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# Hybrid Electric Propulsion Systems for Skydiving Aircraft

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## Objectives

- Show viability of novel hybrid electric and all-electric aircraft concept for skydiving missions.
- Push forward investment in new electrical propulsion technology equipped light commuter category aircraft.

## Introduction

Skydiving is a popular aviation sport throughout the world. Hundreds of thousands of people are active in approximately 1000 centres worldwide [1]. The United States Parachute Association alone recorded 36,770 members at the end of 2014 [2].

Continuing airworthiness of ageing legacy aircraft is a maintenance safety challenge. Legacy aircraft also possess unsatisfactory emissions qualities. Great opportunities exist for new paradigm aircraft type.

Case study uses novel 'Air Ute Pty Ltd' [3] conceptual design for investigation of an alternative aircraft type for this application, including trade-off studies with a new analytical model.

FIG. 1 – Legacy Type

FIG. 2 – New paradigm Hybrid

## Mission

a. Carriage of minimum eight parachutists (loads), to a height of 4000m with a duty cycle of 3 to 4 loads per hour.

b. Configurable for freight transport role.

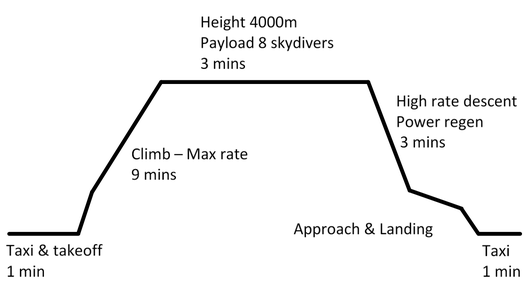


FIG. 3 – Mission Profile

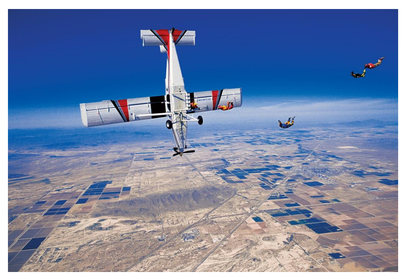

FIG. 4 – Descent

## Hybrid Electric system weight and performance comparison analysis

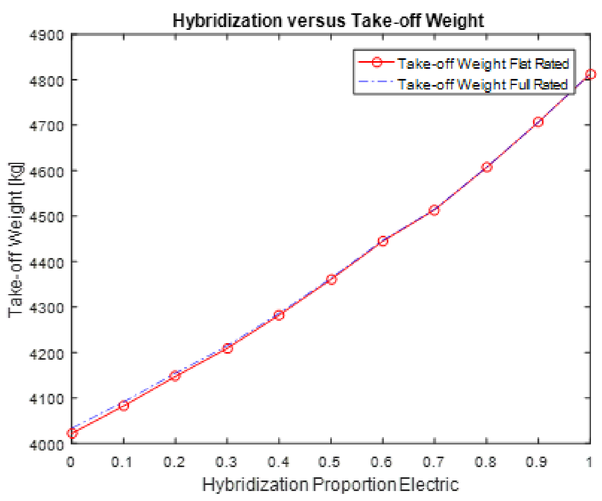


FIG. 5 – Take-off Weight

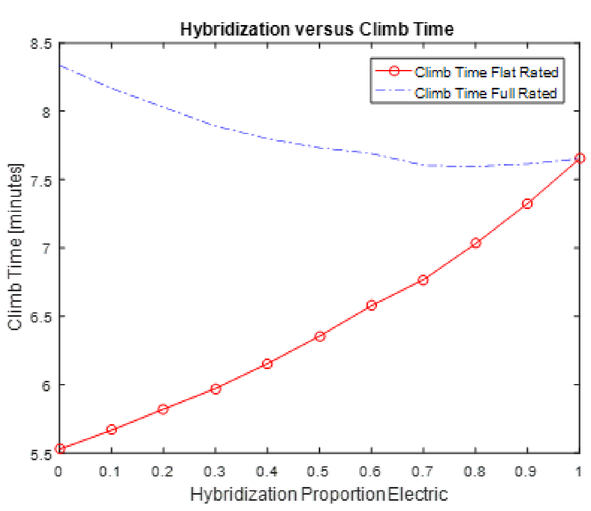


FIG. 6 – Time to Climb

[1] Dropzone inc. "Where to dropzone". Available: http://www.dropzone.com/dropzone
[2] The USA Parachute Association. "Who Skydives?". Available: http://www.uspa.org/facts-faqs/demographics
[3] Air Ute Pty Ltd, Australia. Contact: Tibor Glesk

## Conventional Propulsion System

FIG. 7 – Conventional Layout 'Air Ute' with LD3

- 800kW single turboprop
- Large (LD3) cargo loading capacity

## Hybrid Propulsion System

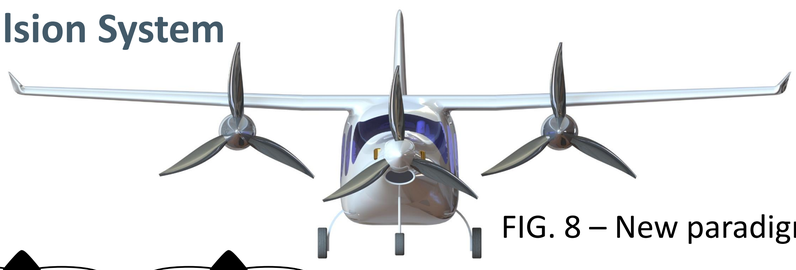

FIG. 8 – New paradigm Hybrid

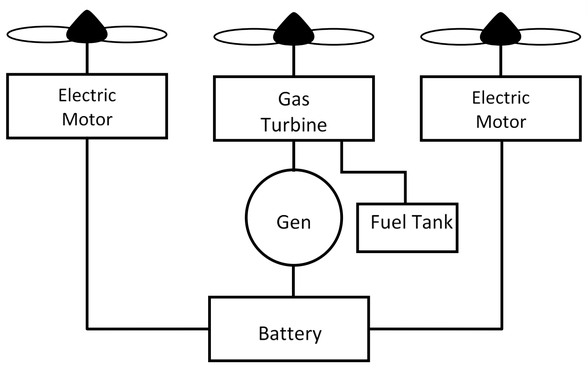


FIG. 9 – Hybrid Propulsion layout

- 800kW installed power
- Increased disc area
- Higher propulsive efficiency at lower airspeed
- Increased climb angle
- Lower drag

- Trade cargo capacity for modular Battery
- Rapid battery exchange via ultra-large cargo door or external "cargo pod" concept

FIG. 10 – New paradigm Hybrid

## Conclusions Summary

- A Hybrid Electric skydiving lift aircraft has been found to be viable using current state of the art Electrical Propulsion System technology from an aerodynamic standpoint.
- An All-Electric propulsion system is feasible given the condition that the battery is replaced or recharged for each mission.
- The time to climb for a fully electric example is acceptable and the improvement over a non Flat Rated powerplant operating to the prescribed altitude is very significant.
- Engine emissions can be reduced or eliminated for this aircraft mission without hindering performance or economic utility.