Inverted-Flight Drone with 3D Thrust Control

Project Summary

Develop a drone capable of fully autonomous inverted flight. The UAV should be able to invert thrust during flight, fly upside down, land on ceilings or inclined walls, and maintain position using reverse thrust.

Project Type

- BA Thesis (3-6 months)
- MA Thesis (6 months)
- Praktikum (3 months)

Required Qualifications

- Solid understanding of control systems and mechanics
- Experience with Python or C++ (ROS preferred)
- Interest in nonlinear control and aerial robotics
- (Optional) Experience with UAV hardware or flight testing

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Detailed Description

In contrast to conventional quadrotors that can only generate thrust in one direction, this project investigates a drone with reversible thrust motors that allow it to operate in full 3D flight regimes. The student will design and implement control strategies that handle large-angle rotations, smooth transitions between upright and inverted flight, and stable hovering in any orientation. A particular focus lies on enabling the UAV to autonomously attach to ceilings, vertical walls, or inclined surfaces. After landing, the drone must maintain its position by directing thrust toward the surface, effectively "sticking" to it, and later detach safely.
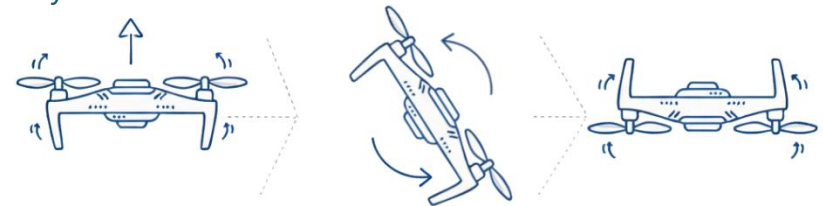
NORMAL FLIGHT   TRANSITION   INVERTED FLIGHT

References

- W. Jothiraj, C. Miles, et al., "Enabling Bidirectional Thrust for Aggressive and Inverted Quadrotor Flight," in International Conference on Unmanned Aircraft Systems (ICUAS), Atlanta, GA, USA, 2019, pp. 534-541.
- https://youtu.be/26UFFd5Tj8s?si=Z6_42E4VtLZoPrit