Real-time Vision-Aided Inertial Navigation for Vertical Take-Off and Landing Unmanned Aerial Vehicles During Critical Flight Stages

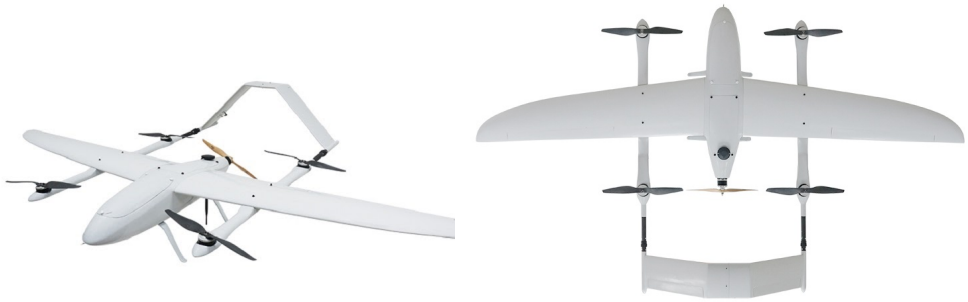

Figure 1: Pictures of the VTOL aircraft.

Overview

This thesis aims to develop a robust vision-aided inertial navigation framework for a special class of Vertical Take-Off and Landing (VTOL) Unmanned Aerial Vehicles (UAVs) during critical flight stages. The vehicle is capable of convertible flight, namely from multi-rotor mode to fixed-wing mode, and is used to transport blood samples between hospitals.

Visual Inertial Odometry is the process of estimating the pose and motion of a vehicle using the input of a single or multiple cameras attached to it, in combination with IMU data. The research in this thesis will emphasize robust navigation using this technique, to ensure high safety and precision flight for the aircraft during the most critical phases of flight. During takeoff and landing the aircraft will be operating on the hospital roofs, and it is in these flight stages that high performance state estimation is critical.

The method will be implemented on the companion computer mounted on the aircraft depicted in fig. 1. Depth data will be gathered using a stereo camera mounted on the aircraft. The entire setup will be tested on the aircraft, together with the modified PX4 open-source autopilot software running on the aircraft.

Tasks and Sub-objectives

1. Literature review: Visual odometry and inertial navigation.
2. Implementation of navigation framework onboard companion computer.
3. Integration with the flight controller running the PX4 Autopilot.
4. Implementation and flight testing on-board the prototype VTOL UAV.

Aviant

This thesis is written in collaboration with Aviant, a Norwegian company specializing in autonomous drone transportation of blood samples and critical medical supplies between hospitals. Transportation of biological samples is currently one of the biggest bottlenecks in diagnosing patients, a problem that can be greatly alleviated using drone technology. Aviant has a collaboration with St. Olav Hospital, one of the largest hospitals in Norway, where this solution is currently being tested and implemented. The goal of this thesis is to implement the results on the vehicle that is used in day-to-day operations between hospitals in Norway.

References

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