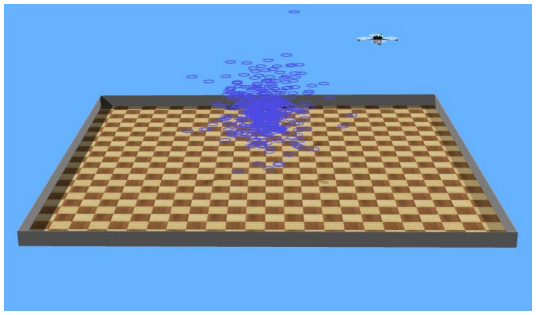
# Integration of Quadcopters in Odor Distribution Mapping

Chiara Ercolani

Professor : Alcherio Martinoli
Assistant(s) : Ali Marjovi

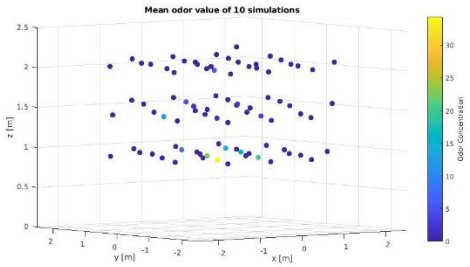
The Odor Distribution Mapping (ODM) technique consists in creating a map of an odor distribution to identify where and how the odor is dispersed in a given area. This technique has applications when situations like gas leaks, environmental emergencies and toxic chemical dispersion occur. Enabling robots to perform this task would provide a powerful tool to prevent dangerous situations and assist humans when emergencies arise.

This project focuses on a preliminary study on the integration of quadcopters in ODM with the goal of producing a 3D map of a gaseous plume in an environment. Prior to this work, simulations and real time experiments focused on odor distribution mapping and localization exploiting mainly ground robots. Including quadcopters in these experimental settings is an important step to explore 3D mapping and localization algorithms and move towards experiments that are closer to real world scenarios.



*Simulation environment created in Webots*

The first past of this project focused on integrating quadrotors in an existing Webots simulation. This simulation is using a plugin to simulate how ethanol particles disperse in the air. A quadcopter was successfully integrated in this simulation and it was possible to control its movement in the arena. Moreover, a simulated sensor was added to the quadrotor and odor source values were logged, allowing the user to create a simulated map of the arena. The biggest limitation of this simulation is that the effect of the propellers is not taken into account in the dispersion model of ethanol. This could be accomplished with a computational fluid dynamics simulation of the quadrotor.




*Mean odor value of 10 simulations. Odor concentration values are higher closer to the source which is located at [0,0,0]*

The second part of this project focused on carrying out experiments in the flying arena facilities of DISAL. A STORM Drone 4 quadrotor equipped with a Pixhawk autopilot and a Raspberry Pi was used to carry out these experiments. The first step of this task was to mount an existing odor sensor on the quadrotor and set up a network to allow data logging in the flying arena facilities. Moreover, the arena was prepared for experiments by enabling the placement of the odor source in two different locations: on the ground and hanging from the top of the arena.

The experiments successfully allowed an expert user to fly the quadrotor in the arena and simultaneously log odor data. However, this data is not very meaningful because the effect of the quadrotor on the odor dispersion was too big. Moreover, the experiments were affected by several limitations: limited flight time, limited size of the arena and frequent failures of the odor sensor logger.

Future work on this project will focus on carefully analyzing the effects of the propellers on odor dispersion and try different flying vehicles to accomplish the task. Moreover, studying the positioning of the sensor on the quadrotor to maximize the odor reads could offer some helpful insights to improve this technology.