DAS Departamento de Automação e Sistemas
CTC Centro Tecnológico
UFSC Universidade Federal de Santa Catarina

A Fixed-wing UAV Capable of Vertical Take-off and Landing for Aerial Mapping and Photogrammetry.

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Willian de Medeiros Galvani

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Este relatório foi julgado no contexto da disciplina

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Prof. Ubirajara Franco Moreno

Orientador

Fly, you fools!

J. R. R. Tolkien

Resumo

This work proposes the usage of a VTOL (Vertical Take-Off and Landing) fixed wing aircraft for aerial photograpy and mapping. It entails the gathering of requisites, design, protyping, and testing of the proposed UAV.

Palavras-chave: otimização sem derivada, poços de petróleo, simulação, sintonia automática .

Abstract

Aerial mapping is one task that got revolutionized by the arrival of drones on the latest years. The manual job of taking pictures, printing and assembling them together was changed into putting coordinates into a software, and the pictures into another after the flight.

Depending of the task at hand, the operator can chose a multicopter for smaller areas, or a fixed-wing aircraft for larger ones. Both categories have their quirks: While multirotors are precise and can take-off/land virtually anywhere, their autonomy suffers as they generate all their lift by using propellers, Fixed-wing aircrafts, on the other hand, can cover large areas quickly with a smaller power consumption, but are harder to position, and require larger areas for take-off an landing.

This work prososed an aircraft in between these two worlds. The prototype designed is a tail-sitting fixed-wing aircraft, able to take-off as a multicopter and transition into fixed-wing mode for more efficiency, enabling it to cover larger areas while needing a small area for take-off or landing and no additional apparatus for take-off.

results!

Keywords: derivative-free optimization, oil well, simulation, automatic tuning.

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Sumário

1 Introduction

1.1 Motivation

Technology and auomation have been changing and improving a lot of tasks on last few decades. One of the tasks is aerial mapping, which started with balloons, then manned airplanes, and now, for smaller areas, is done mostly with drones

citation needed, improvent needed

1.2 Objectives

The final objective of the work is to have a working prototype of a VTOL fixed-wing UAV able to autonomously take off vertically, transition into fixed-wing mode, follow a planned path taking pictures, transition into hover mode, and land autonomously. It's planned to have a smaller prototype to test and tune the hover mode before testing the larger, heavier and more powerful final prototype, for safety and practicity reasons. The possible on-board electronics will be briefly described and one of them chosen. An overview will be given of the control systems in place and their tuning. The requisites for the job will be gathered, and the eletro-mechanical structure designed and built around it. It's expected that the prototype fulfills the hole between rotating-wing and fixed-wing aircraft by being able to land in tight spaces, but having a perfomance close to that of fixed-wing aircrafts.

1.3 Structure

This report is structured in 5 chapters. Chapter 1 gives an introduction to the report. Chapter 2 describes the fields of aerial mapping and photogrammetry. Chapter 3 explains the requisites imposed on the aircraft. Chapter 4 delves into the flight mechanics and the UAV's mechanical design. Chapter 5 shows the electronics involved. Chapter 6 shows the control structure and it's tuning.

2 Aerial Mapping and Photogrametry

2.1 The need for mapping the land

The first known map (actually a painting of a city) dates up to the 7th millenium BCE,[1], while the oldest surviving world maps are from 9th century BCE Babylonia[2].

In the past, maps were used mostly for localization and navigation [citation needed], and were made without special tools, mainly by sight. During the Age of Exploration, new tools such as the sextant and magnetic compass helped improve accuracy, while remaining as a navigational tool.

On the last centuries, maps began being used to precisely map properties, natural landscapes, and cities. Mapping properties, for example, requires high dimensional accuracy, hard to get with regular tools. This is usually the job of land surveyors, professionals who use a multitude of tools, such as total stations, robotic total stations, GPS receivers, retroreflectors, 3D scanners, radios, handheld tablets, digital levels, subsurface locators, drones, GIS, and surveying software.

2.2 Aerial Mapping

Aerial mapping consists of using photographs taken from the air, usually with the camera facing straight downwards, and assembling these

2.3 Aerophotogrammetry

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3 The Requisites

3.1 Objective

3.2 Requisites

3.3 Functional Requisites

4 Flight Mechanics and Design

4.1 Brief Introduction to Flight Mechanics

4.2 XFLR5

4.3 Design

5 The Eletronics

5.1 Propulsion

5.2 Batteries

5.3 The Control Surfaces

5.4 The Flight Controller

6 The Control Structure

7 Conclusions

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