

Long-Term Inspection in GNSS-Denied Environments Using a Tethered System

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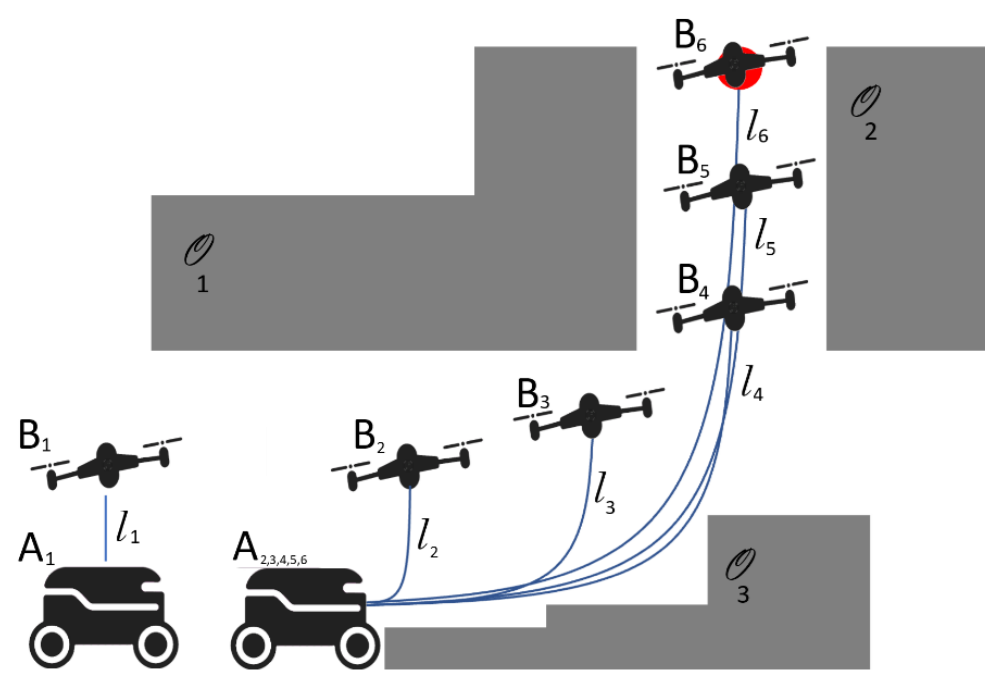
Workshop on Field Robotics - ICRA 2026



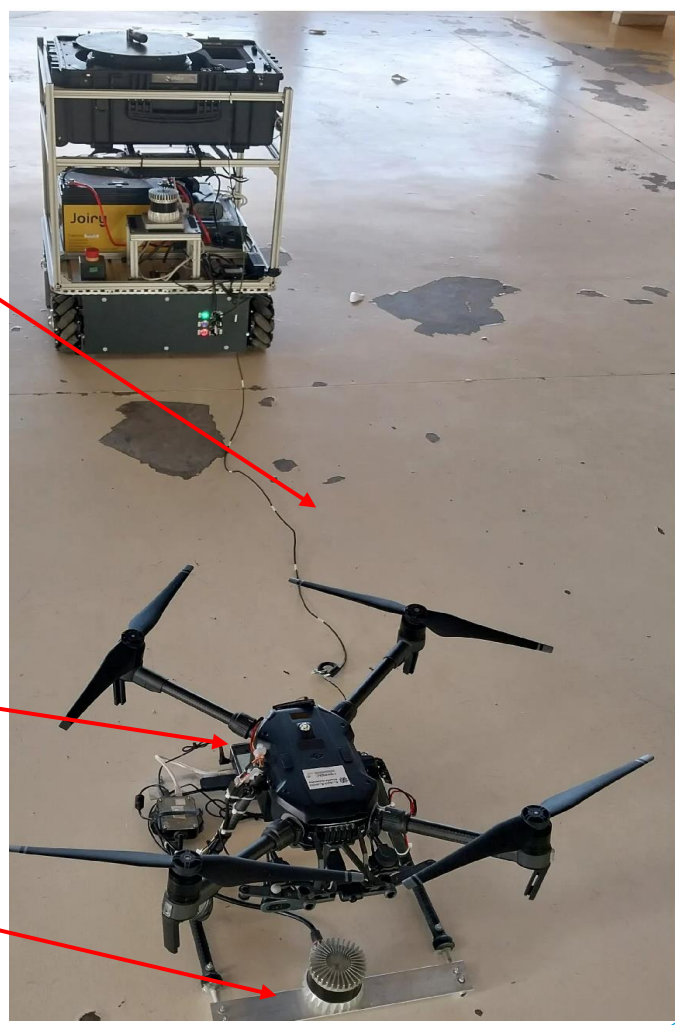
Architecture

GNSS-denied environments demand sustained autonomy and robust localization—constraints that severely limit battery-powered UAVs. Our **tethered marsupial UGV-UAV system**, based on the ARCO UGV, that enables continuous UAV operation via a managed power tether using a custom open-source navigation stack.

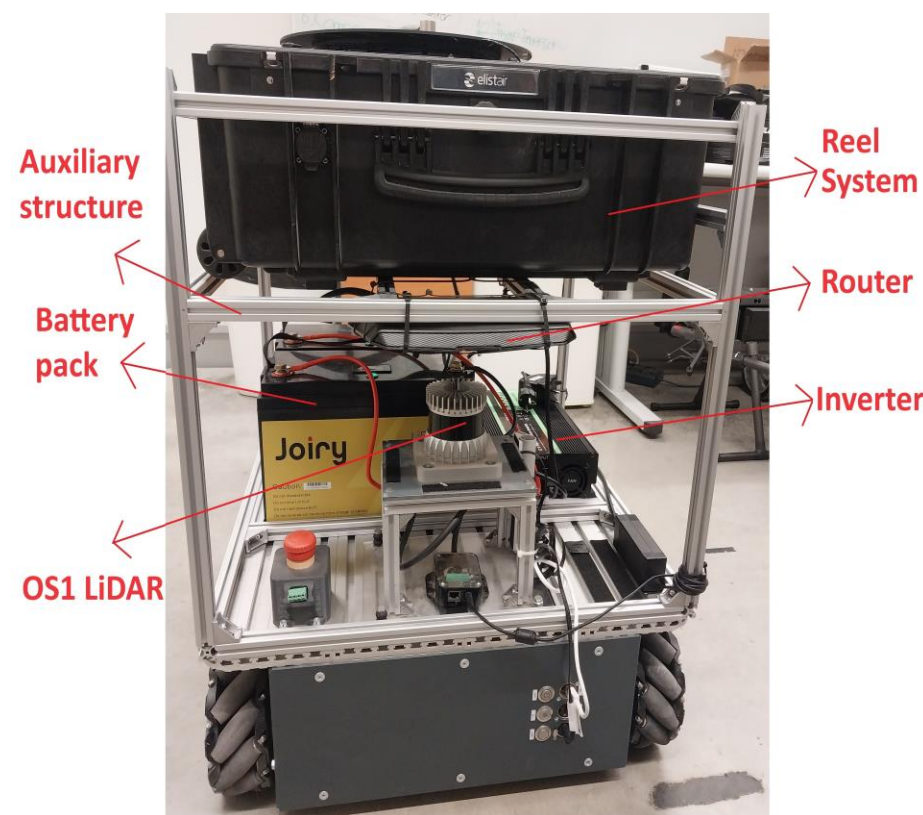
Problem statement



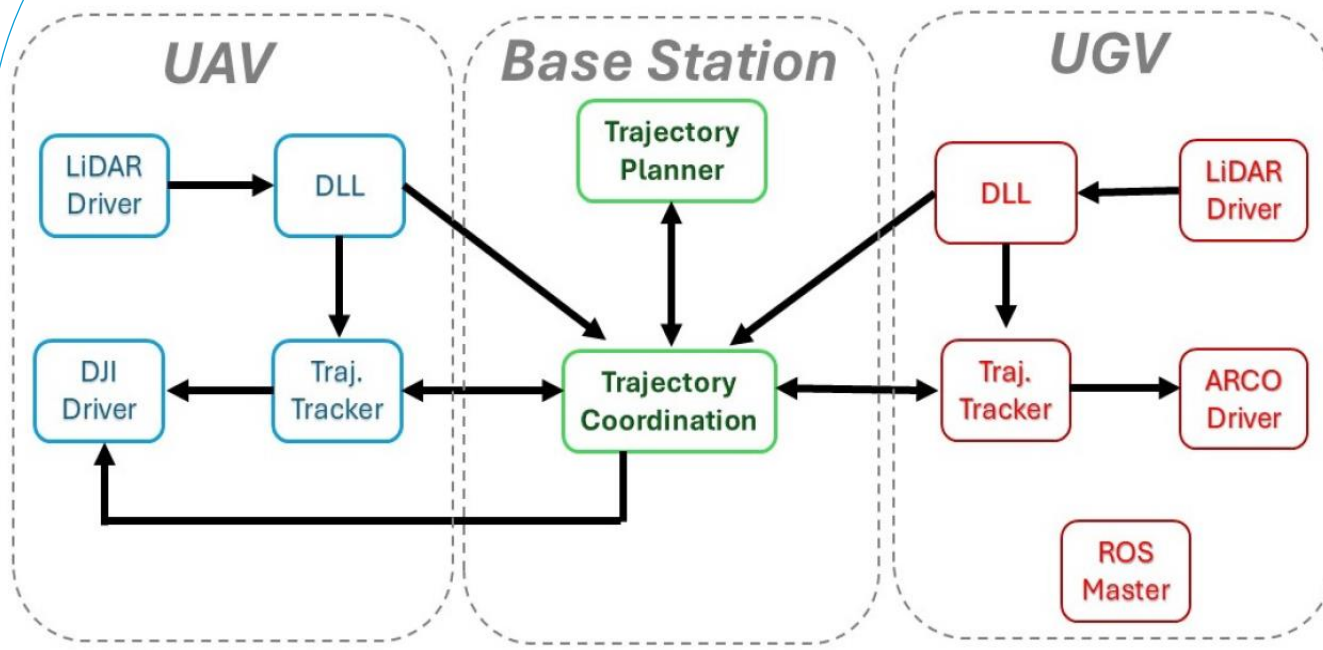
UAV DJI Matrice 210



UGV ARCO



Main ROS nodes



GitHub

DLL: Direct
LiDAR
Localization



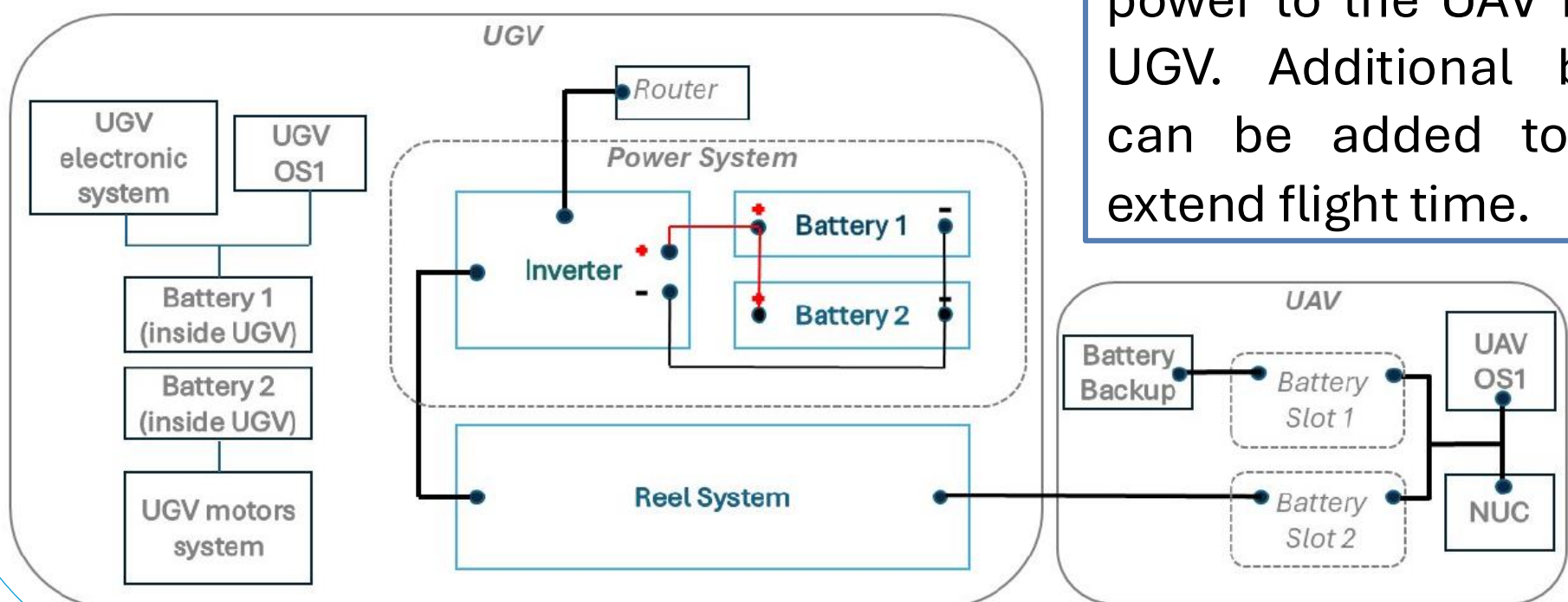
Coordination:
Adapts the
speed of the
systems.



Marsupial Trajectory Planner: optimization-based planner for the marsupial system that computes collision-free trajectories

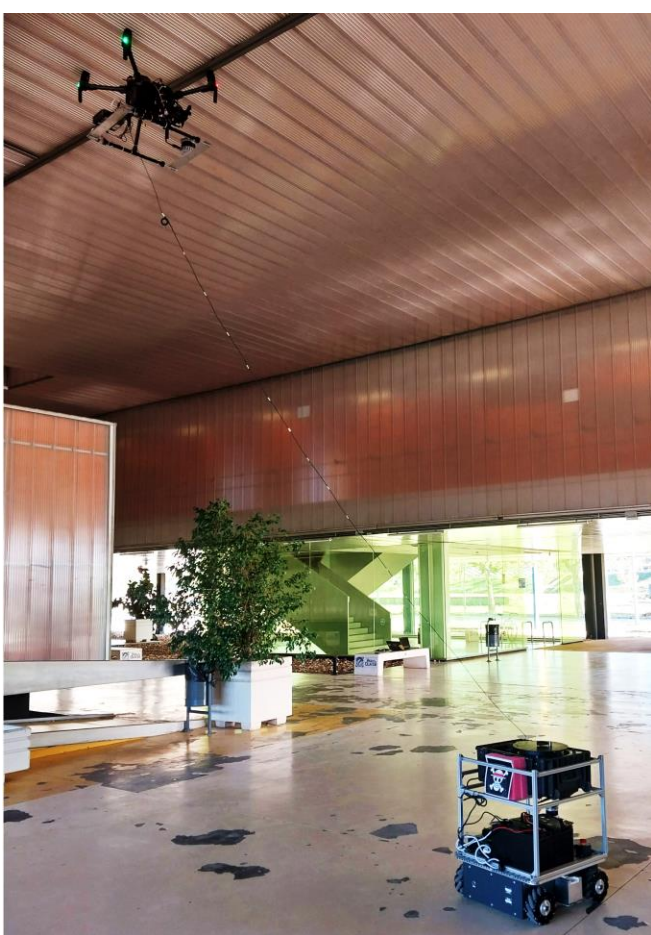
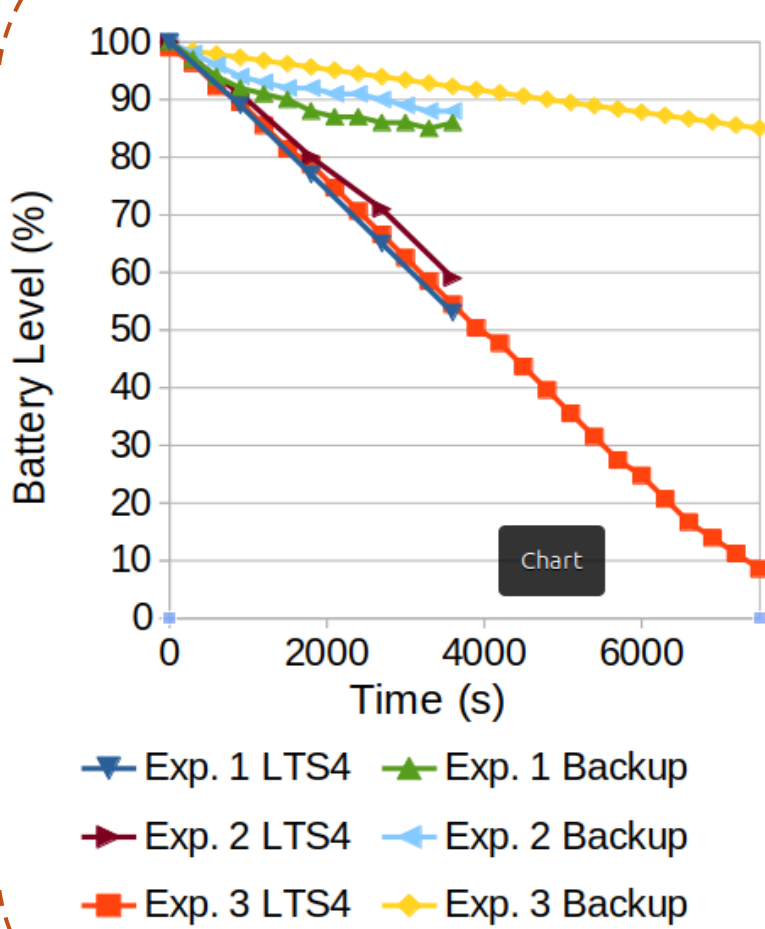


Power system



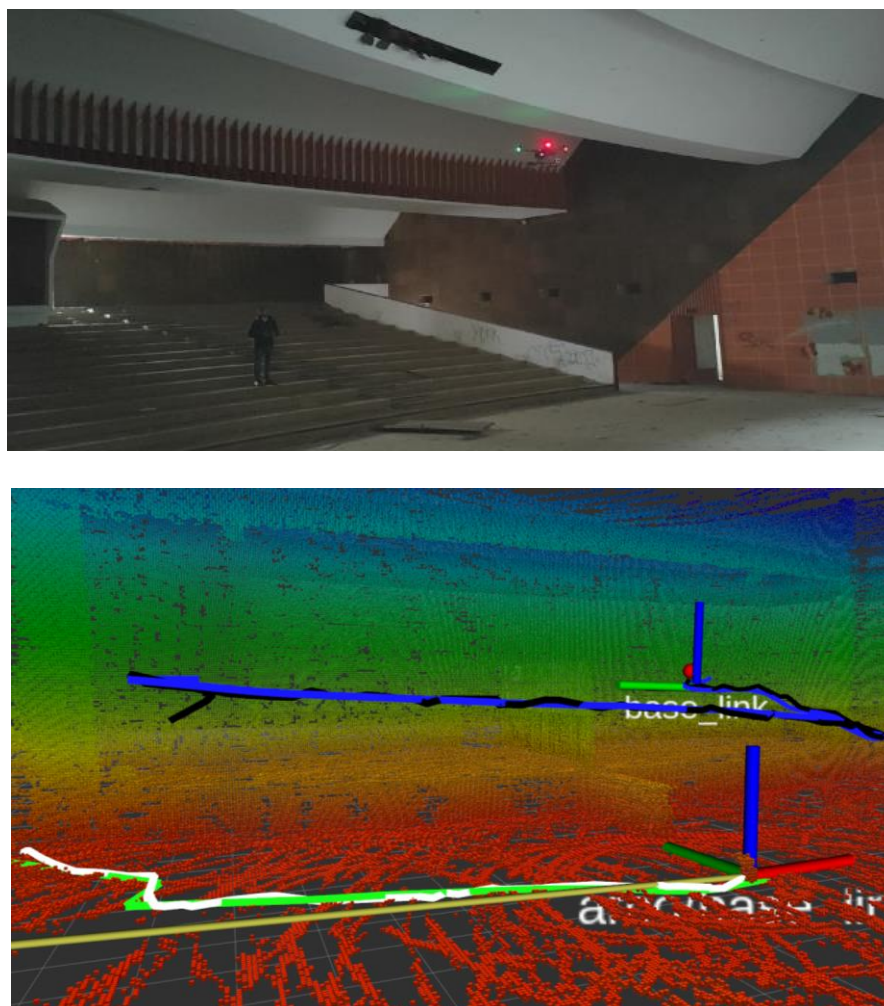
The power system supplies power to the UAV from the UGV. Additional batteries can be added to further extend flight time.

Flight duration



Autonomous navigation

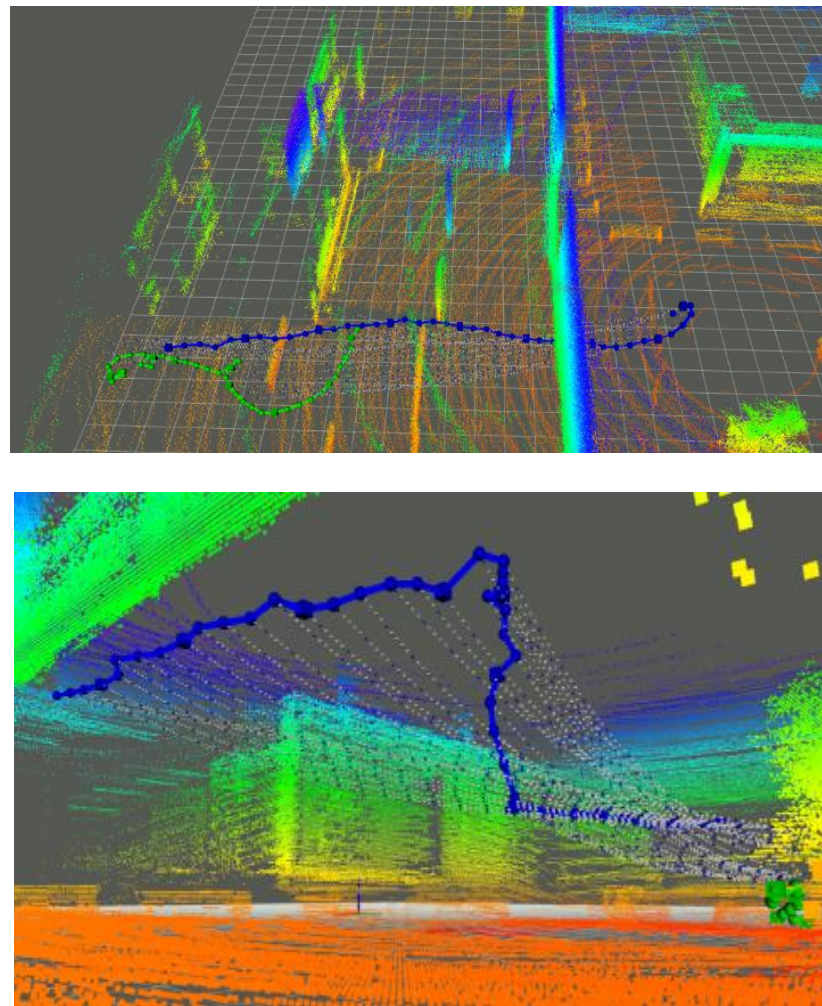
Scenario 1



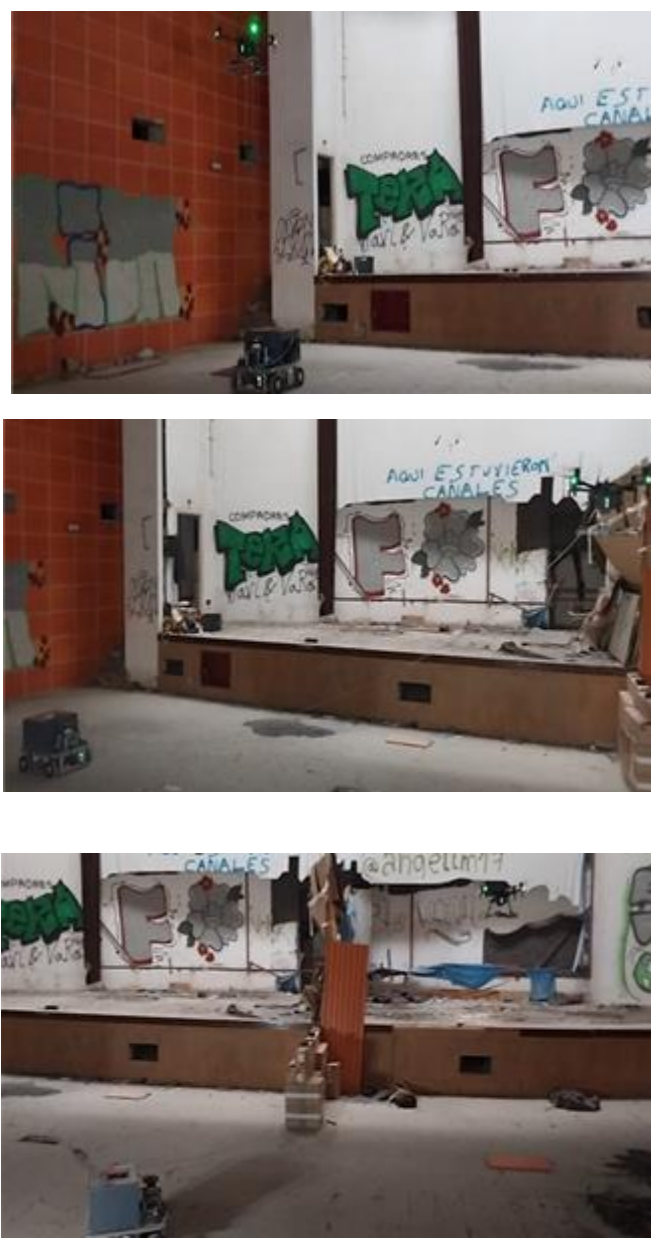
Scenario 2



Scenarios 3 & 4



Experiment 1



Experiment 2



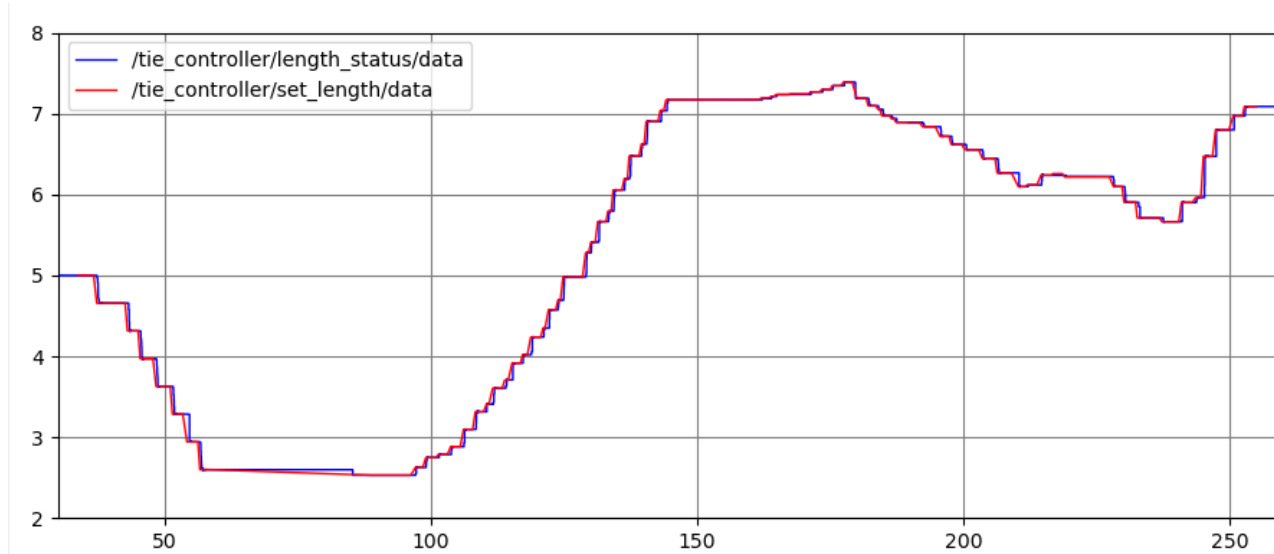
Experiment 3



Experiment 4



Tether length tracking. Scenario 1



Trajectory Tracking errors

Table 1: Mean and standard deviation of Cross-track error (CTE), Along-Track Error (ATE) and Altitude Error (AE) trajectory tracking errors in meters

Scen.	UGV		UAV		
	CTE (m)	ATE (m)	CTE (m)	ATE (m)	AE (m)
1	0.03 ± 0.02	0.06 ± 0.05	0.05 ± 0.04	0.08 ± 0.05	0.06 ± 0.04
2	N/A	N/A	0.07 ± 0.02	0.05 ± 0.02	0.08 ± 0.03
3	0.03 ± 0.04	0.04 ± 0.03	0.11 ± 0.04	0.09 ± 0.08	0.16 ± 0.10
4	0.01 ± 0.01	0.06 ± 0.07	0.14 ± 0.11	0.09 ± 0.08	0.19 ± 0.11

Summary

- Autonomous operation in **three different environments** using a custom navigation stack
- Flight duration experiments of **up to 2 hours** of operation
- **Tracking errors of few cm** in GNSS-denied environments
- Coordination of the system via speed adaption

What is next?

- Integration of multi-modal sensing devices such as radar, multispectral cameras and/or IR cameras
- Application of Building Information Models (BIM) for inspection planning, localization, and reporting
- Enhance coordination by using an MPC controller

SRL
Website



Video



Contact