Adapting a Quadrotor to Wind Tunnel Experiments

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The aim of this project was to develop a flying structure and platform for future developments. This project is the seed through which future projects could be explored. A modular quadcopter capable of positioning itself relatively in the Wind tunnel, capable of supporting multiple sensing modules and capable of autonomous control. During the course of this project a quadcopter was carefully chose and built. A study of preexisting range sensing systems was concluded, a sensing tower and a collision protection implemented. In this project all the important steps leading to the final results of this project, and valuable information that will serve future developments was presented.

In this project, a comparative research is made on available solutions to cope with the needs and functions necessary for this project. We have studied the best quadcopter kits available in the market, separated in two main categories.

The final choice was the ERLE-Copter, which is equipped with Erle-Brain 3 an artificial brains for robots and drones. A Linux-based embedded computer with full support for ROS (the Robot Operating System) that integrates the sensors, power electronics and abstractions necessary to easily create autonomous vehicles and monitor them.

One of the main desired features of the quadcopter if to have accurate reading of the height at the measurement of the distances between the four main walls of the wind tunnel and the quadcopter. This reading are intended to be used in the future for autonomous navigation and positioning inside the wind tunnel. Following the comparison and description of the range sensors, two main sensors overtop the rest as being best suited for the desired application, mainly for their availability, accuracy and lack of unnecessary features. This two sensors are: IR Sharp sensor, and HC-SR04 ultrasonic sensor. Basically, due to variety of measurement errors inducing characteristics of the sonar sensors, the SHARP IR sensors are better suited for the wall distance measurement task.

Therefore the best sensing solution is a dual combination of the GP2Y0A710K0F (100 cm to 550 cm) and the GP2Y0A02YK0F (20 cm to 150cm). A combination of the two sensors would provide readings ranging from 20cm up to 550cm.

The quadrotor developed in this project

The Quadcopter is now complete with all the mandatory features. The platform is functional, the protective frame is solid, and the sensing system performs well.

Few improvements are actually possible, for example a better filtering and a reduction in the electric noise of the SHARP sensors would reduce the spikes of errors that occur periodically in the sensors readings, the quadcopter protection can be upgraded with a top hat that would protect the sensing tower. The biggest challenges facing this platform now are autonomous navigation, take off positioning and landing.