NavSight project

Autonomous navigation GPS Free with SLAM

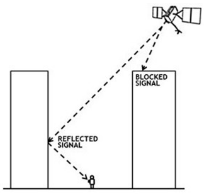
Context

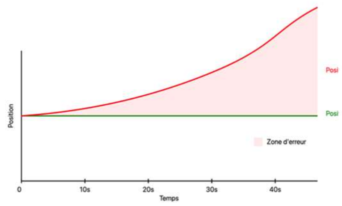
Deployment of autonomous drones to:

- **Surveillance and missions** (military, patrols, security).
- **Inspection of complex infrastructures** (industry, energy).
- **Rescue** (confined areas, rough terrain).

Challenges

- **GPS Dependency:** Inoperative in Indoor and Urban Canyons
- **IMU limitations: Inertial drift:** Loss of accuracy over time.
- **Limited mapping capability:** A drone alone cannot cover large areas.
- **Relocation Challenge:** Difficulty in regaining a reliable position after losing tracking.

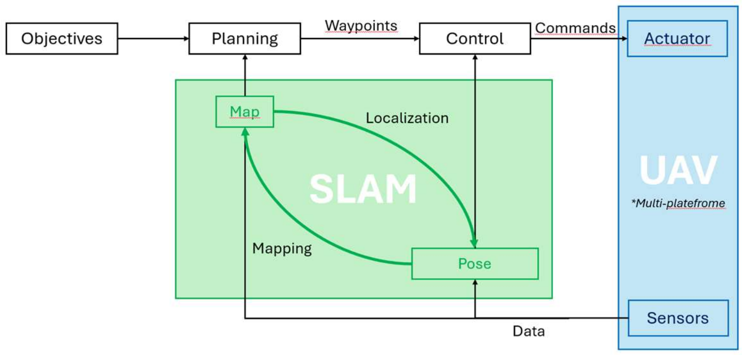


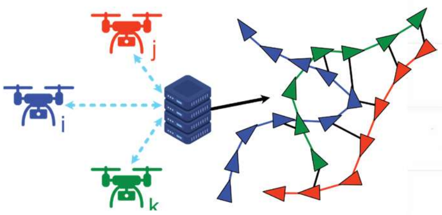


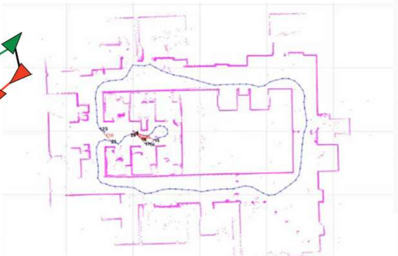
Collaborative SLAM

Simultaneous Localization and Mapping

- **Autonomous location and navigation** without GPS via data fusion **(IMU, camera).**
- **Multi-drone coordination:** Distribution of mapping and data processing.
- **Robust relocation:** Sharing visual cues between drones to compensate for tracking losses.







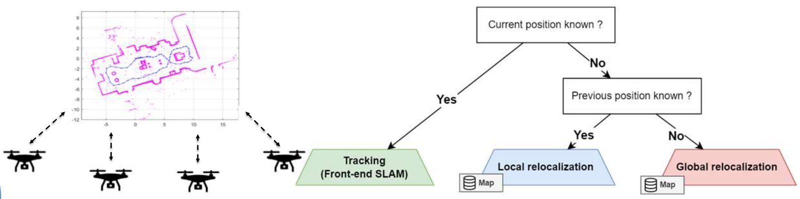
Implementation

Simulation 3D / Simulink

- **Modeling of drone dynamics** (Forces, Moments)
- **Feedback loop** for position control.
- **SLAM integration** and generation of a global map.
- Inputs: IMU sensor data, videos and waypoints.
- **Guidance and relocation** from the shared map.

First version – Asynchronous collaboration

1. A first drone **maps** the area *(Computation performed offline)*
2. The map is **shared** with the swarm.
3. Drones **self-locate** using camera only, with a **similar precision than High Accuracy GPS (Error<40cm)**



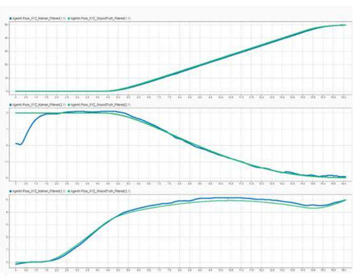
Experimental part

- Experimentation with **physical drones.**
- Use of **targets** and **Optitrack**
- **Evaluation of the performance** of algorithms in a real environment (ESTACA Lab).

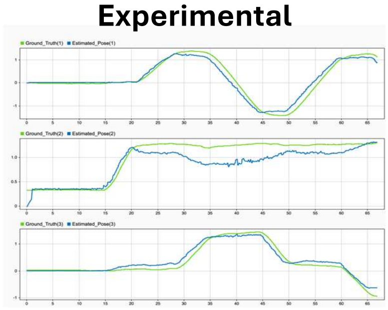
Results

- **High accuracy:** The estimated position follows the ground truth well after convergence : **RMSE < 40cm**.
- **Stability:** Reduced error after the transient phase.
- **Robustness:** Good performance on all axes despite delay.

Simulation



Experimental



Ground truth *Estimated position*

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ESTACA ECOLE D'INGENIEURS