



UNIVERSITÀ DEGLI STUDI DI NAPOLI
FEDERICO II

itee^{PhD}
information technology
electrical engineering



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Salvatore Marcellini

Unmanned Aerial Vehicles in indoor/GPS denied environments

Tutor: Prof. Vincenzo Lippiello

Cycle: XXXVI

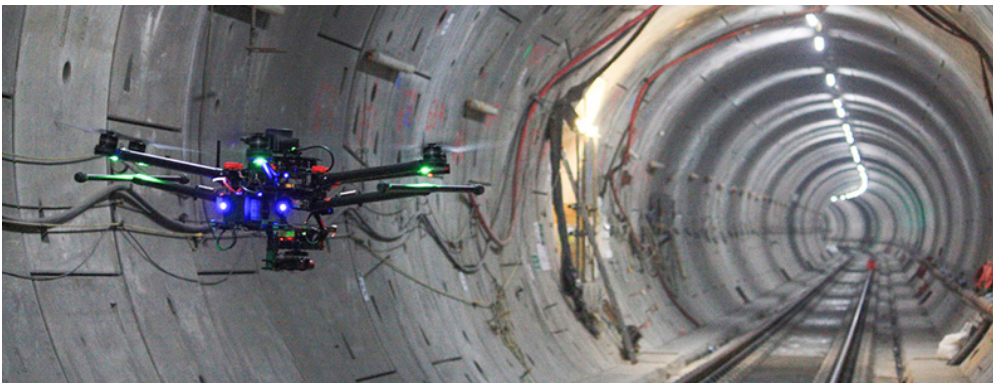
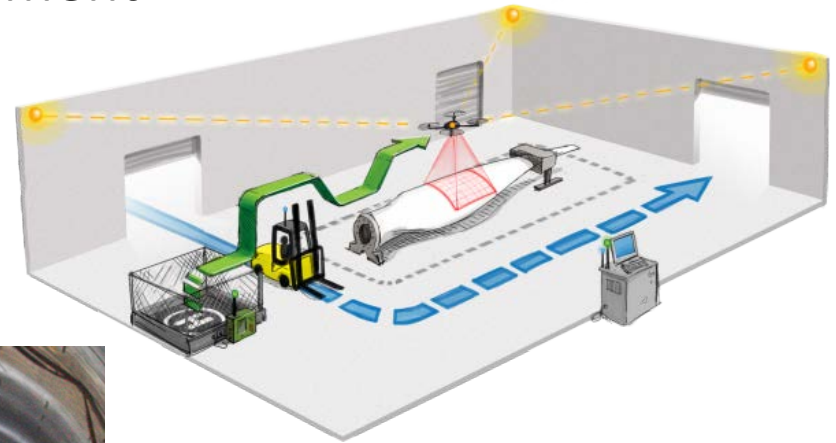
Year: First

My background

- M.Sc. in Automation Engineering, Università degli Studi di Napoli Federico II
- Group: PRISMA Lab
- PhD start date: 1/11/2020
- Scholarship type : Company-funded
- Partner company: Leonardo – «Leonardo Drone Contest»

Research field of interest

- **Objective:** Develop an aerial autonomous system for indoor/GPS denied environment
- **Why drones:** thanks to their agility and dimensions, they can move in different types of environment



Research field of interest

- Drones can have different shapes and sensors, according to the needs
- Drones can work both autonomously and in cooperation with humans



Summary of study activities

- Ad hoc PhD courses / schools:
 1. **“Modeling complex systems”**, Lecturer: Prof. Mario Di Bernardo: the course provided an overview on the nonlinear controls, the collective behavior of a network of systems and the controls that can be used
 2. **“Short course on Deep Learning and Computer Vision for Autonomous Systems”**, Lecturer: Prof. Ioannis Pitas, Aristotle University of Thessaloniki: The course provided a general overview on the different solutions in the state of the art of the drone imaging, vision, surveillance and cinematography, with several applications.
- Courses borrowed from MSc curricula
 1. **“Robotics lab”**, Lecturer: Prof. Vincenzo Lippiello: The course gave an overview of the fundamental tools and techniques used to program advanced robotics systems

Research activity: Overview

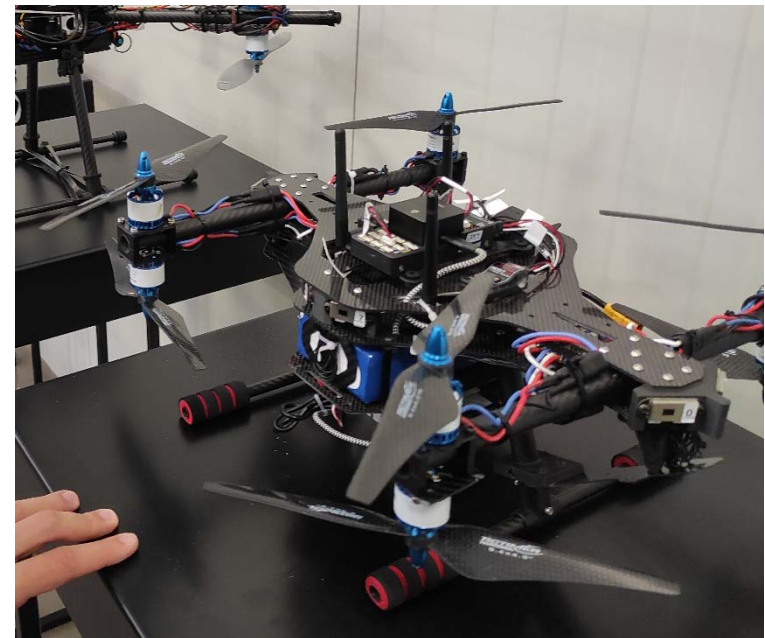
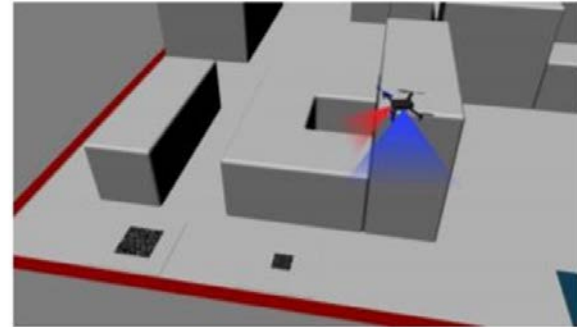
- **Main problems about indoor intruder research:**
 - Localization inside the environment
 - Fast and safe movements avoiding obstacles
 - Predict the position of the intruder
 - Recognition of the intruder



Research activity: Overview

Research activity during the First Year

- Search of the state of the art of the indoor inspection with UAVs
- Development and simulation of a Nonlinear Model Predictive Control (NMPC) that generates a research trajectory, considering the dynamic of the system, the movement constraints and the obstacles; based on a time variant heat grid-map that accounts probability distribution of finding an intruder
- Build and programming a drone for the Leonardo Drone contest challenge



Research activity: Overview

Future work

- Implementation of the NMPC on the real drone
- Controller extension to work with multiple systems
- Controller extension to work with moving obstacles