Tiltwing Electric Vertical Takeoff and Landing (eVTOL)

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Summary

This project focuses on the design of a tiltwing eVTOL drone that combines the efficiency of fixed-wing aircraft with vertical takeoff and landing capabilities. The rotating thrust vector enable the aircraft to transitions between hover and cruise.

Figure 1 : Tiltwing eVTOL Concept Design

Goals and Objectives

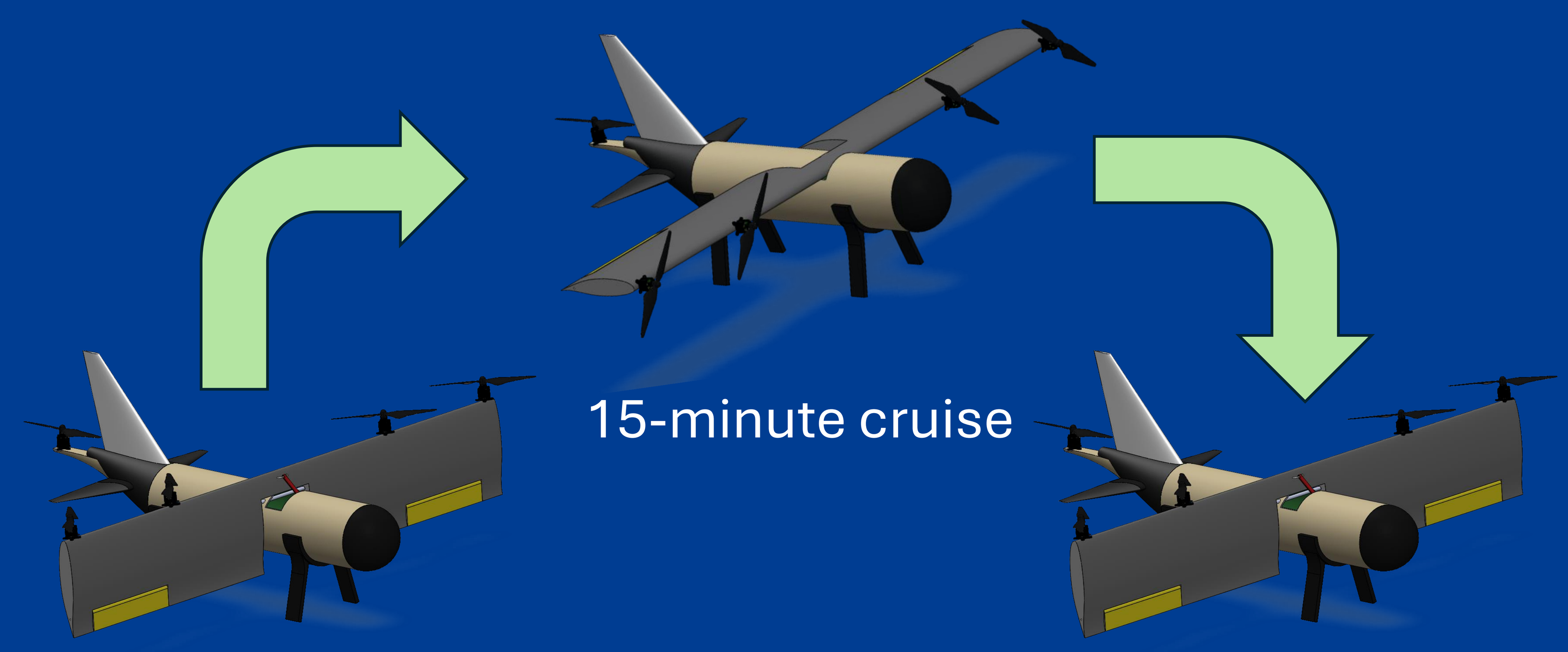

Figure 2: Mission Profile

Main Constraints and Requirements

- The project budget is limited to $600, covering both the prototype and final product.
- The project must be completed within two academic quarters.
- The total aircraft weight shall not exceed 6 lbs.

Design Choice

Sizing

Initial sizing is based on statistical data from similar aircraft geometry.

- Aspect ratio: 6
- Wingspan: 4 ft
- Fuselage length: 3.5 ft

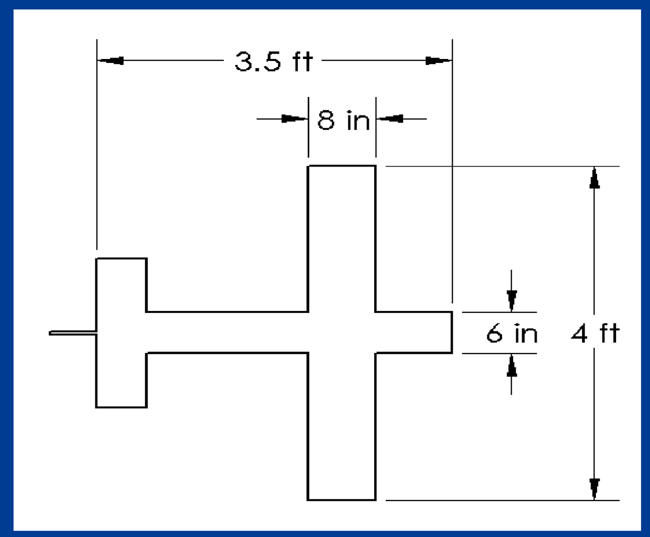

Figure 3: Design Size

Features

- 4800 kg takeoff thrust
- Wing-tip propellers for efficiency
- Tilt-wing
- Tail motor for pitch stability

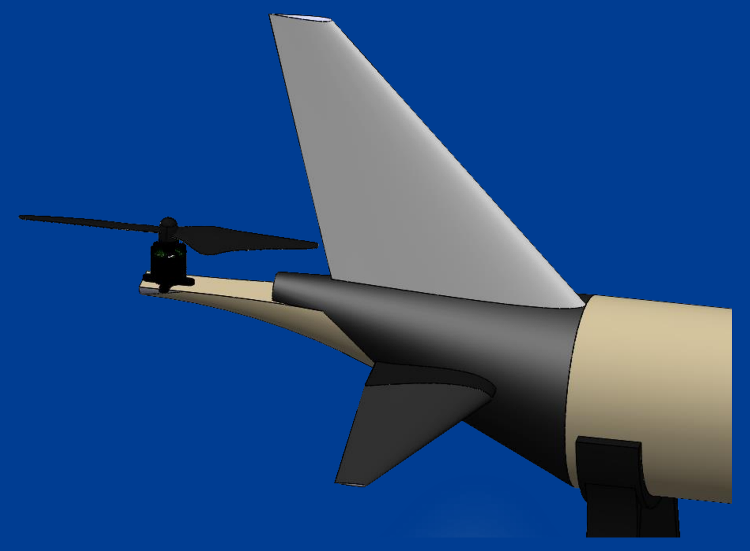

Figure 4: Tail motor

Tilt-Mechanism

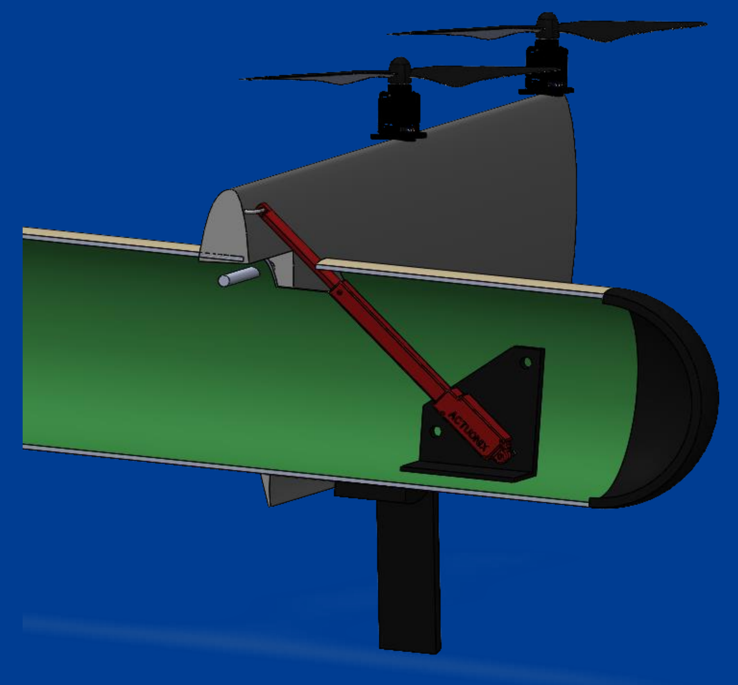

Figure 5 : Section View of Tilt Mechanism

- Linear actuator-powered tilt mechanism for stable transitions
- 200N max force & 0.3mm accuracy for precise control
- Lightweight (56g) & efficient for stability and performance
- Low power consumption (6V,650mA stall current) for energy- efficient operation

Wing Airfoil Selection

LS-0417 airfoil was chosen based on trade studies for:

- Cruise Efficiency
- High lift at low speed, low angle of attack
- High stall angle

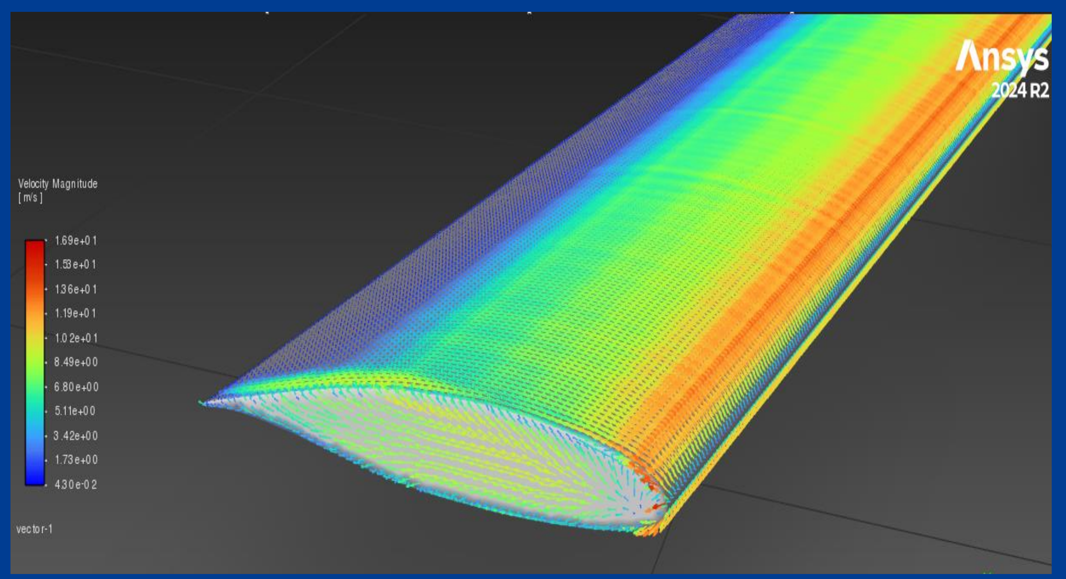

Figure 6: LS417-il Under CFD Simulation

Block Diagram

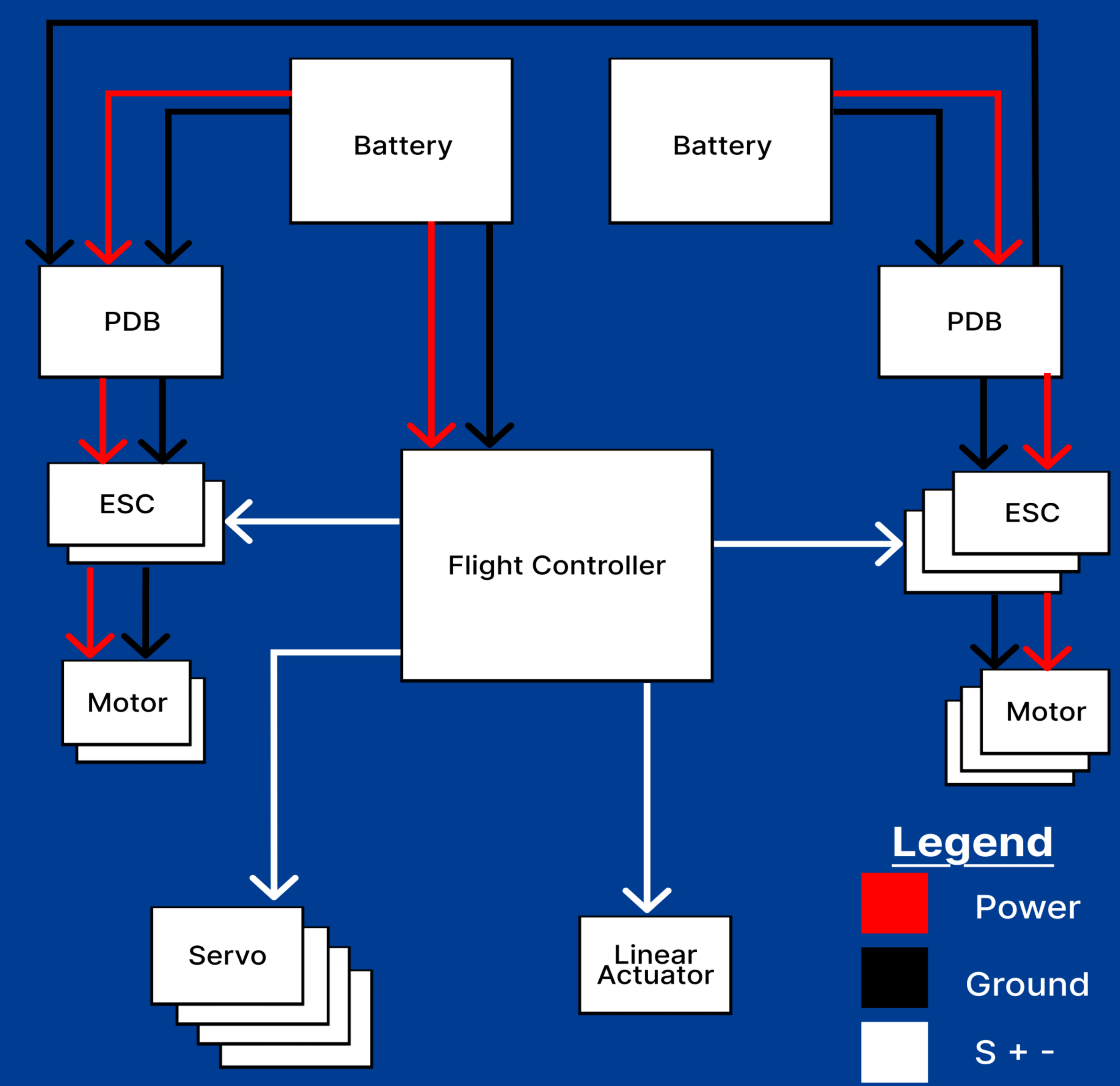

Figure 7 : Block Diagram

Future Improvements

- Building 1/2 scale prototype to validate hover stability and control
- Focus on stabilizing transition flight
- Integrating a speed sensor to determine the optimal speed for a stable transition.
- Optimize Aircraft sizing & configuration for maximized cruise efficiency and stability
- Derive Flight Dynamics for controls analysis and optimization

References and Acknowledgements

- Sponsor : Dorsa Shirazi (Rotorcraft Engineer at NASA Ames Research Center)
- Moses Choi & Derek Irwin (UCI Staff)
- W. J. Fredericks, R. G. McSwain, B. F. Beaton, D. W. Klassman, and C. R. Theodore, “Greased Lightning (GL-10) Flight Testing Campaign,” Nasa.gov, Jul. 2017. https://ntrs.nasa.gov/citations/20170007194 (accessed Feb. 25, 2025)