High Wind Transition for a Class of Vertical Take-Off and Landing Unmanned Aerial Vehicles

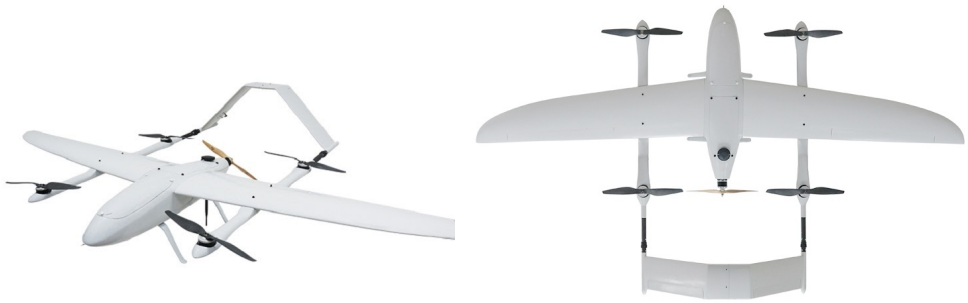

Figure 1: Pictures of the VTOL aircraft.

Overview

This thesis aims to develop an optimized flight control and motion planning framework to enable operation in highly windy environments for a special class of Vertical Take-Off and Landing (VTOL) Unmanned Aerial Vehicles (UAVs) capable of convertible flight, namely from multi-rotor mode to fixed-wing mode.

The research will emphasize robust control in the presence of strong wind disturbances during transition from multi-rotor to fixed-wing flight. During this transition phase, the total kinetic energy of the system is low, and the vehicle is especially vulnerable to wind gusts and strong static winds. The VTOL vehicle used for this research is over-actuated in the sense that it contains actuators from both a quadcopter and a fixed-wing vehicle. By combining these actuations principles, robust control, wind measurements and an accurate model of the UAV under the influence of wind, the goal of this thesis is to enable reliable and safe transition in virtually any environment.

The method will first be implemented in simulation on the modified PX4 open-source autopilot software running on the drone, and will later be implemented on the prototype VTOL UAV depicted in fig. 1.

Tasks and Sub-objectives

1. Literature review: Flight control and motion planning for VTOL UAVs, fixed-wing control and rotorcrafts.
2. Modelling of VTOL UAV under the influence of wind.
3. Optimized control for VTOL navigation in environments with strong wind gusts.
4. Optimized motion planning for VTOL navigation in environments with strong wind fields.
5. Implementation as part of the PX4 open-source autopilot.
6. Implementation onboard a 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.

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