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

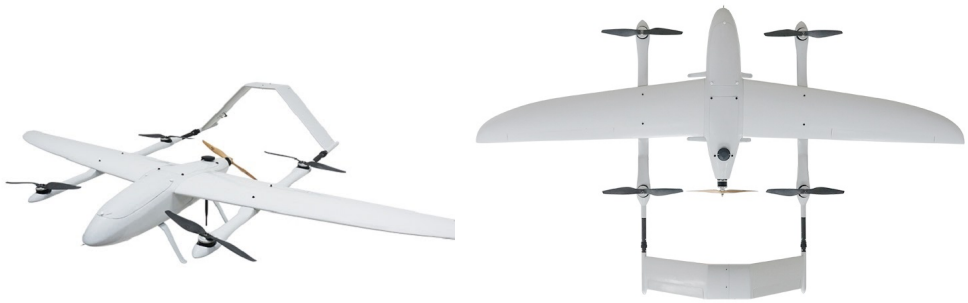

Figure 1: Pictures of the VTOL aircraft.

Overview

This thesis aims to develop an optimized flight control and motion planning framework to enable high energy landing 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 disturbances and highly varying initial conditions. High energy landing is similar to perching and deep stall landings, which has previously been a research topic for fixed-wing vehicles, due to the possibility of much shorter landings than those performed on runways. However, due to the nonlinear and unpredictable aerodynamic behaviour of the high angle-of-attack flight regime, perching continues to be a very challenging tasks for fixed-wing vehicles. 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, the goal of this thesis is to develop a novel approach to high energy landings.

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: Deep stall landings and perching for fixed-wing vehicles, and coverage of literature of VTOL UAVs, fixed-wing control and rotorcrafts.
2. Modelling of VTOL UAV
3. Trajectory optimization for generation of optimal and dynamically feasible trajectories for high energy landing.
4. Flight control and stabilization of high energy landing trajectories.
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.

References

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