

Progress Report

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Thesis: *Visual-Inertial based autonomous navigation of an Unmanned Aerial Vehicle in GPS-Denied environments*

1 Introduction

The goal of my dissertation is to develop an autonomous navigation system for a *Unmanned Aerial Vehicle* (UAV) using the on-board sensors and cameras.

This project will allow an UAV to safely navigate in a GPS-denied environment without requiring pre-made maps or precoded information to avoid collisions. This will be achieved by using visual odometry and onboard IMU (inertial measurement unit) to develop localization, estimation and planning algorithms.

2 Development Stage

Task	Stage	Result
Familiarization with the OpenCV library for C++	Completed	n/a
Familiarization with LaTeX	Completed	n/a
Research about the ARDrone hardware and software	Completed	information regarding control over the drone and data exchange was acquired
Familiarization with navigation nomenclature	Completed	a clear distinction between <i>pitch</i> , <i>roll</i> and <i>yaw</i> was acquired
Construction of a website to host all the research data, progress and milestones	In progress	website is accessible and working properly
Research about object detection and navigation	In progress	n/a

2.1 Observations

- The possibility of using an open-source software to replace the SDK provided by the *ARDrone* manufacturer has been taken into account. Some alternatives have been researched and considered as possible solutions [1, 2].

3 Difficulties

- The assignments for the classes I am enrolled in have proven to be more time consuming than expected. This has taken a toll on the time dedicated to the tasks and milestones I set out to accomplish.
- The variety of approaches to image processing raised questions regarding which method to research thoroughly.
- The *ARDrone* is not able to stream images from both cameras simultaneously. The choice of which camera mode to use is critical.

4 Further Developments

Task	Notes
Continue researching navigation and object detection	n/a
Redaction of the Final Report / State of the Art	deadline: beginning of February
Assessment of the best approach and most adequate solution	n/a
Planning the structure of the project	set up the overall guidelines and milestones

References

- [1] T. Krajník, V. Vonásek, D. Fišer, and J. Faigl, “AR-Drone as a Platform for Robotic Research and Education,” in *Research and Education in Robotics: EUROBOT 2011*, (Heidelberg), Springer, 2011.
- [2] T. Krajník, M. Nitsche, S. Pedre, L. Přeučil, and M. Mejail, “A Simple Visual Navigation System for an UAV,” in *International Multi-Conference on Systems, Signals and Devices*, (Piscataway), p. 34, IEEE, 2012.