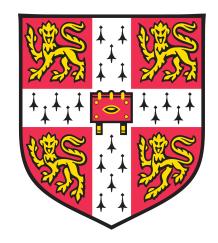
University of Cambridge Department of Engineering

Masters Project Report





Propulsion Systems for e-VTOL UAV

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Abstract

Abstract here..

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		Discuss Instation of design method (e.g. disation
		for high s/c) at its (Fi) is weeful
		Could reference Myan Leve, show that
		CFD can get close to experimental measurements
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	2	. 2 Hying Test Bed Experients
		. 2 Flying Test Bed Experients - Eriksen manoneure ides.

6. Condusions

Electric Vertical Take-Off and Landing e-VTOL FTB Flying Test-Bed Axial Flow Velocity V_x Fan Speed Ω Fan Hub Radius r_h Fan Casing Radius r_c Fan Mid-line Radius r_m $= \Omega \cdot r_m$ Mid-line Fan Speed Flow Coefficient Stage Loading

NOMENCLATURE TO DO

Introduction

Intro and motivation

1.1 Literature Review

1.2 Research Questions

Propulsor and Experimental Design

2.1 Propulsor Design

2.1.1 Diffusing Ducted Fan

Theoretical thrust and power Derive $M_f = \sqrt{2\sigma}$ ESDU diffusion tables?

2.1.2 Turbomachinery Design

Blade design code.
Profiles
Deviation
Span-wise psi distribution
Boundary conditions (Constant P exit, Vx, etc)
Sweep/Lean
Blade number

2.2 Mechanical Design

2.2.1 Weight Reduction

Thrust = Weight condition
Mass model to close the problem

2.2.2 Shroud Tip Clearance

Shroud thickness FEA 3D printer tolerances

2.2.3 Hollow Stators

Power supply Weight reduction Tolerance How to

2.2.4 3D Printing

Printer used Printer tolerance Design adjustments to enable good printing - Straight TRAILING edge

- Raft and reduce air-gap

2.3 Electrical Design

2.3.1 Choice of Electric Motor

Size (d < 36mm)

2.3.2 Power vs Torque Design Space

2.3.3 Power Supply

Want to simulate using a battery pack for actual flight conditions but increase run-time. Choose 12V steady state operating voltage (14.8V nominal Li-Po).

2.3.4 Instrumentation Design

RPM

Thrust

- Calibration

Power

Pressures

2.4 Systems Design

2.4.1 Precursory UROP

Platform design chassis etc Pixhawk 4 RPi ADC

2.4.2 Subsystem Function

Pixhawk 4 RPi ADC

2.4.3 Subsystem Interaction

2.4.4 Telemetry

 $\operatorname{QGroundControl}$ - Telemetry module SSH

Method

3.1 Experiments

3.1.1 Stationary Propulsor Test

Setup

- Stand

Test variables

- Speeds
- Sigma
- Rotor design

3.1.2 Computational Fluid Dynamics

3.1.3 Hover Test

3.2 Experimental Method & Data Processing

3.2.1 Non-dimensional Quantities

Pressure quantities, FOM, ϕ , ψ .

3.2.2 Instrumentation

Power (DC Current and Voltage), Thrust, FOM, RPM, Pressures

3.2.3 Flight Management for Auto Position Hold

System not used.

3.2.4 Data Acquisition

Acquisition and integration of systems and software.

3.2.5 Cage Design & Tether

Experiment

4.1 Stationary Propulsor Test

4.1.1 Version 1.0 EDF

Heavy Blue: 3 exits and 3 rotor vortex designs. Comparison of intake performance (long and short).

- Power (Current and Voltage)
- Thrust
- FOM
- RPM

4.1.2 Version 2.0 EDF

1 exit and 2 rotor vortex designs. Long intake only.

- Power (Current and Voltage)
- Thrust

- FOM
- \bullet RPM
- Pressures

4.1.3 Version 3.0 EDF

1 exit and 1 rotor vortex designs. Long intake only.

- Power (Current and Voltage)
- Thrust
- FOM
- \bullet RPM
- P1 Only
- 4.1.4 Propeller
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