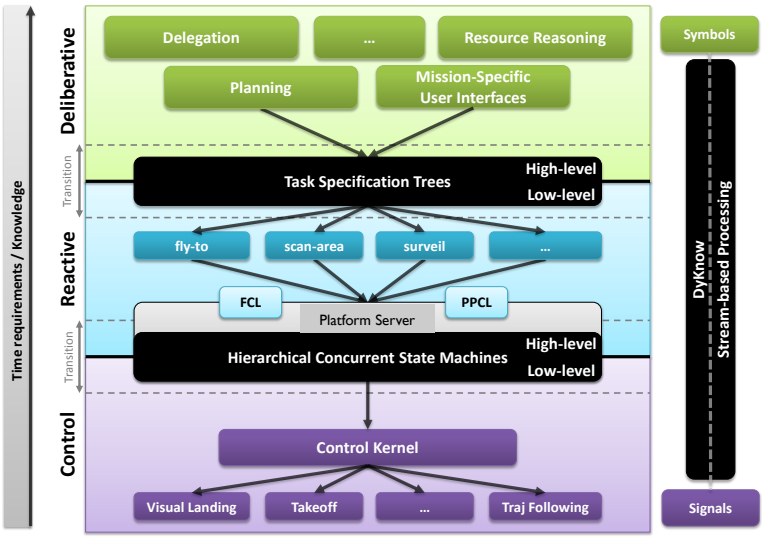
HDR3C: New Generation Hybrid Software Architecture



Supports Interacting Cyber-Physical Systems

HDRC3: A Distributed Hybrid Deliberative/Reactive Architecture for Unmanned Aircraft Systems
P. Doherty, J. Kvarnström, M. Wzorek, P. Rudol, F. Heintz, G. Conte
Handbook of Unmanned Aerial Vehicles
K.P. Valavanis, G.J. Vachtsevanos (eds.), Springer Science (2014)

LINKÖPING UNIVERSITY

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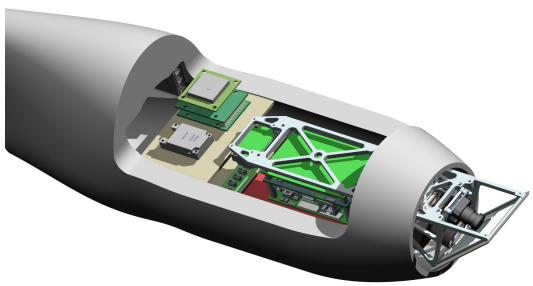
Hawks: ETH TechPod

SEVENTH FRAMEWORK PROGRAMME

It has a wingspan of 2.60m, classic T- tail configuration and is equipped with one propeller.
The sensor pod and PX4 auto-pilot are mounted inside the fuselage. TechPod is hand-launchable.



SensorPod

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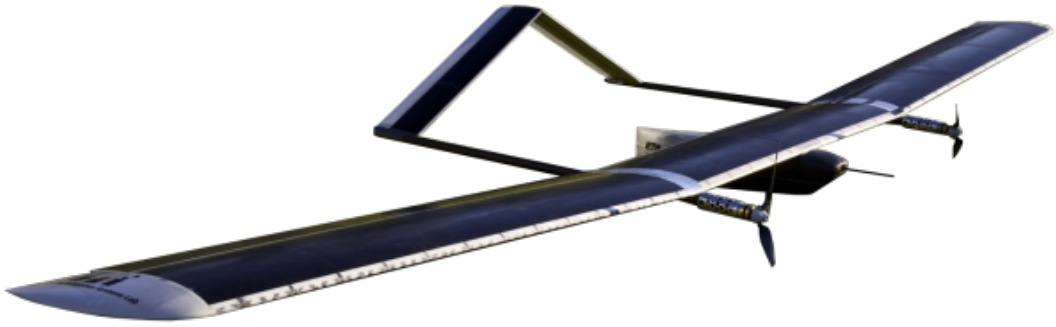
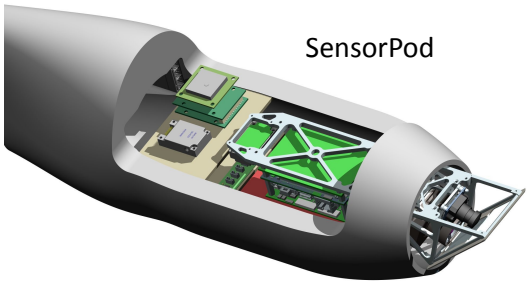
Hawks: ETH SenseSoar



It has a wingspan of 3.1m. With its solar panels it is able to generate an electric power of around 140 W and shows high autonomy in the sense of flight time. SenseSoar is hand-launchable and carries the sensor pod inside the fuselage.

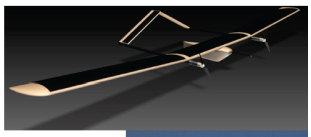


Application

Search and Rescue in unfriendly and possibly hostile environments (weather) through use of Human-Robotic Teams

Trials in:
Italien and Swiss Alps
Summer/Winter Scenarios

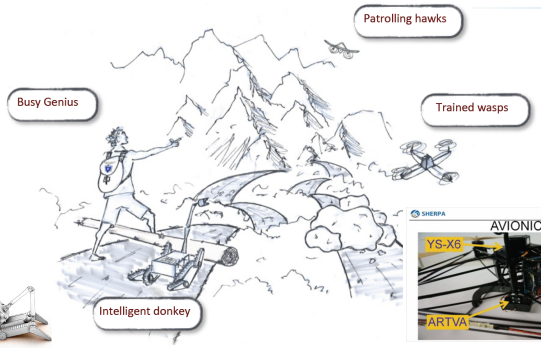
ETH Solar Powered Fixed Wing

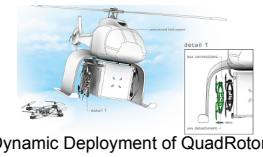


LiU Autonomous RMAX Helicoptor

SHERPA TEAM

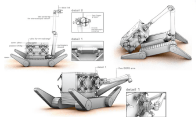
Club Alpino Italiano





Dynamic Deployment of QuadRotor systems from the RMAX

Bologna University & ASLATECH
Robust Autonomous Quadrotor System



University of Twente & Bluebotics

Ground Robot

Universität Bremen · ETH · UNIVERSITY OF TWENTE. · KATHOLIEKE UNIVERSITEIT LEUVEN · Linköping University INSTITUTE OF TECHNOLOGY · create · BLUEBOTICS Mobile Robots at Your Service · ASLA TECH

Collaborative Missions (LiU & ETH)

Mission 1:
Collaborative 3D Mapping (RMAX, TechPod)

Mission2:
Interactive Image Collection (TechPod)

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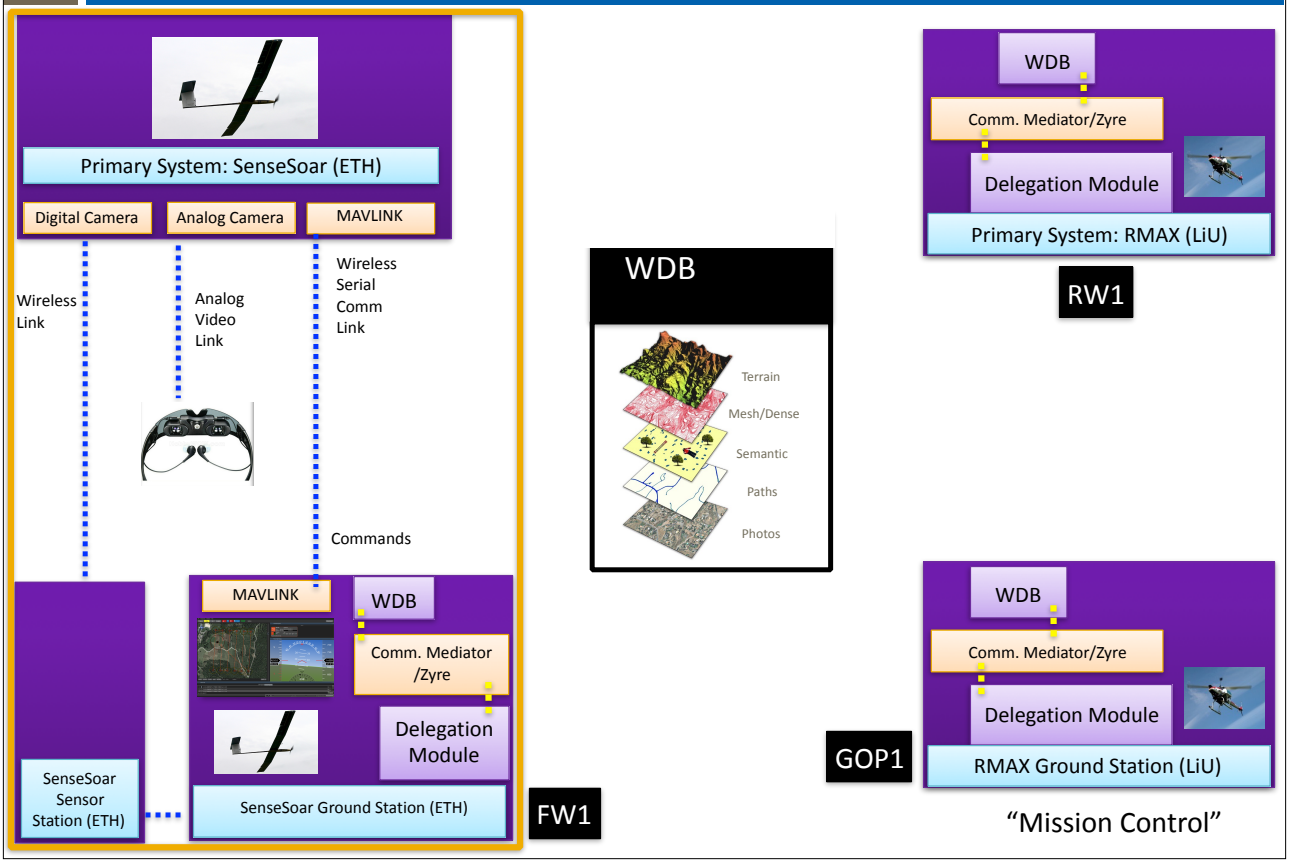
Experimental Overview



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Experimental Set-up

Northside view

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Mission 1
Generate a 3D map of a larger area

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Mission1A: TechPod/SenseSoar Scan Region

Monday: senseSoar

Friday: TechPod

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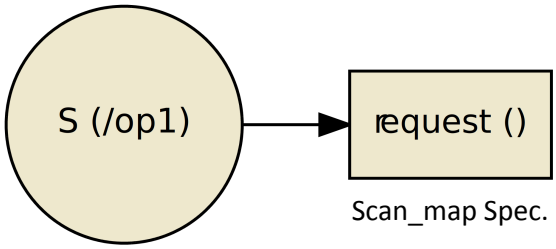
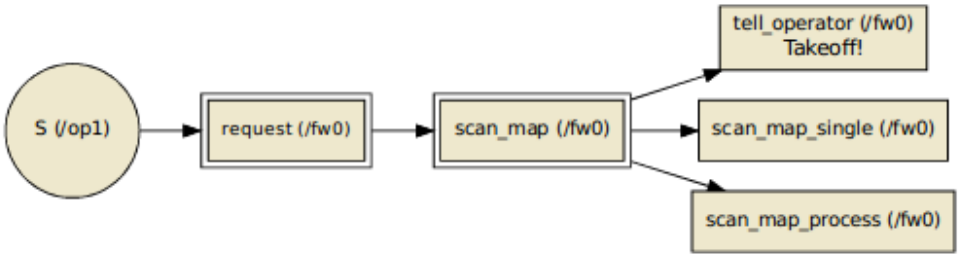
Mission 1A: TechPod/SenseSoar Scan Region

Goal Request TST



Scan_map Spec.

Generated Plan TST



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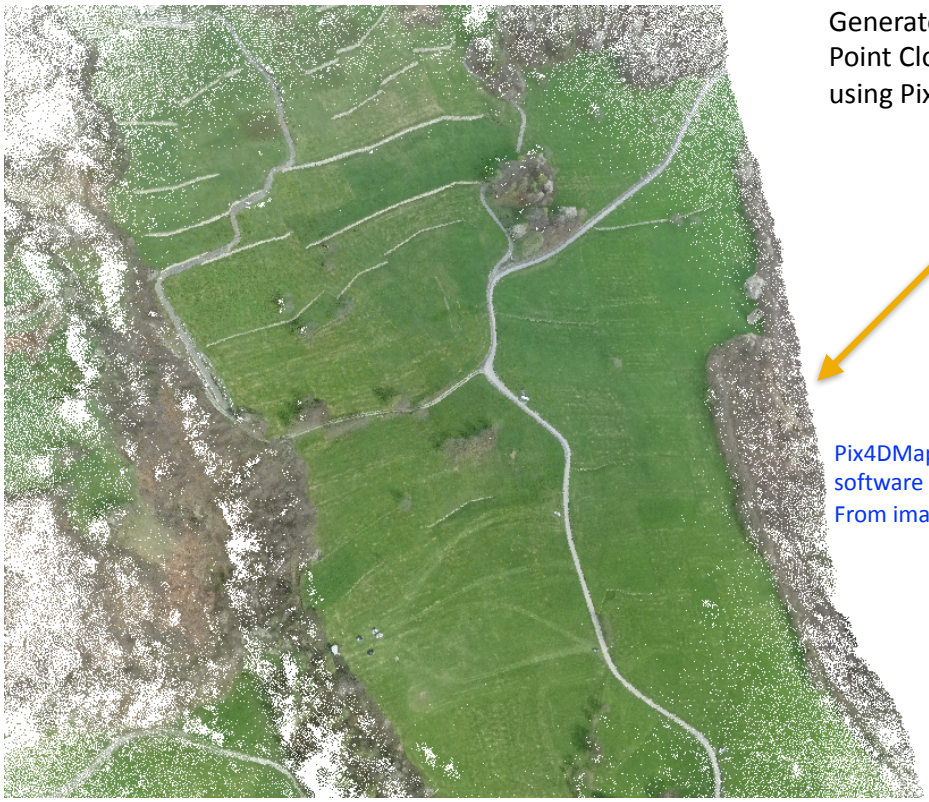
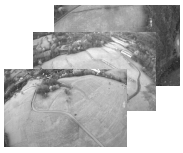
SensorSoar Generated PointCloud from Images



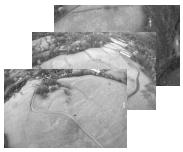
Generated
Point Cloud
using Pix4D



Pix4DMapper - is a professional software system for Drone mapping. From images to 2D and 3D models.

SensorSoar Generated OrthoPhoto from Images

OrthoPhoto with mosaiking using Pix4D



Mission 1B: RMAX Scan Region

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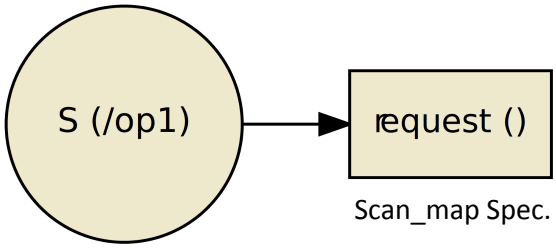
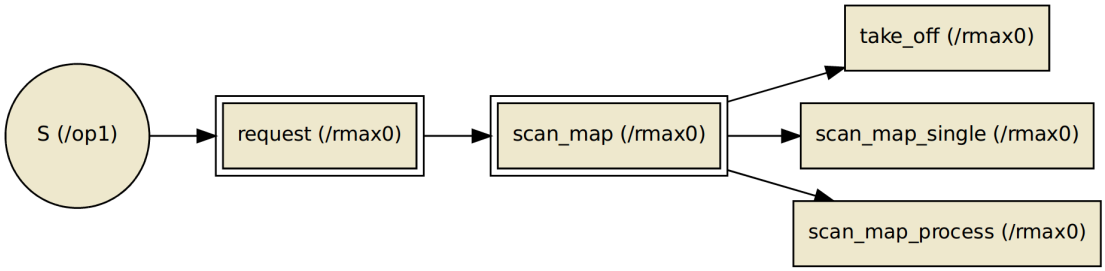
Mission 1B: RMAX Scan Region

Goal Request TST



Scan_map Spec.

Generated Plan TST



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Mission 2A: RMAX Scan

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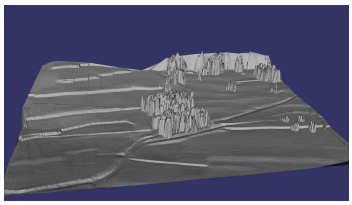
RMAX Generated (vector) TIN DEM

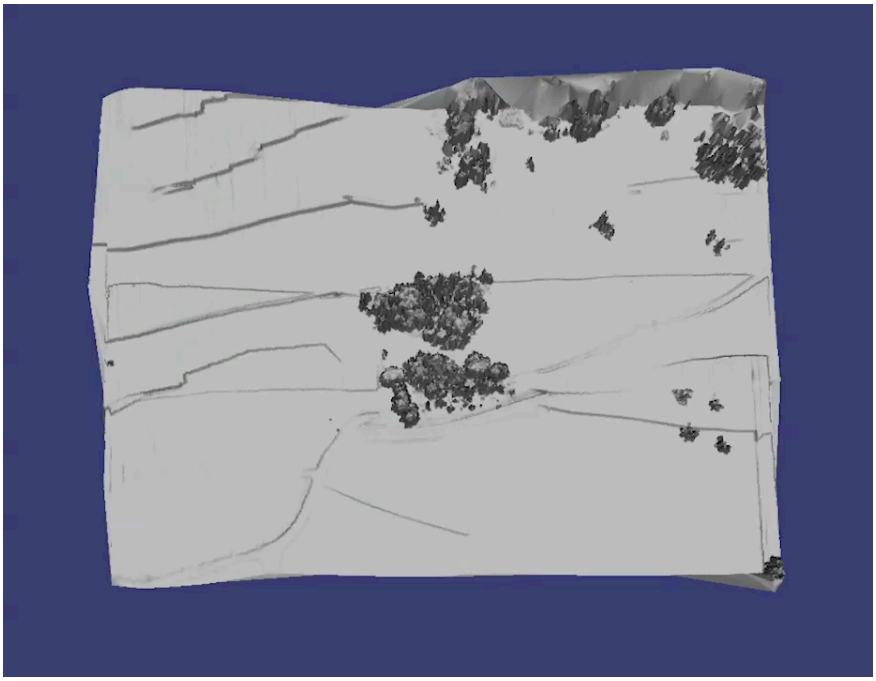
SEVENTH FRAMEWORK PROGRAMME

Post-Processing LAZ file direct from WDB

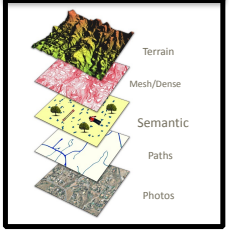
LASTool

TIN = Triangular Irregular Model





SHERPA WM



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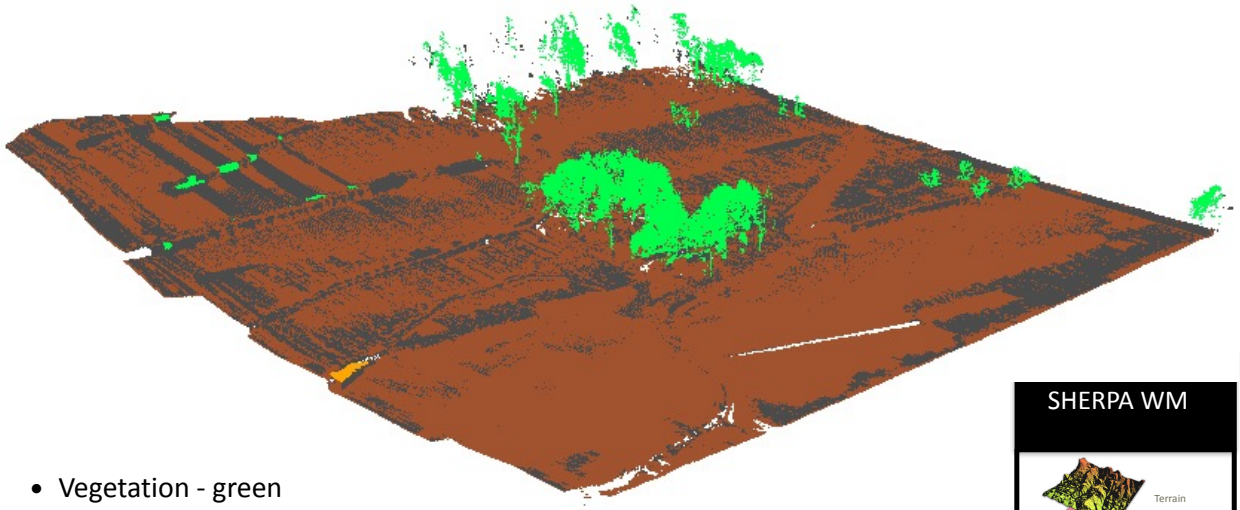
Semantic Classification

SEVENTH FRAMEWORK PROGRAMME

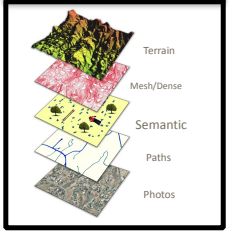
Color-coded semantic classification

LasTool



- Vegetation - green
- Terrain - brown
- Gray - unclassified

SHERPA WM



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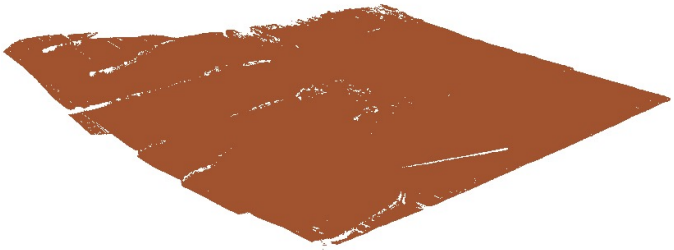
Semantic Classification

Color-coded semantic classification

LasTool



- Vegetation - green
- Terrain - brown
- Gray - unclassified

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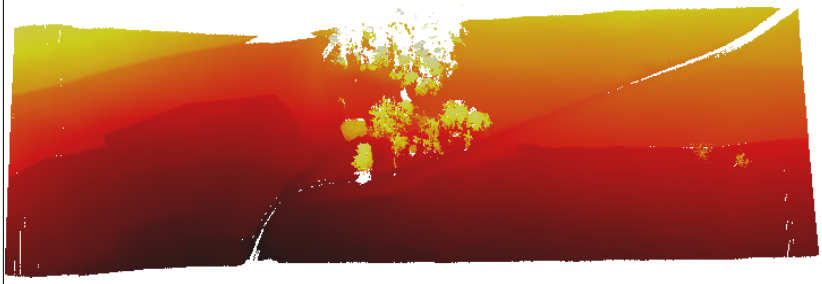
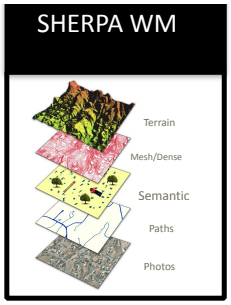
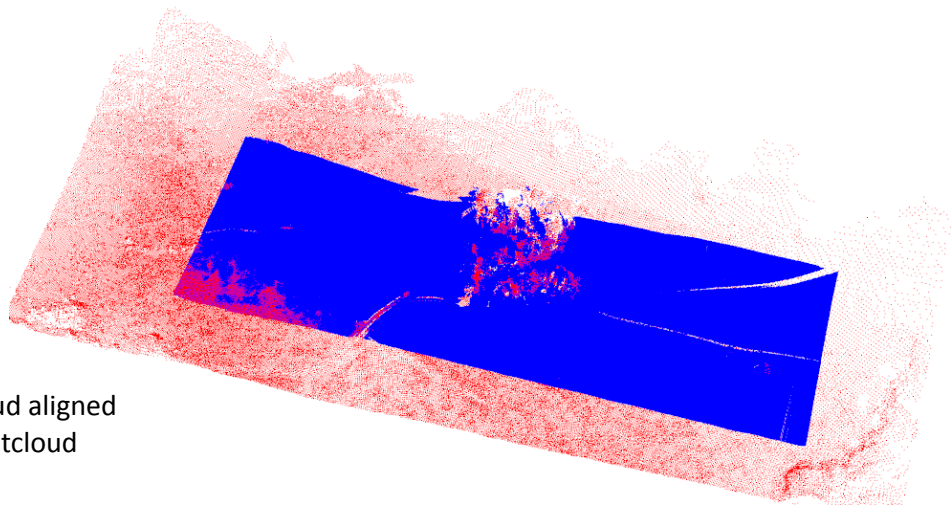
3D MAP FUSION



First Strip of Point-cloud generated by the RMAX LIDAR, including some trees. The pointcloud is colored by height.





RMAX strip of Point-cloud aligned with the senseSoar pointcloud using Pix4D++ software.

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Mission 2
Collect surveillance photos of selected locations

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Mission 2: Image collection with ETH TechPod

Choose arbitrary number of locations where an image should be collected

A TST goal request is generated from the interface input.

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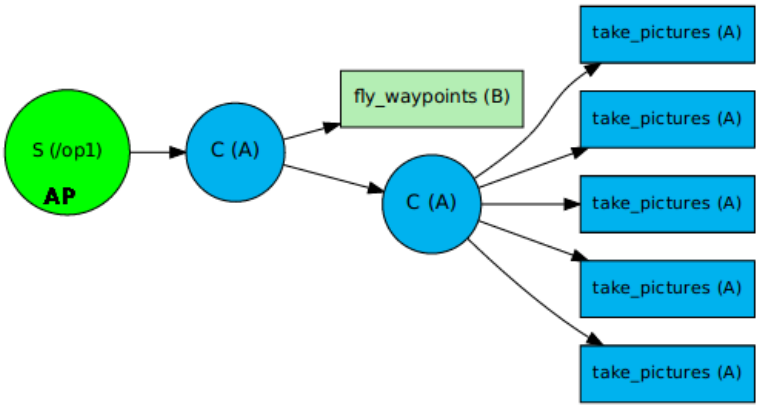
TST Goal Request

Mission control attempts to delegate this TST to the ETH TechPod.



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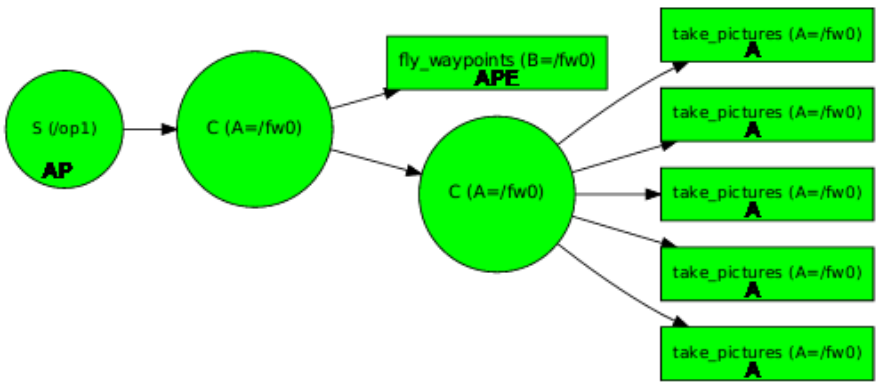
Agent Allocated TST

Successful allocation results in an instantiated TST: A=/fw0, A=B

The ETH system has internally generated a path plan based on the locations input to the interface.

fly_waypoints is run concurrently with **take_pictures** tasks. The appropriate take_pictures task is fired when the platform is over the proper location.



Abortable
Pausable
Enoughable

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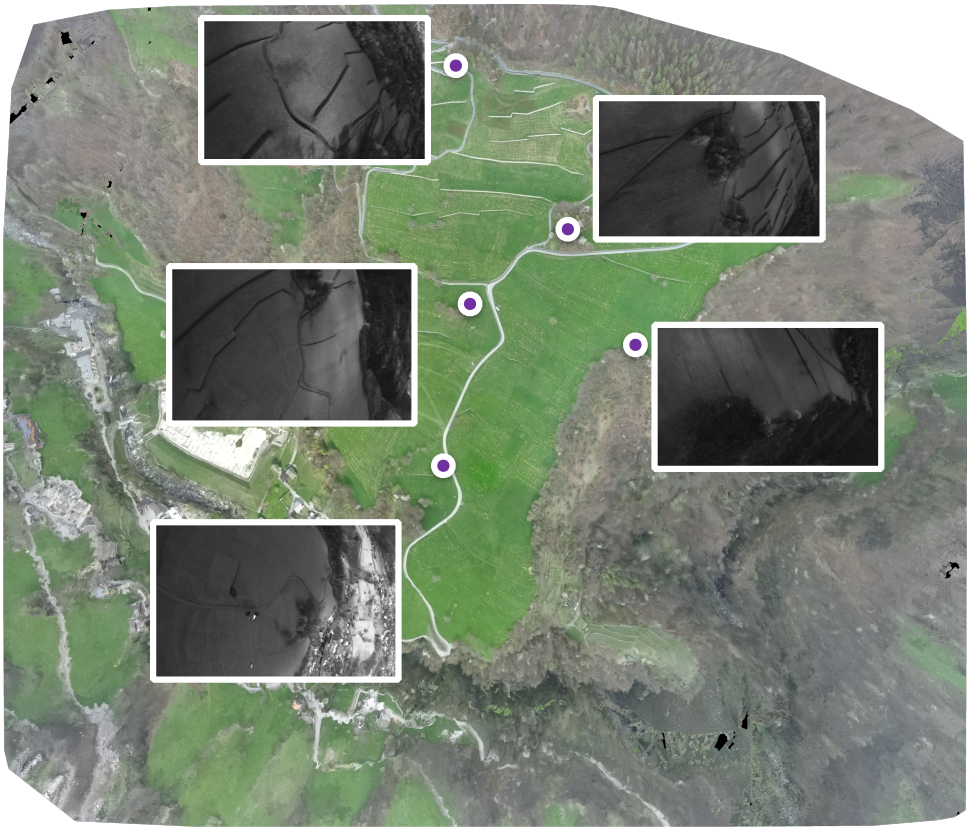
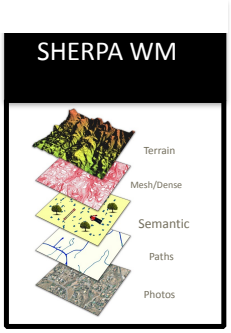
Mission 3: Results

The mission concludes with the TechPod loitering near its base station and downloading target images that are then stored in the WDB for later access.





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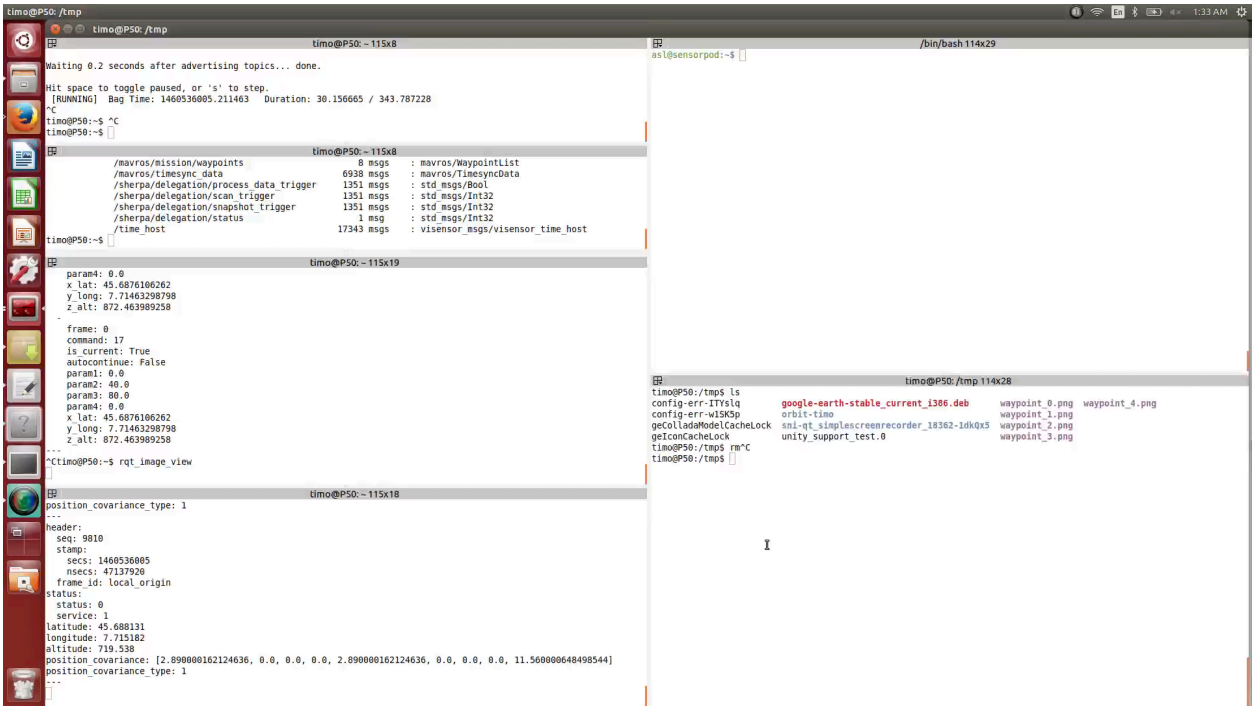
Live Mission



Takeoff
Waypoint trigger mode

Delegation Process
Waypoints uploaded

Loiter
Images Downloaded

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Teaser for Future Work: Deployment

Automated delivery and loading of an RMAX with Medical or other supplies

Automatic deployment at a specified site

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Jonas Kvarnström
Tommy Persson
Cyrill Berger

ETH Zurich

Igor Gilitschenski
Thomas Stastny
Timo Hinzmann
++

Conclusions

LiU/AIICS Robot Team