Algorithms for controlling and tracking UAVs in indoor scenarios

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Overview

1. Introduction
2. System setup
3. Model overview
4. State estimation and control
5. Software architecture
6. Landing on a mobile platform
7. Conclusions

The quadrotor

The number of applications in which UAVs (Unmanned Aerial Vehicles) are involved is exponentially increasing, especially in indoor scenarios.

The most popular architecture is the **quadrotor**: a helicopter with four rotors. The main features are:

- Good stability
- Omni-directional kinematics
- Hovering on a fixed point
- Medium payload

Due to its properties, the quadrotor is the main chosen architecture for indoor flight.

Problem statement

Goal

We want to design a set of algorithms and SW components enabling a quadrotor to achieve stability, through position feedback given from a motion capture system, and perform different tasks in an indoor scenario.

The work of this thesis produced:

- A correct integration between the on board autopilot and the mocap system
- A functioning experimental setup mounted in the new laboratory
- A software architecture capable of letting the robot execute tasks sequentially from a list
- A procedure for landing on a moving platform

Work flow

The total work is divided in main steps:

1. Analysis of state of the art approaches to UAV control, modeling, trajectory planning and execution
2. Technical analysis and documentation on the given tools (Autopilot, Motion Capture, Quadcopter)
3. Integration between mocap and the quadrotor
   - Integration and testing between mocap and onboard estimation modules
   - Integration and testing of onboard controller through set point control
4. Relocation of the equipment in the new laboratory
5. Design of the high level software architecture
6. Testing the software, coding and debugging different kind of tasks
7. Design and testing an algorithm for landing on a mobile platform

Setup

We can identify five distinct parts:

- IRIS quadcopter from 3D robotics
- Motion Capture system from Optitrack
- Linux workstation
- Windows machine
- Flight arena

IRIS

The IRIS quadcopter is flying robot manufactured by 3DRobotics and commercially available.

Main features

- Relatively cheap
- High quality and robust
- Ready to fly
- Compatible with Android tablets

Main components

- Four 850 KV motors (PWM)
- One 11.1 V LiPo battery
- Control electronics
- Auto pilot software

IRIS

Figure : IRIS Pictures. On the left the top view while on the right the robot with a camera and control devices.

Multiple Columns

Heading

- Statement
- Explanation
- Example

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Table

Treatments	Response 1	Response 2
Treatment 1	0.0003262	0.562
Treatment 2	0.0015681	0.910
Treatment 3	0.0009271	0.296

Table : Table caption

Theorem

Theorem (Mass–energy equivalence)

$E = mc^2$

Verbatim

Example (Theorem Slide Code)

```
\begin{frame}
\frametitle{Theorem}
\begin{theorem}[Mass--energy equivalence]
$E = mc^2$
\end{theorem}
\end{frame}
```

Figure

Uncomment the code on this slide to include your own image from the same directory as the template .TeX file.

Citation

An example of the `\cite` command to cite within the presentation:

This statement requires citation [Smith, 2012].

References

John Smith (2012)
Title of the publication
Journal Name 12(3), 45 – 678.

Thank you