



UNIVERSITÀ DEGLI STUDI DI NAPOLI
FEDERICO II

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Vincenzo Scognamiglio

Autonomous Navigation in GPS-denied Environment

Tutor: Prof. Vincenzo Lippiello

co-Tutor: Eng. Alessandro Massa (Leonardo S.p.A.)

Cycle: XXXVII

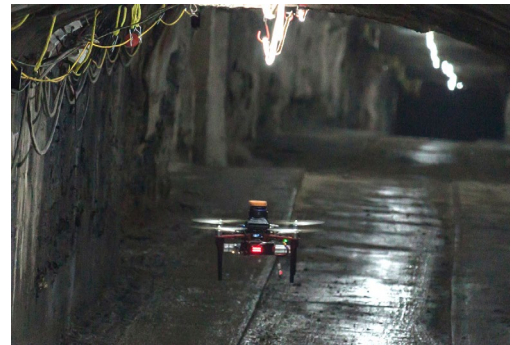
Year: First

My background

- M.Sc. in Automation Engineering, Università degli Studi di Napoli Federico II (Sep 2021)
- Group: Aerial Robotics of Prisma Lab
- PhD Start Date: 1st November 2021
- Scholarship Type: Company-funded
- Partner Company: Leonardo S.p.A.

Research field of interest

- **Objective:** Develop a navigation framework to allow mobile robots to navigate fully autonomous in GPS-denied environment.
- **Why:** In most application where robots are implemented, they cannot have access to GPS-signal.
- **Why Drones applications:** they are widespread in several contexts, and they mostly suffer of the lack of GPS-signal.



Summary of study activities

- Ad hoc PhD courses / schools:
 - **"Neural Networks and Deep Learning"**, Lecturer: Prof. G. Buttazzo, Scuola Superiore Sant'Anna: the course focuses on the theoretical foundations of neural networks and deep learning and presents practical implementation issues.
 - **"IEEE RAS Summer School On Multi-Robot Systems 2022"**, Organizer: Czech Technical University, Prague: the summer school covers all the topics related to autonomous navigation of multi-robot systems. During this school they give us the opportunity to do practical flight tests.
- Conferences / events attended:
 - **"Leonardo Drone Contest"**, Organizer: Leonardo S.p.A., Torino: Contest between six Italian universities, the goal was to fly with a drone in a city-like scenario without GPS-signal.

Research activity: Overview

- Problem

The main problem when we are in a GPS-denied environment is the localization of the agent. To move in order to do specific tasks, it has to know where is located and where are located possible obstacles.

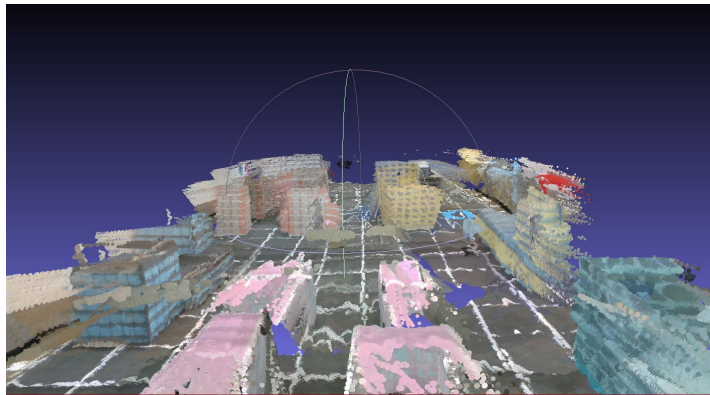
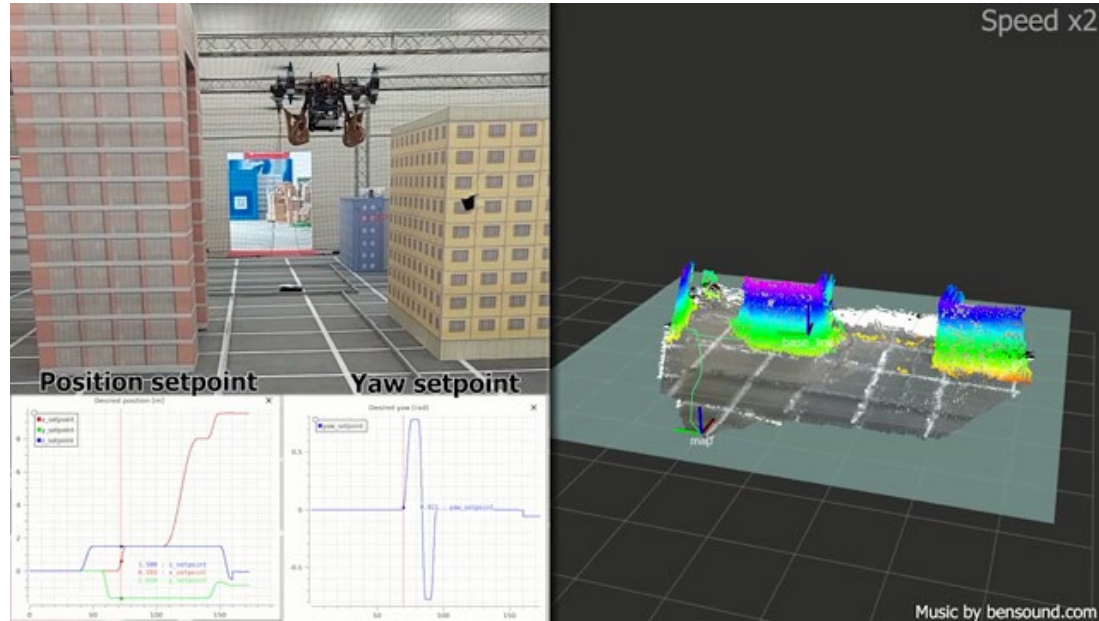
- Objective

To define a complete framework which let a mobile robot to achieve autonomous navigation without GPS-signal

- Methodology

After studied the state of the art, SLAM problem (Simultaneous Localization and Mapping) has been recognized as playing a crucial role for the localization task. Some SLAM algorithms have been implemented (RTAB-Map and ORB-SLAM2), firstly on bench using different sensors and then on board a drone.

Research activity: Overview



Research activity: Overview

- Problem

Fault Detection and Isolation of an actuator in an aerial robot

- Objective

To investigate an accurate estimator of faults in actuator of a drone to allow Fault Tolerant Control (FTC)

- Methodology

We devised a data-driven estimator, and we are comparing this technique with others model-based. We started implementing a simulation using Simulink.

Next Year

- Improve the robustness of the implemented techniques.
- Work on quality of the mapping process to recognize better the obstacles.
- Explore new families of sensors (lidar, laser, etc...).
- Test the system in different scenarios.
- Study and implement SLAM on multi-robot systems.