Salvatore Marcellini

Control of autonomous drones for navigation and inspection

Tutor: Prof. Vincenzo Lippiello

Cycle: XXXVI

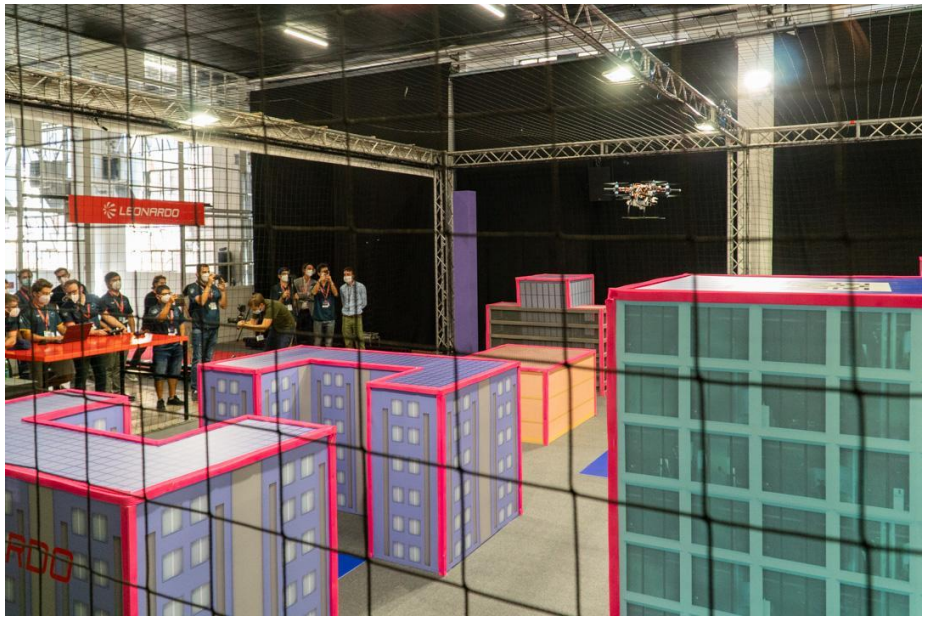
Year: Second

My background

- M.Sc. in Automation Engineering, University of Naples 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

- My research is focused on the control of autonomous drones for navigation and interaction with the environment.
- I participate in the “Leonardo Drone Contest”, a contest between six Italian universities for the development of an autonomous drone capable of navigating inside urban-like GPS-denied environments



Research field of interest

- For the interaction with the environment, I work on the control of omnidirectional drones with tilting propellers.

- The tilting mechanism gives to the drone a higher agility and maneuverability

Summary of study activities

- Ad hoc PhD courses:
  - Imprenditorialità accademica
  - Neural Networks and Deep Learning
- Summer School:
  - IEEE RAS Summer school on multirobot system
    CZECH Technical University in Prague
- Conferences:
  - ICRA 2022 workshop: Shared Autonomy in Physical Human-Robot Interaction: Adaptability and Trust
- Events:
  - PX4 Developer Summit

Research activity: Overview

- Problem (of your own research activity)

  (Describe the problem in as few words as possible.

  Make it clear why it is important, and for whom)

- Objective

  (Describe the solution you foresee for the problem)

- Methodology

  (Describe the scientific approach to pursue/build and validate the proposed solution)

Research activity: Area surveillance

- **Problem: area surveillance**
- The surveillance task is often carried out with cameras that continuously look at some areas of interest, however, the main problem is their placement. An UAV can provide a mobile viewpoint from above with a broader area coverage and redirect the survey to the desired point of interest.

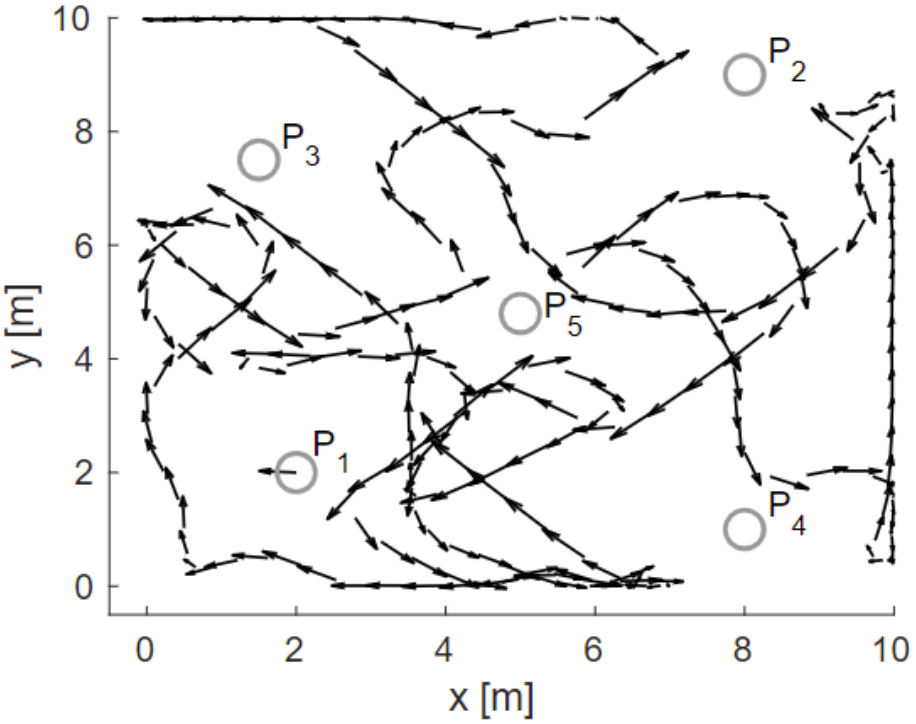
Research activity: Area surveillance

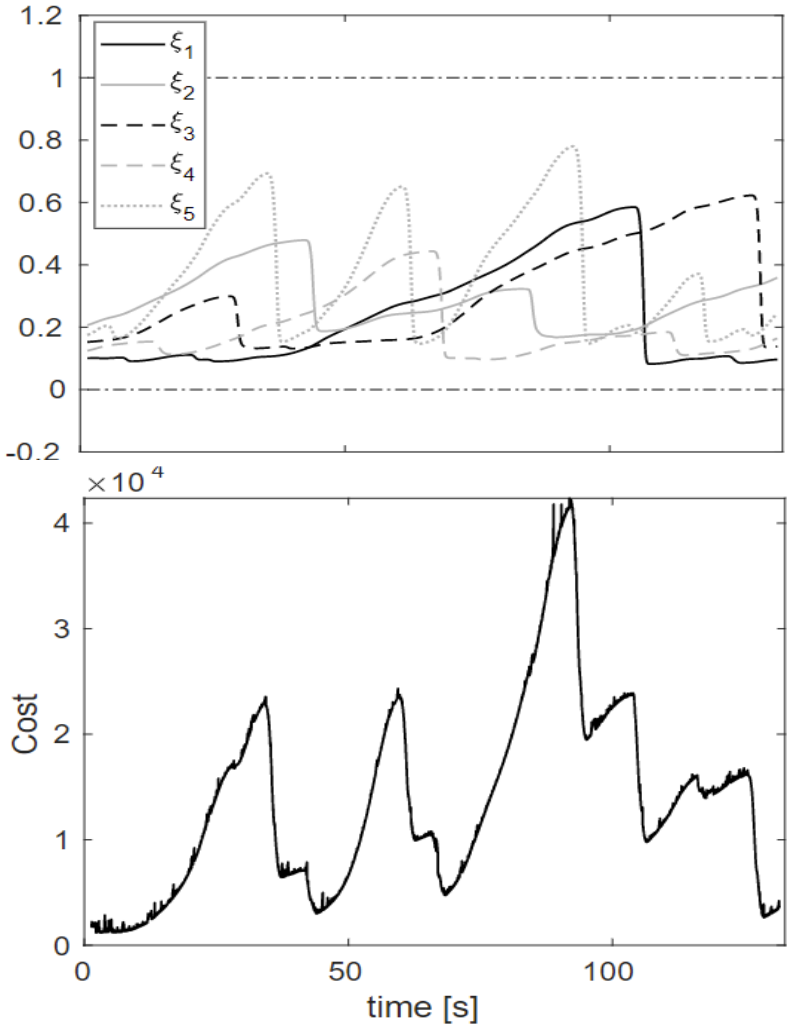
- **Objective:** a single multirotor UAV in a reconnaissance mission has to fly on a limited map, avoid collisions with obstacles and repeatedly visit some points of interest (POIs).
  The mission can be, for instance, the research of a moving intruder or gas leaks.
- **Methodology:** the POIs are characterised by their coordinates and a probability related to the application (e.g., the probability of the intruder's presence or gas leak). The probability in each POI must evolve over time and with respect to the position of the scouting UAV.

  We utilize a **NMPC** to compute the trajectory to visit alle the POIs

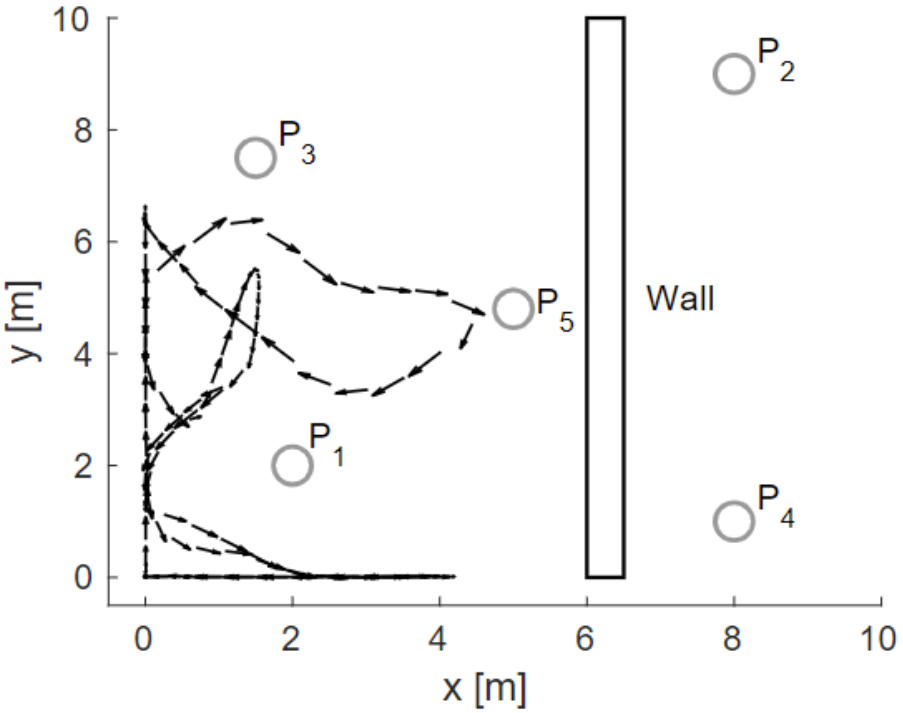
  that satisfy the constraints given by the full dynamic model of the UAV, the distance from the obstacles and the evolution of the probabilities of each POI.

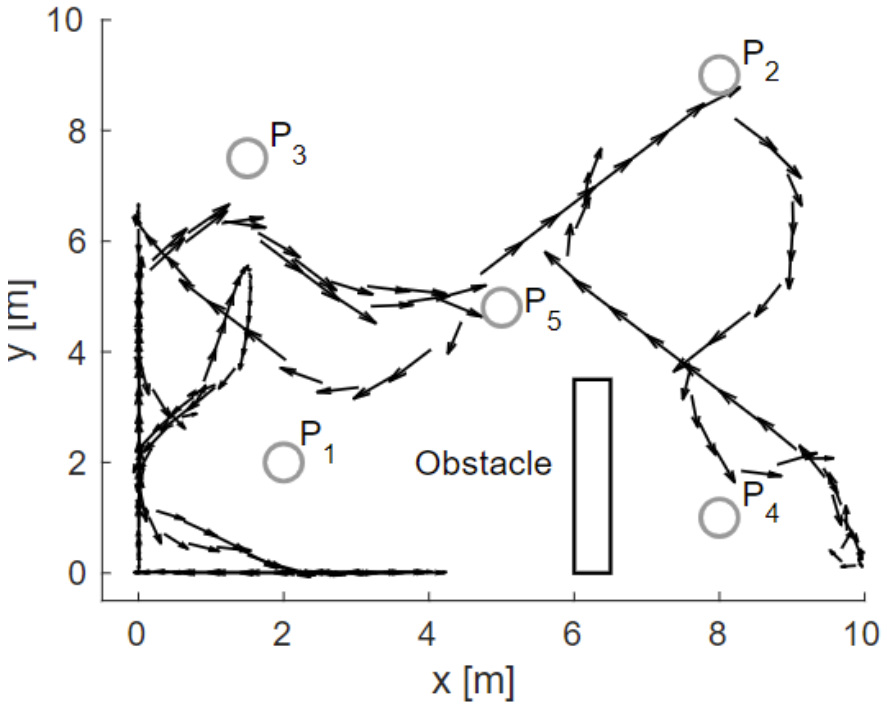
Research activity: Area surveillance





Research activity: Area surveillance





Research activity: Area surveillance

Nonlinear Model Predictive Control for Repetitive Area Reconnaissance with a Multirotor Drone

Salvatore Marcellini, Fabio Ruggiero, Vincenzo Lippiello

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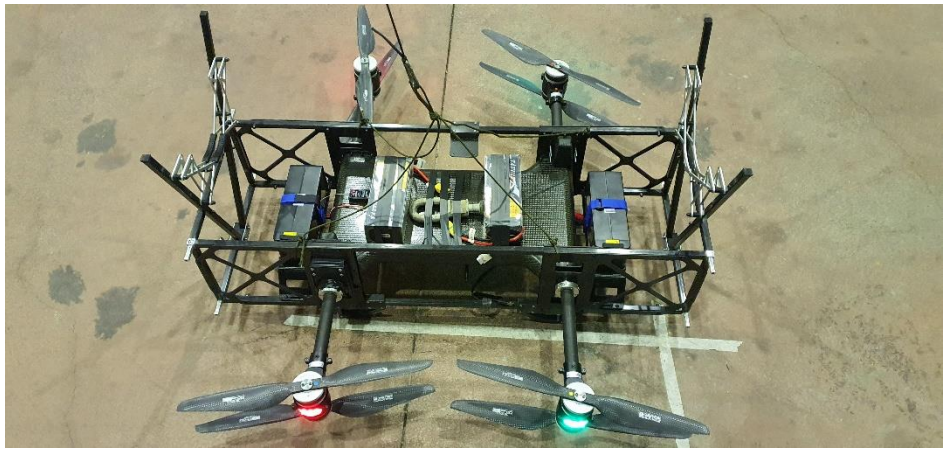
Research activity: Tilting drones

- Created a custom version of the PX4 autopilot firmware, including the control for a H-shaped tilting drone and omnidirectional tilting drones



Products (if any, otherwise remove)

[P1]	S. Marcellini, F. Ruggiero, V. Lippiello, "***Nonlinear Model Predictive Control for Repetitive Area Reconnaissance with a Multirotor Drone***", submitted to the 2023 International Conference on Robotics and Automation, London, GB.

- **Tutorship:**
  - "Robotics Lab", course of M.Sc. in Automation Engineering