PILOTING

PILOTS for robotic Inspection and maintenance Grounded on advanced intelligent platforms and prototype applications

Integration Workshop Kick-Off

September 15th, 2021

CATEC Centro Avanzado de Tecnologías Aeroespaciales

Autonomous Systems Lab

Universidad de Sevilla

Chevron

ferrovial construction

Honeywell

Applus RVIS

EGNATIA ODOS S.A.

Waygate Technologies a Baker Hughes business

Quasset

SINTEF

inlecom

ICCS

Robotnik

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WP7 planning

Proposed plan for WP7 (GM May 2021)

- Pre-phase (June-August 2021): pending works for other WPs
  - Finalize construction of robotic systems
  - Finalize design and implementation of DMS, DDHL, Visualization portal and gRCS
- First stage
  - September-December 2021 -> Three parallel tracks:
    - Integration of autonomous robotic systems with gRCS -> Results required to complete D7.1
    - Offline integration between inspection/robotics data and DMS (through DDHL)
      - gRCS data
      - Mission-related data

      Obtained in lab or controlled environment experiments (at least three “large” datasets per robotic system)
    - Integration of DMS with Visualization portal based on logged data in DMS database (obtained from robotic systems experiments)

    Online meeting in September to Kick-off the integration works
      - Proposal: week of September 13th
- Second stage
  - January-February 2022
  - Offline and remote integration works
  - One week integration at CATEC facilities with all WP7 partners
  - It will serve to test the robotics systems, integrated with the PILOTING I&M platform before the real pilot experiments
  - Results to complete D7.2

Proposed planning for integrations

	September		October				November					December			
	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15
Integration of autonomous robotic systems with gRCS															
Heartbeat protocol															
Telemetry protocol: position, orientation and message status															
Navigation protocol															
Tx/Rx commands															
Tx/Rx checklist															
Tx/Rx list of alarms															
Tx/Rx alarms status															
Tx/Rx list of high-level actions															
Offline integration between inspection/robotics data and DMS (through DDHL)															
gRCS pre-mission data															
gRCS post-mission data															
mRCS pre-mission data															
mRCS post-mission data															
D7.1 preparation															
Robotic Engine Integration															
gRCS Integration															
	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15

Proposed planning for integrations

- Integration of autonomous robotic systems with gRCS
  - Heartbeat protocol (gRCS → robotic systems) [Week 1]
  - Telemetry protocol: position, orientation and message status (robotic systems → gRCS) [Weeks 2-3]
  - Navigation protocol [Weeks 4-6]
    - Tx/Rx waypoint list (gRCS → robotic systems)
    - Tx/Rx set current waypoint (gRCS → robotic systems)
    - Tx/Rx progress of the waypoint list (robotic systems → gRCS)
  - Tx/Rx commands (gRCS → robotic systems) [Week 7]
  - Tx/Rx checklist (robotic systems → gRCS) [Week 8]
  - Tx/Rx list of alarms (robotic systems → gRCS) [Week 9]
  - Tx/Rx alarms status (robotic systems → gRCS) [Week 10]
  - Tx/Rx list of high-level actions (robotic systems → gRCS) [Week 11]

Proposed planning for integrations

- Offline integration between inspection/robotics data and DMS (through DDHL)
  - gRCS data
    - Pre-mission (DDHL ✉ gRCS) [Weeks 1-5]
    - Post-mission (gRCS ✉ DDHL) [Weeks 6-11]
  - Mission-related data
    - Pre-mission (DDHL ✉ mRCS) [Weeks 1-5]
    - Post-mission (mRCS ✉ DDHL) [Weeks 6-11]

Proposed planning for integrations

- Integration of DMS with Visualization portal based on logged data in DMS database (obtained from robotic systems experiments)

  - Using data (from laboratory, controlled environments or real scenarios) obtained from robotic systems experiments
    - Since it needs this data to really start testing the integration, it is possible that cannot be started until November
    - No problem since this integration is part of D7.2 [M26] -> February 2022

  - To be leaded by INLECOM (leader of T7.3)
    - Please provide a plan for integration before next GM
    - Also please provide a proposal for D7.2 index before October 15th

Proposed contents for D7.1

- D7.1 : Robotics system integration (first version) [24]
- Integration of all the robotics vehicles with the autonomous functionalities, through robotic engine, and the generic robot control station. The report will include the experiments performed at laboratory or controlled environments to validate this integration.
- Two main sections
  - Robotic Engine integration (ETHZ, WTR, APPLUS, SINTEF, RBNK, CATEC, USE)
  - gRCS integration (CATEC)
- Led by CATEC, due on 31st December 2021
- **First version on 1st December**

Contents

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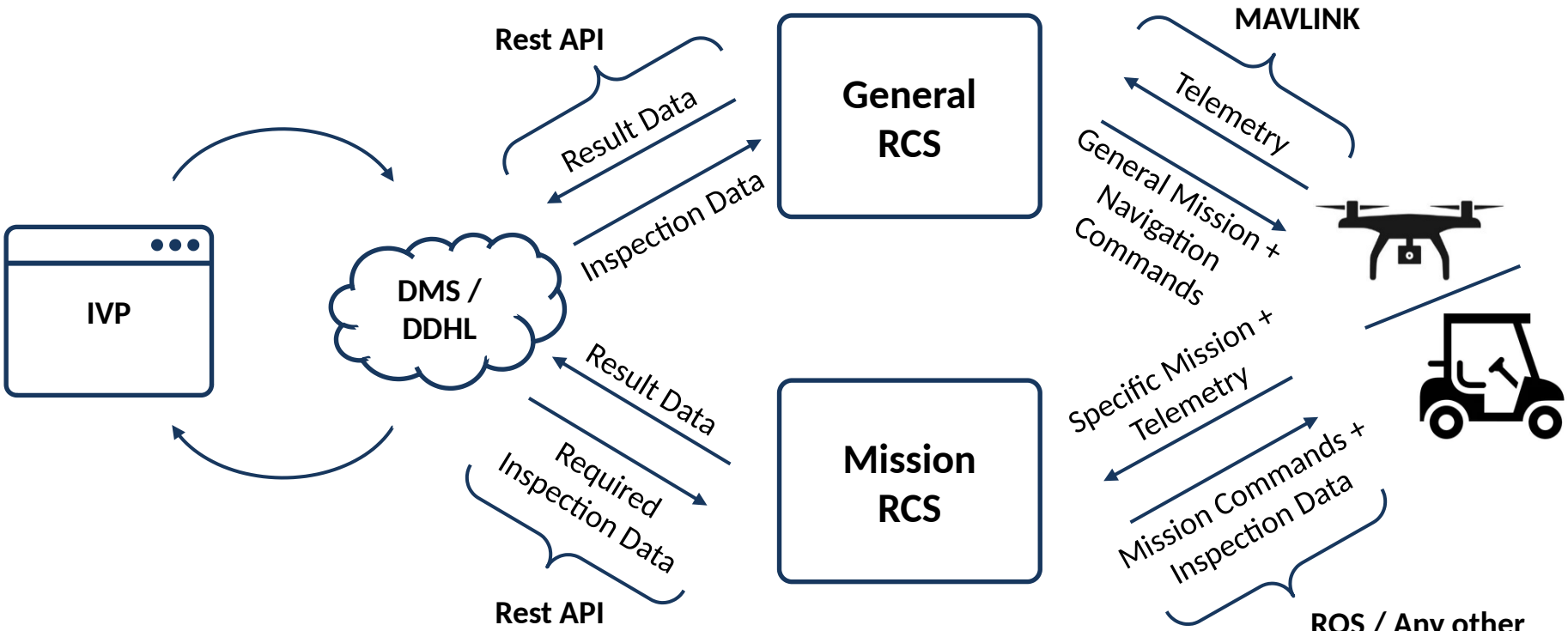
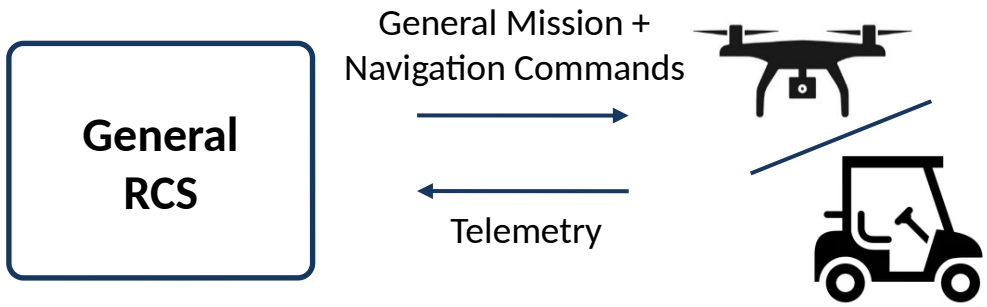
Mission System Workflow

Mission System Workflow - General Overview



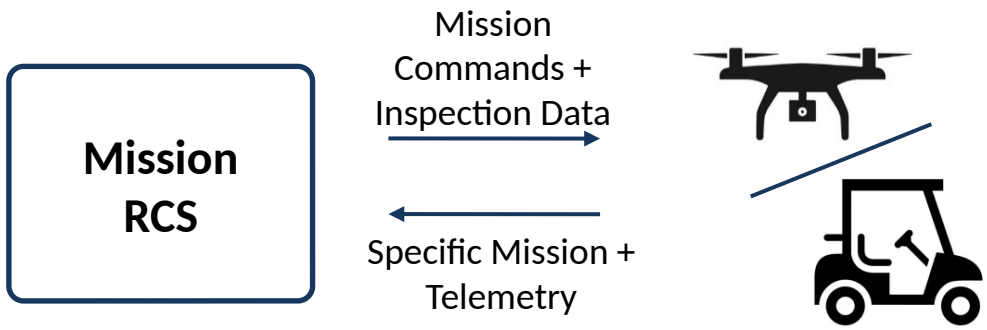
Integration gRCS ↔ Robotic System



- Communication with **Mavlink**
- gRCS creates and sends a **general mission** with waypoints and inspection points/areas
- gRCS sends **general commands** (*ex: start/finish/pause mission*)
- Robot sends **telemetry** continuously (*ex: position + velocity*)
- Robot sends **mission status updates** (*ex: goal and reached task*)
- Robot sends **ACKs** for each command

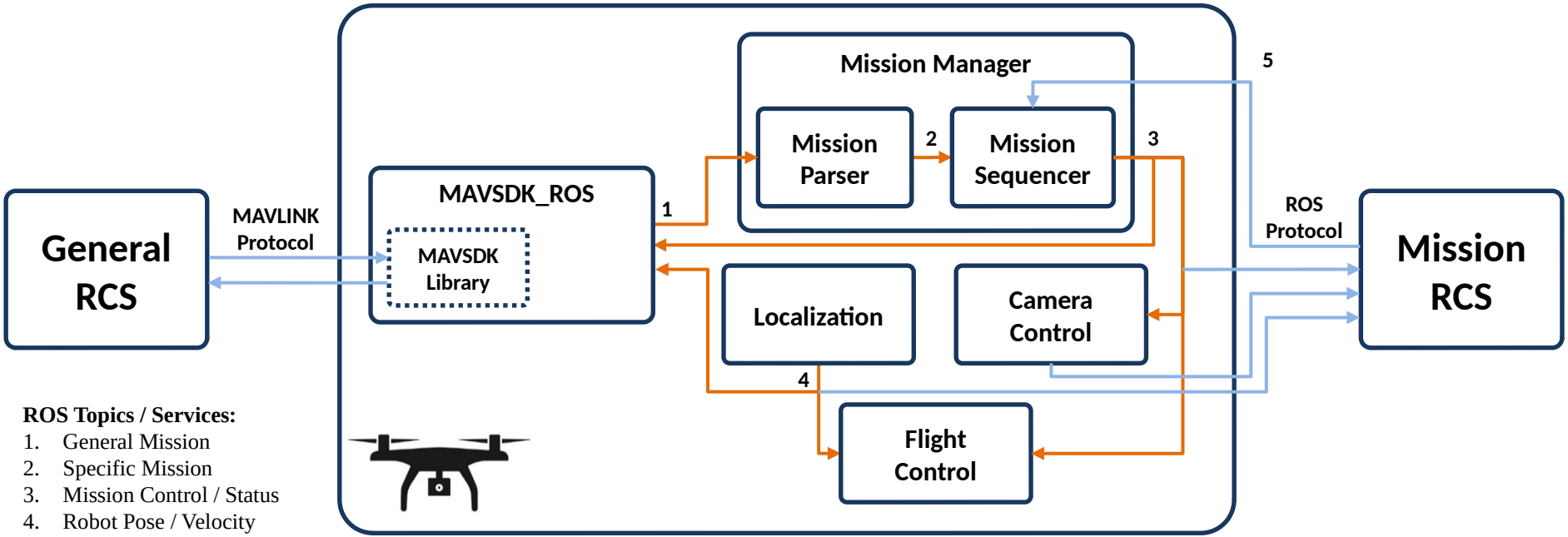
* Full interaction items at proposed plan for integration

Integration Robotic System ↔ Mission RCS



- Communication with **ROS or any other protocol**
- mRCS could send **mission specific commands** (*ex: take a picture*)
- mRCS sends **required inspection data** (*ex: viaduct pointcloud*)
- Robot sends **specific mission** once is automatically calculated
- Robot sends **mission status updates** (*ex: goal and reached waypoint*)
- Robot sends **telemetry** continuously
- Robot sends **specific sensor** status (*ex: taken picture*)

Implementation Example: AERO-CAM
Visual Viaduct Inspection Use case

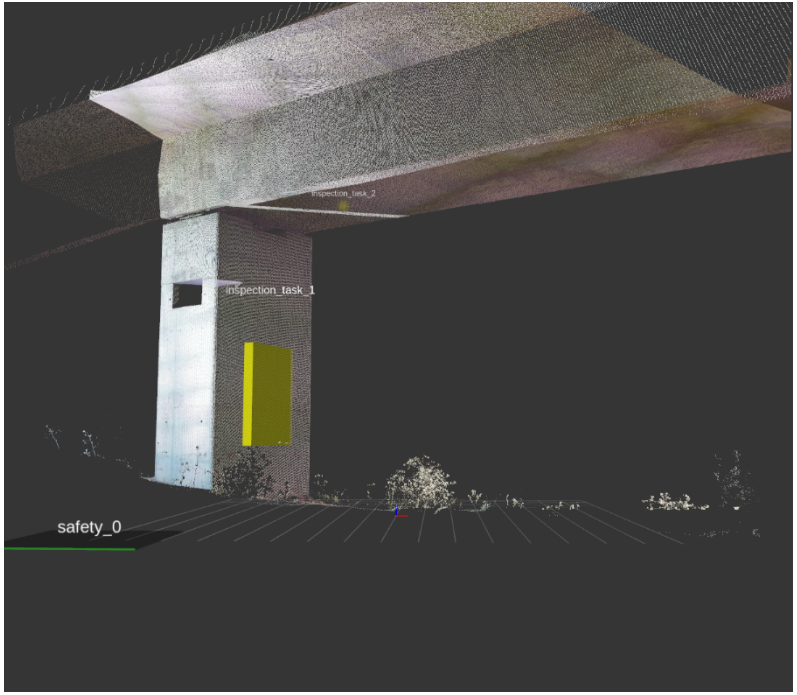


ROS Topics / Services:

1. General Mission
2. Specific Mission
3. Mission Control / Status
4. Robot Pose / Velocity
5. Mission Commands

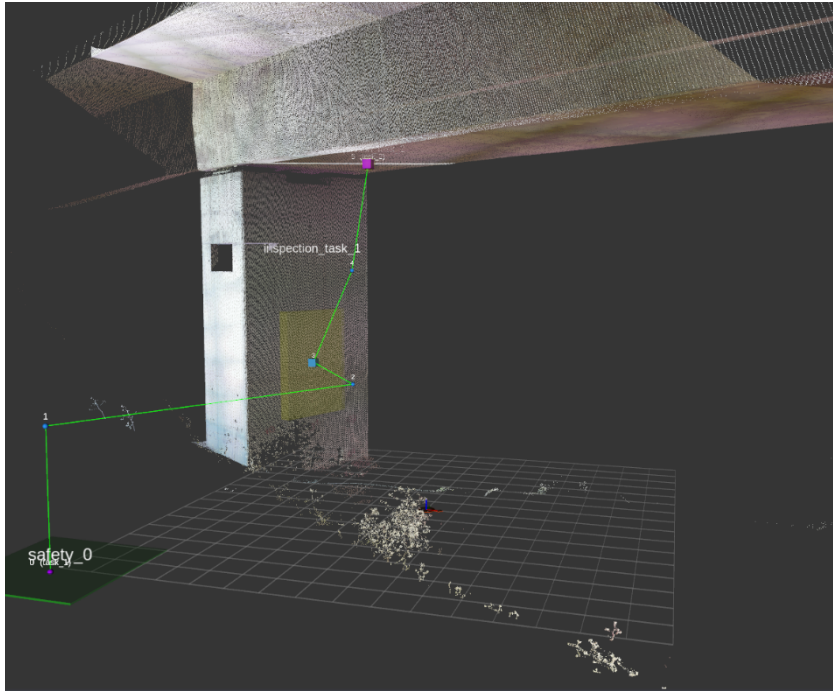
Implementation Example: AERO-CAM

Inspection Plan from the DDHL in the gRCS



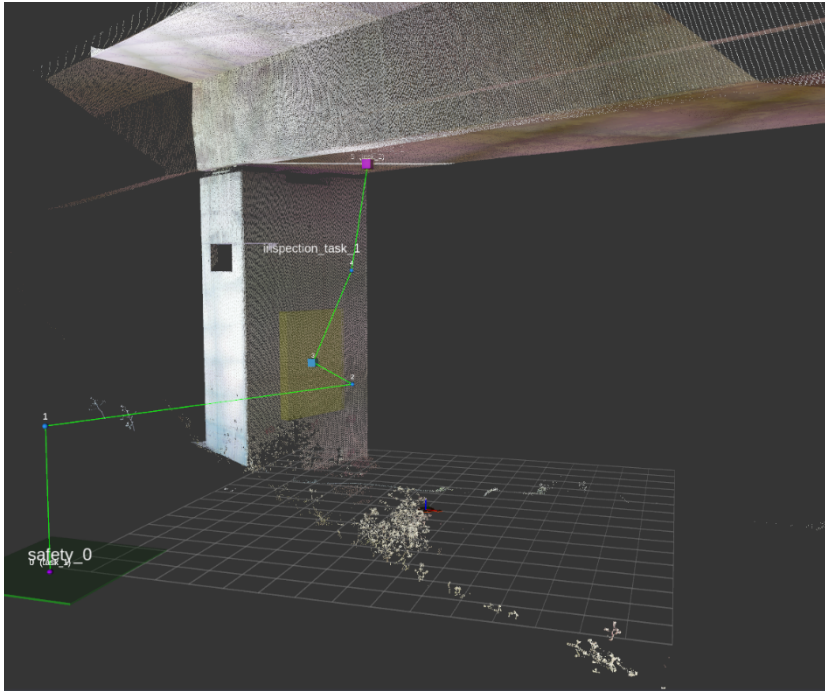
General Mission creation by the operator

General Mission in the gRCS



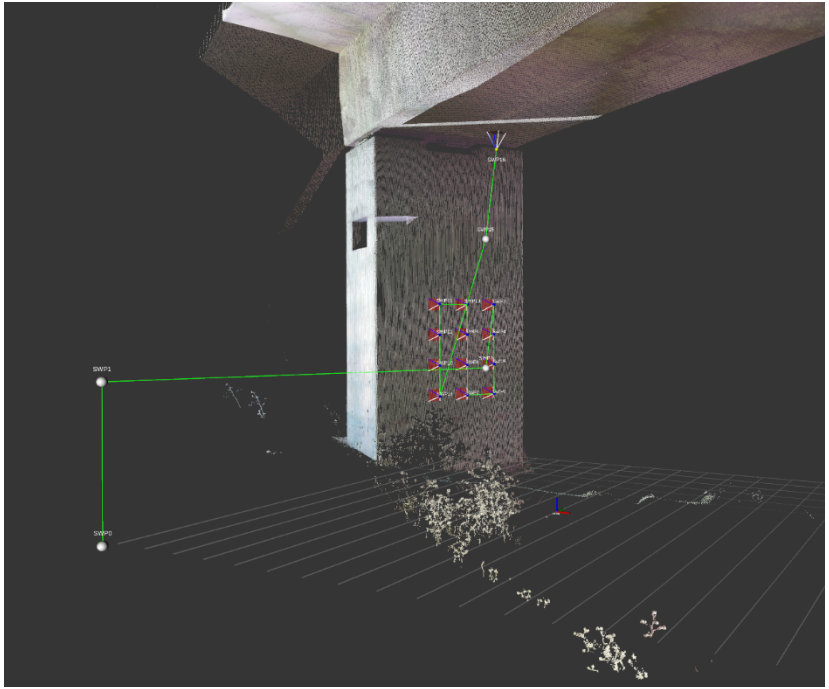
Implementation Example: AERO-CAM

General Mission in the gRCS



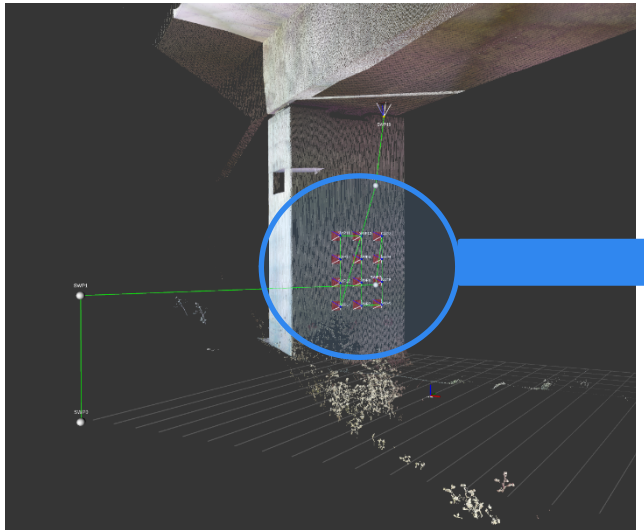
Specific Mission autonomous creation by AERO-CAM Mission Parser

Specific Mission in the mRCS

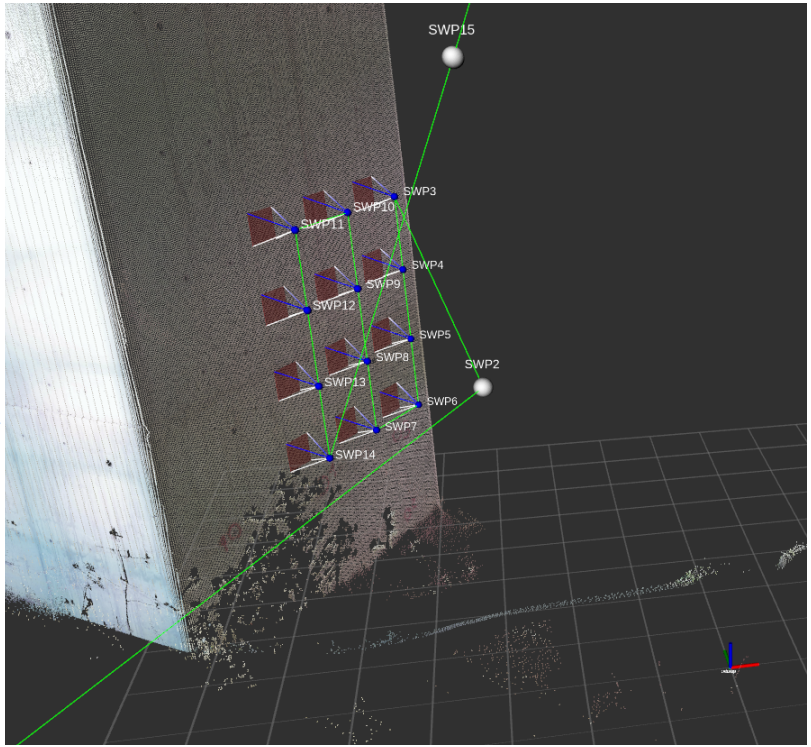


Implementation Example: AERO-CAM

Specific Mission in the mRCS



Specific Mission
in detail



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THANK YOU!

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