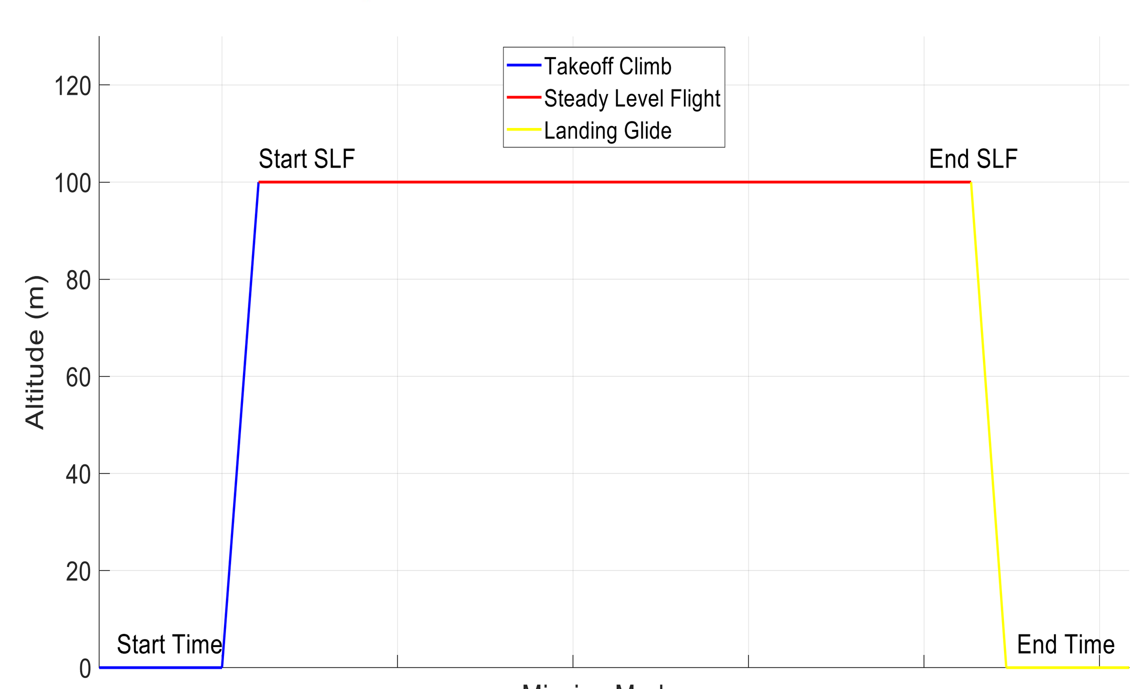
- Identify and adapt to flight test challenges
- Fly in glide, climb, and SLF at several weights
- Record vehicle behavior and derive trends

Modeling:

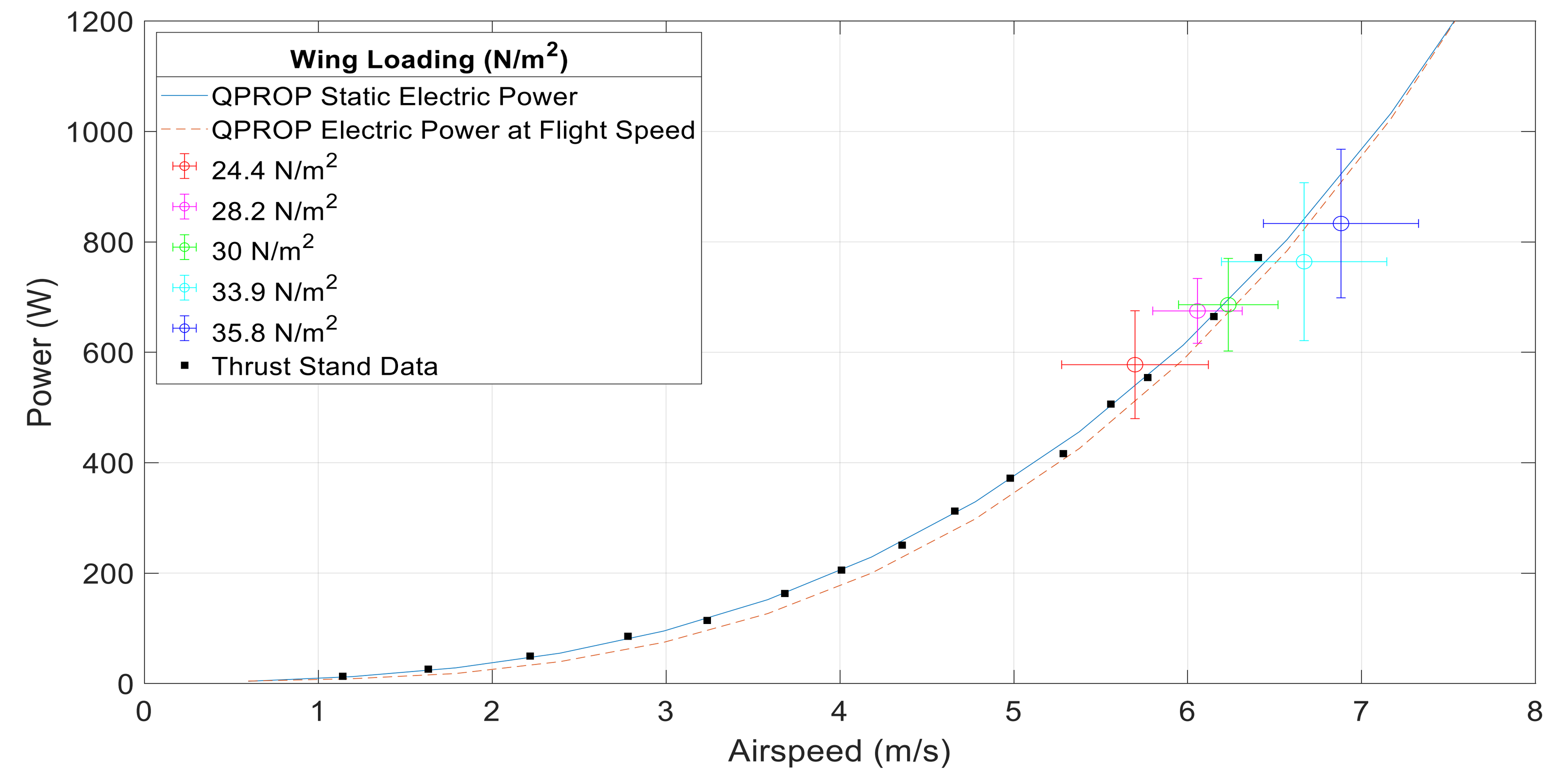
- Qprop used to model propulsion
- Prop geometery laser scanned
- Canopy aerodynamic coefficeints found with geometery

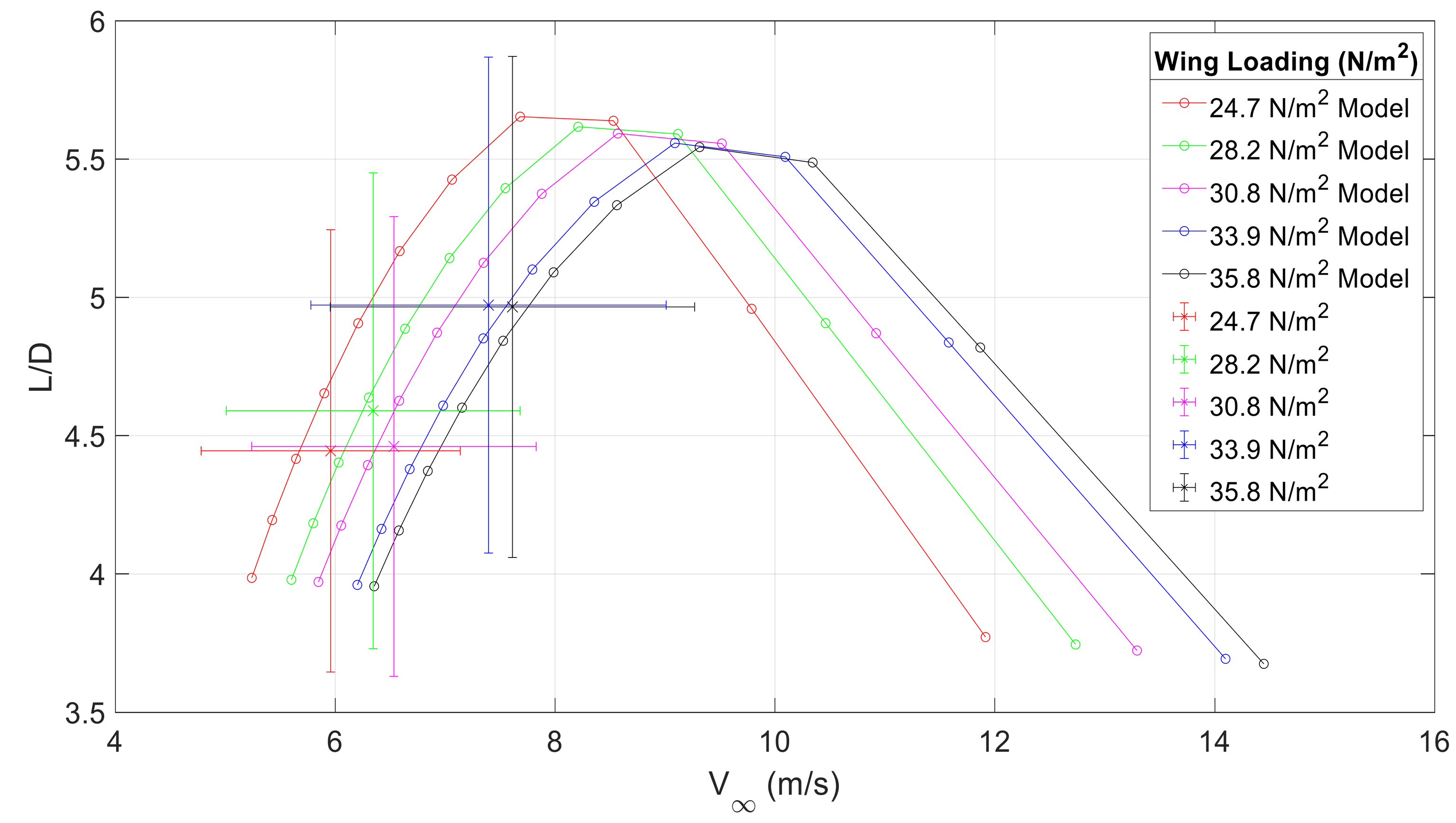
Performance predictions:

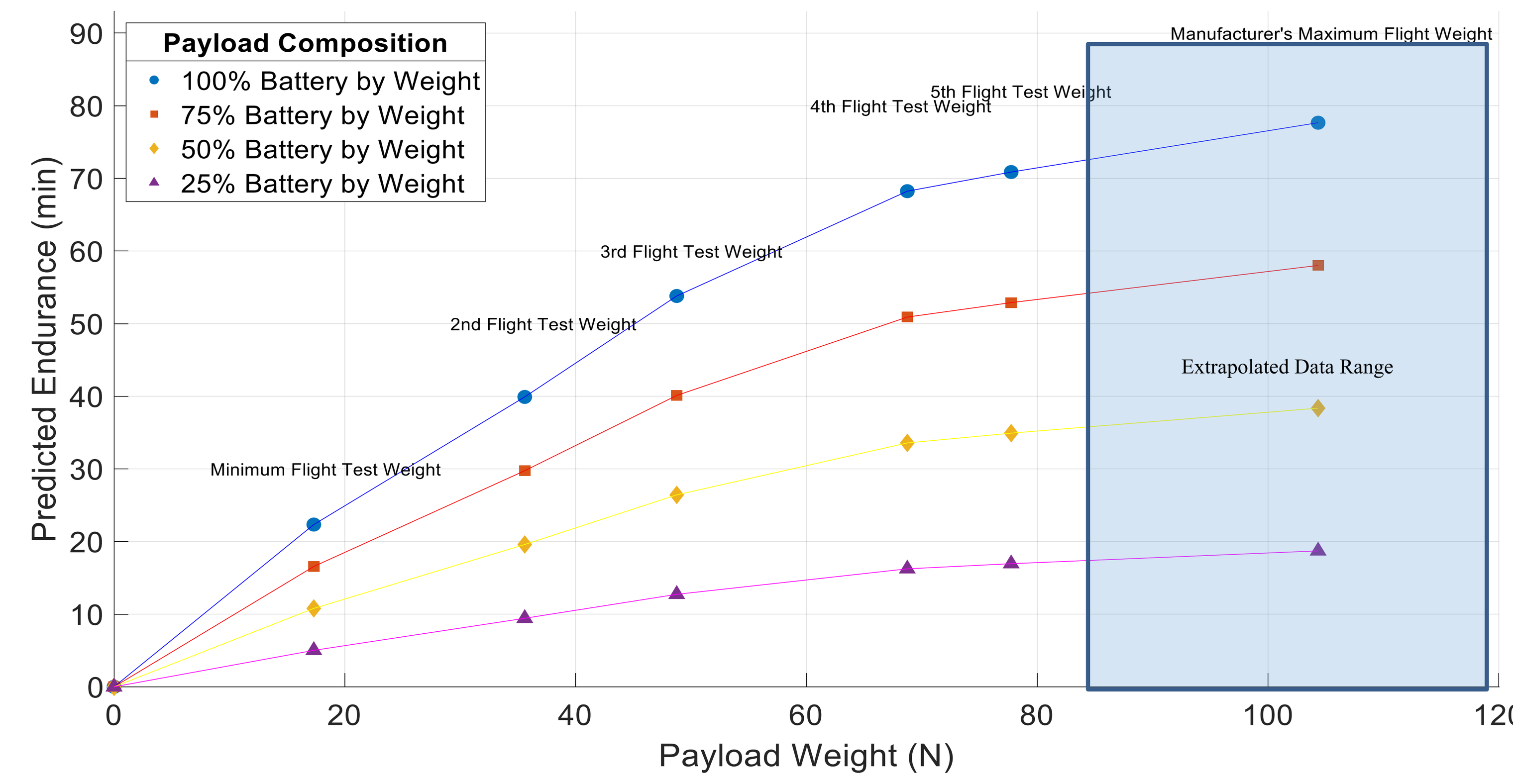
- Standardized flight path devised
- Battery capacity, C rating, and final battery charge were assumed.
- Endurance predictions



Results / Analysis







Future Objectives

- Additional flight test data is required to confirm trends and reduce uncertainty particularly in the climb rate investigation
- An accurate model for climb rate and testing the empirical 54% interference drag assumption would complete the aerodynamic model
- Building a new paramotor and testing endurance predictions of the method described would confirm the utility of this work as a design space aid

Acknowledgements

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References

[1] Haefner, Alex C. *Characterization of the Aero-Propulsive Performance of a sUAS Paramotor*, AIAA, 24 June 2024.

[2] J. Chambers, "Longitudinal dynamic modeling and control of powered parachute aircraft," Rochester Institute of Technology , 2007.

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