

PoliTo Team

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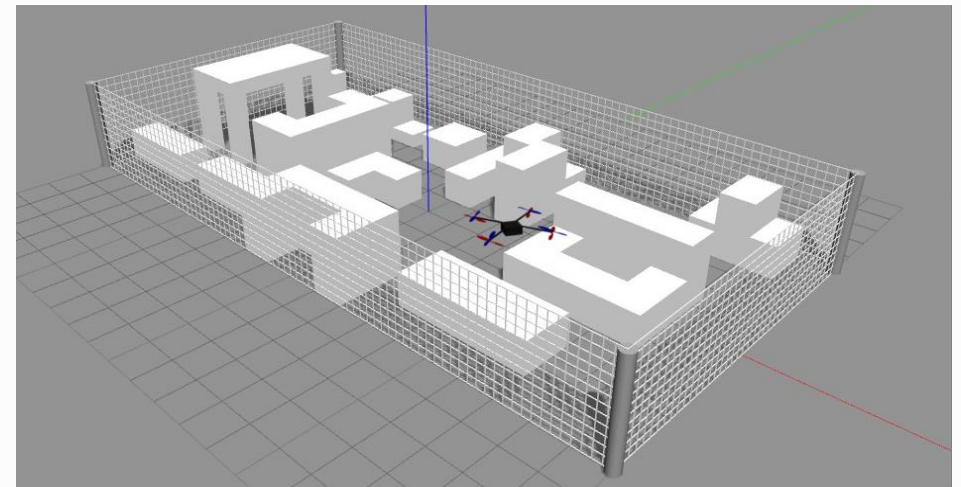
Simone Godio

PhD OBJECTIVES:

- Development of a **single** drone's autonomous Navigation algorithms (obstacle avoidance + object detection + visual navigation) with sensor fusion and new receiving techniques.
- Elaboration and realization of an innovative Navigation system through an **interaction network** between a limited number of autonomous drones.
- Extension of the interaction algorithms to a drone's SWARM in order to realize an optimized communication network, creating a more autonomous system in the Navigation.

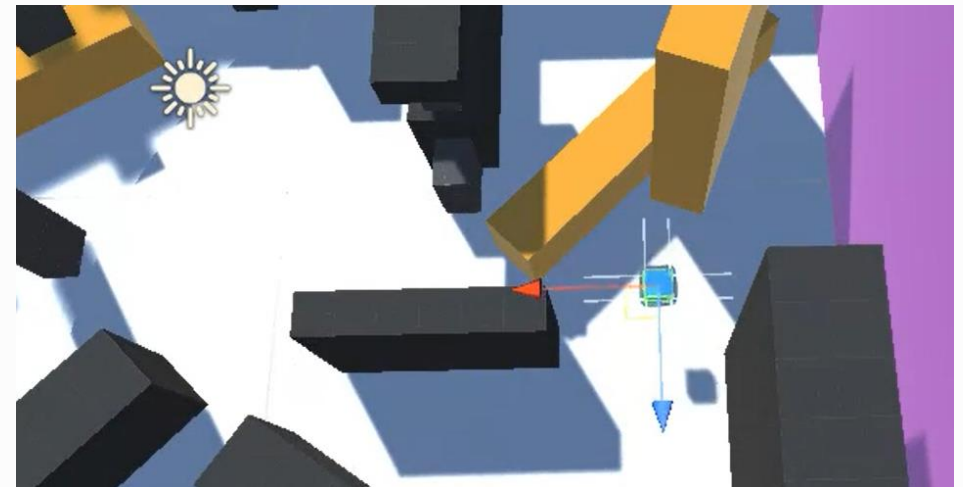
Robotic Systems Engineering

- In-house development of TRIDENT, a tool for the comprehensive multidisciplinary design of rotorcrafts. The tool is meant to support fast evaluation of initial guess of design to be optimized in detailed design phases.
- Definition of standards for orchestration framework development, implementation and operation. A plug-in for Gazebo has been developed to enable the evaluation of the propeller thrust vs. rotation rate considering commonly available information on motors and propellers.



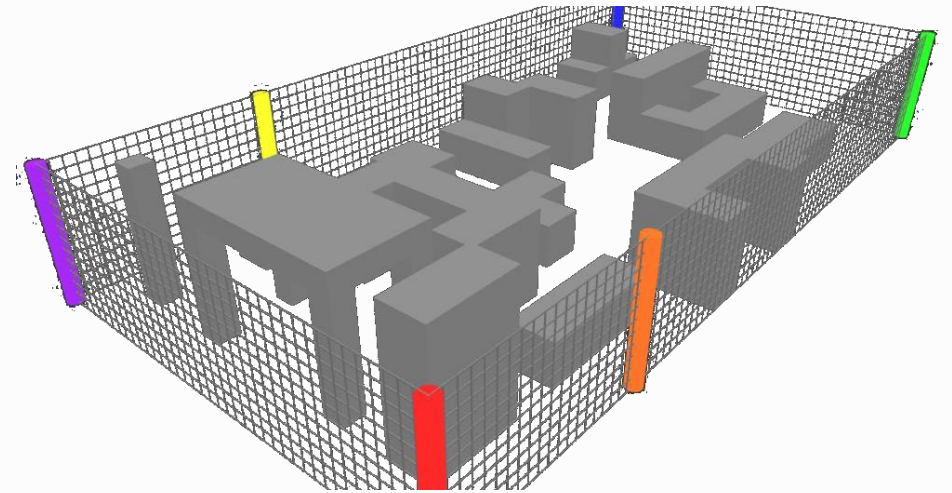
Deep Learning and Computer Vision

- Research in Reinforcement Learning (RL) algorithms to perform proximity collision avoidance. These algorithms improve the response time of the drone in the presence of unexpected obstacles in the drone trajectory. Additionally, RL models generalize specific behaviors in unknown operating conditions.
- Computer Vision applications fused with Deep Learning (DL) algorithms to perform object detection and recognition in real-time. DL allows robust recognition of the targets (i.e. QR codes), regardless of orientation, distortion or completeness of the pattern.



Simultaneous Localization and Mapping

- Research in visual odometry through the usage of stereo camera technology to improve pose estimation and localization. The usage of sensor fusion techniques allows to dramatically increase the accuracy of the pose in GPS-denied operating conditions.
- Development of the drone's sensor suite and its operating system in virtual environments. The extensive usage of simulation of the entire drone software reduces integration problems and increases the number of iterations available to improve the code quality.



Obstacle Avoidance and Motion Planning

- Motion planning algorithm (2D based, 3D tunable). Obtained significant runtime improvements. Investigation of path planning algorithm for reconnaissance to map the entire competition field according to specific constraints.
- Research in advanced optimization: optimal control theory to improve trajectory optimization infused with a dynamic algorithm to ensure smooth, physically feasible, and fast trajectories

