

Development of a Realistic Quadrotor Simulation

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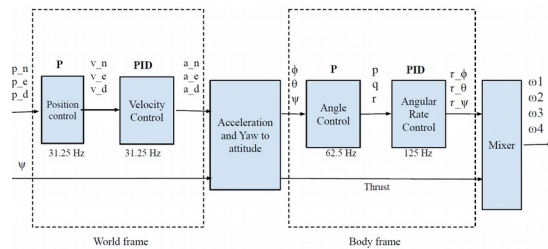
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Videos — <https://bit.ly/3hjH1OK>

Webots is a popular robot simulator, providing a complete development environment to model, program and simulate robots. However, a controller to fly quadcopters stably in Webots was a missing component for multiple research projects relying on drones.

This project aims at implementing this controller, such that the simulated behaviour is as close as possible to a real drone running the popular PX4 auto-pilot.

The proposed control solution is based on nested PID loops, as used in PX4.



Control diagram

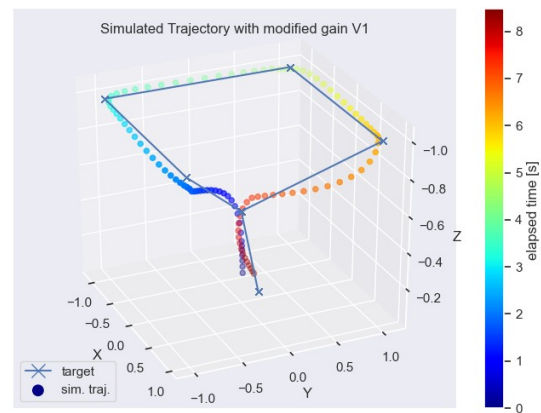
A comparison between the simulated and real trajectory was performed, based on the ModalAI VOXL m500 drone.



Modelled drone based on the VOXL m500, by ModalAI

Adequate PID gains were found, respectively for maximum performance and for maximum resemblance to the real drone.

It was interesting to note that the low-level gains (angle, angular velocity) could be directly extracted from the original drone firmware and reused, but the high-level gains (position, velocity) had to be re-tuned to achieve better performances.



Successful Trajectory completion in simulation

The effect of the control frequency, closely linked to the Webots timesteps, was also investigated, and the controller was shown to be stable with a wide range of different control frequency.

The controller was also shown to be robust to external perturbation (cf. included videos).

The controller was written in python, for faster prototyping and development and ROS compatibility.

A ROS interface was developed following the MAVROS standard, allowing control in position, velocity, acceleration, angle and angular velocity. Code examples to use the auto-pilot were provided for future usage.