WS 2021-2022, SMT-ROB, DISAL-SP160 Project Summary

Development of a Realistic Quadrotor Simulation

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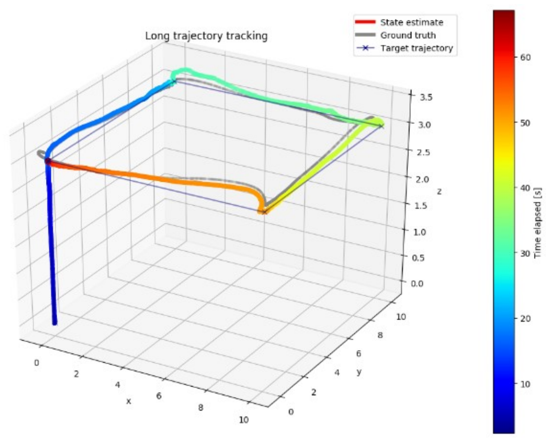
The development of a flying unmanned aerial vehicle (UAV) can often be challenging when working with a real-life robot. Indeed, they are often dangerous for the user and its environment, and testing with them can be slow and unpractical. The setup costs of such experiments are also relatively high, especially in the case of failures. To alleviate such issues, robot simulators are often used to develop flying drones. They allow for the experimentation of UAVs in a controlled environment at a fraction of the cost.

This project focuses on the development of an accurate simulation of a quadrotor drone, which could then be used for research. To achieve this, we have used the Webots simulator as our development environment, a powerful and easy to use tool for robotic simulations. The components of this project communicate with each other over ROS.

Drone flying in the Webots simulator

Two projects which have previously been developed in the laboratory were combined to achieve a realistic simulation of a flying UAV; an auto-pilot module based on the PX4 controller, and a state-estimation module which uses visual inertial odometry (VIO) to estimate the pose of the drone. By combining these two packages, we were able to successfully achieve closed-loop control of a quadcopter in simulation.

The PID gains of the auto-pilot can be adjusted with a configuration file. After tuning these parameters, the controller was found to be able to maintain stable flight of the drone. It can be controlled using set-points in position, velocity, acceleration, and attitude. Experimentation has shown that the controller was able to accurately follow a set of waypoints in the simulation world.



Plot of a trajectory carried out by the drone

The robustness of the controller was also tested by applying frontal and lateral forces to the drone while in flight. Results have shown that the state estimation capabilities of the controller are sufficient to allow for the controller to reject perturbations and stabilize the quadcopter.