Iceland Liechtenstein Norway grants

The final conference of the POLNOR-LEADER project

Mission Planning for Adaptive Pollution Sampling - Examples

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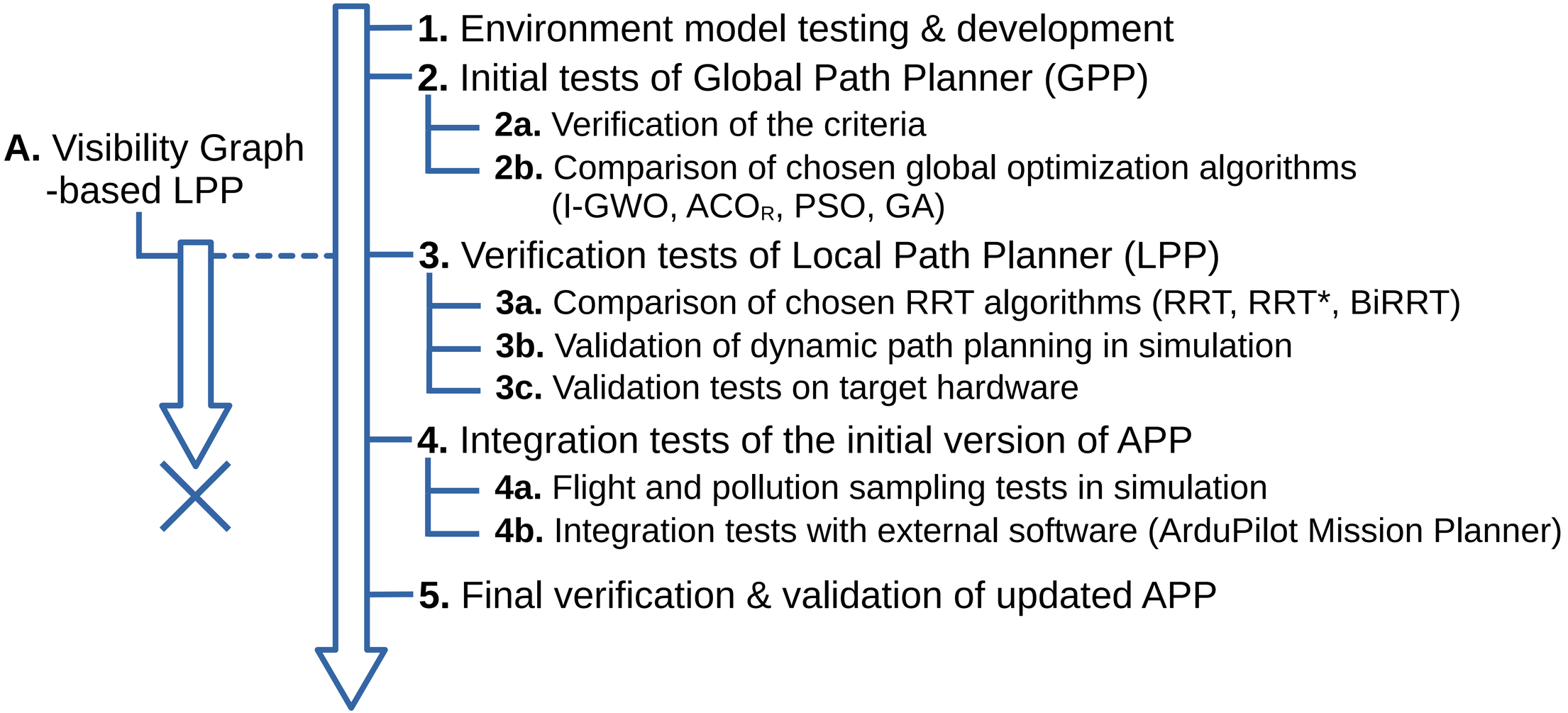
SkyTech eLab

Gliwice, 26.06.2024

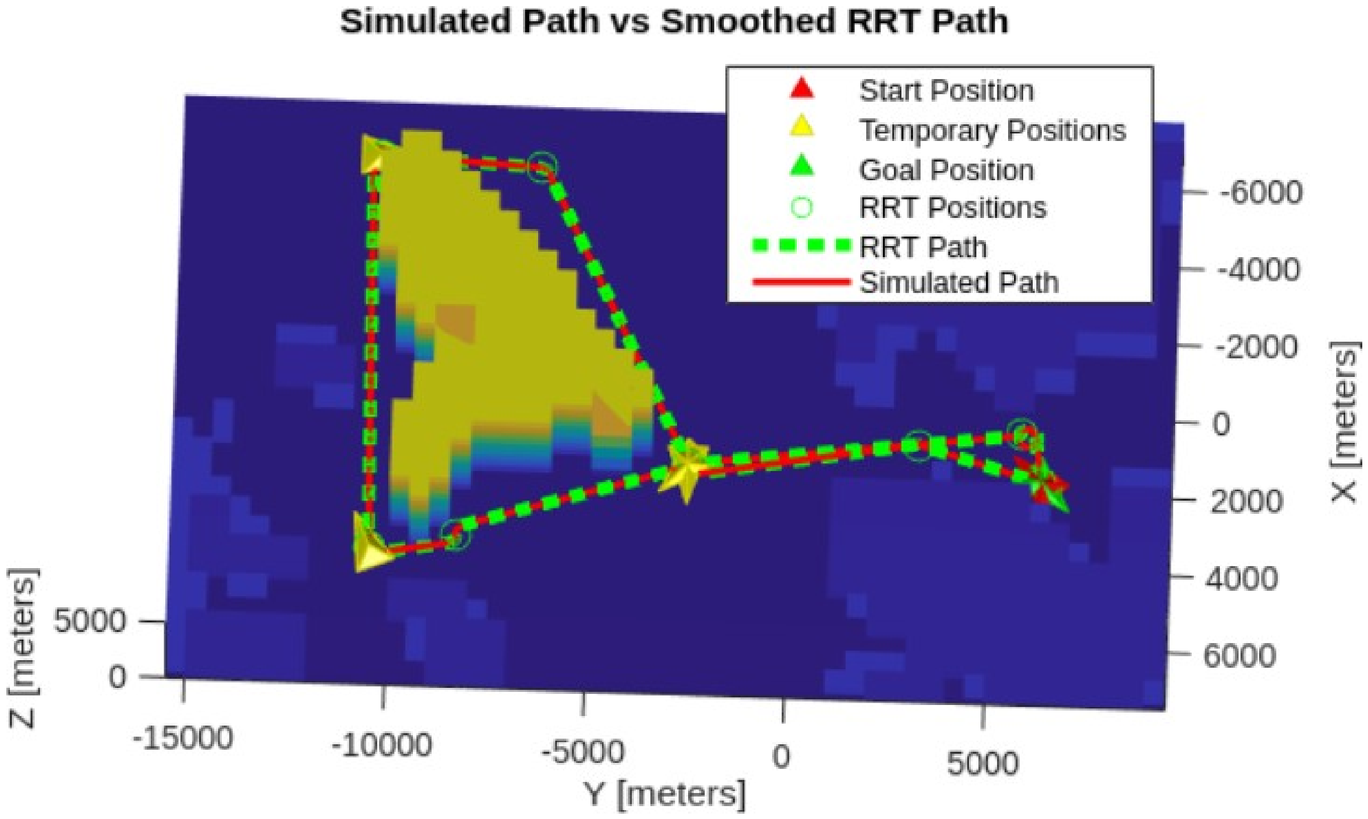
Agenda

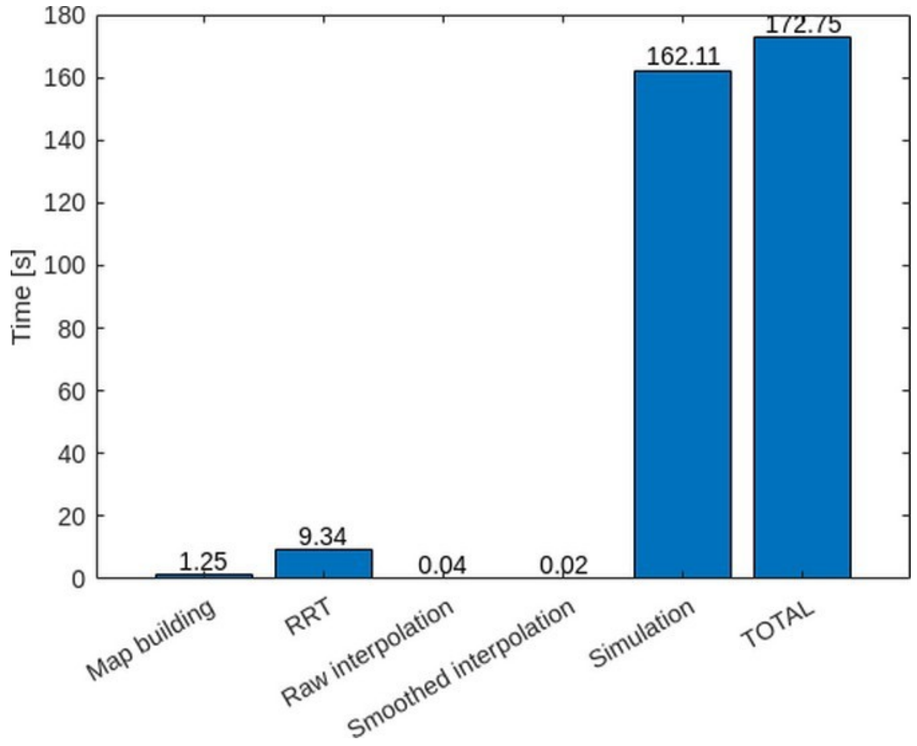
1) Research timeline
2) Early concepts
3) Alternative approach
4) Final solution
5) Summary & conclusions

Research timeline



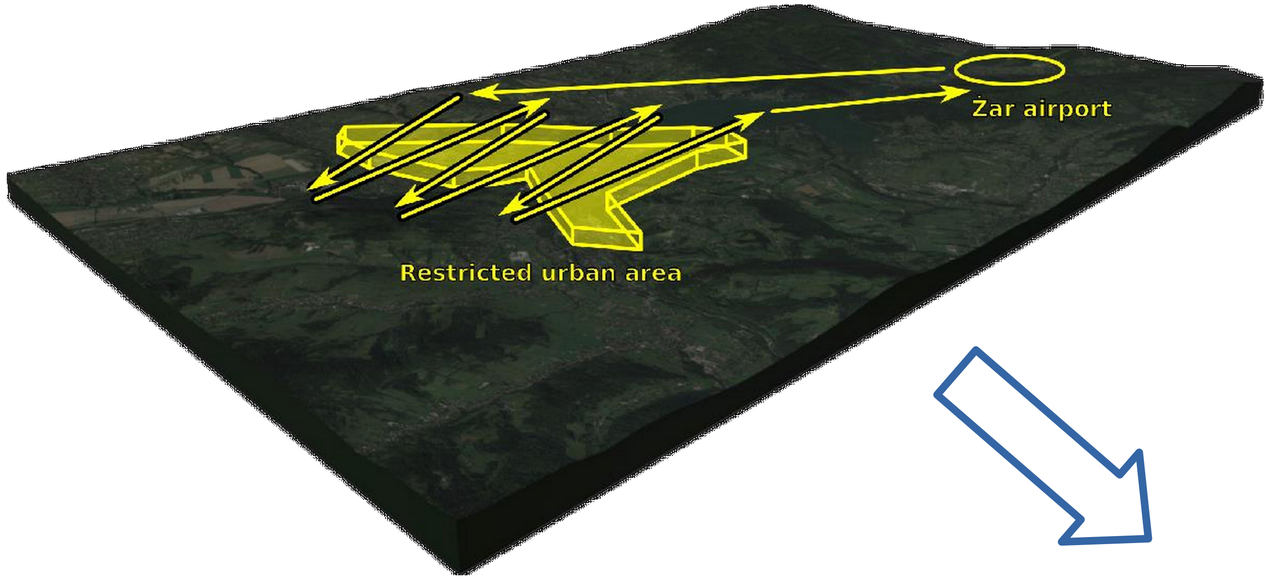
Early concept: Simple collision avoidance

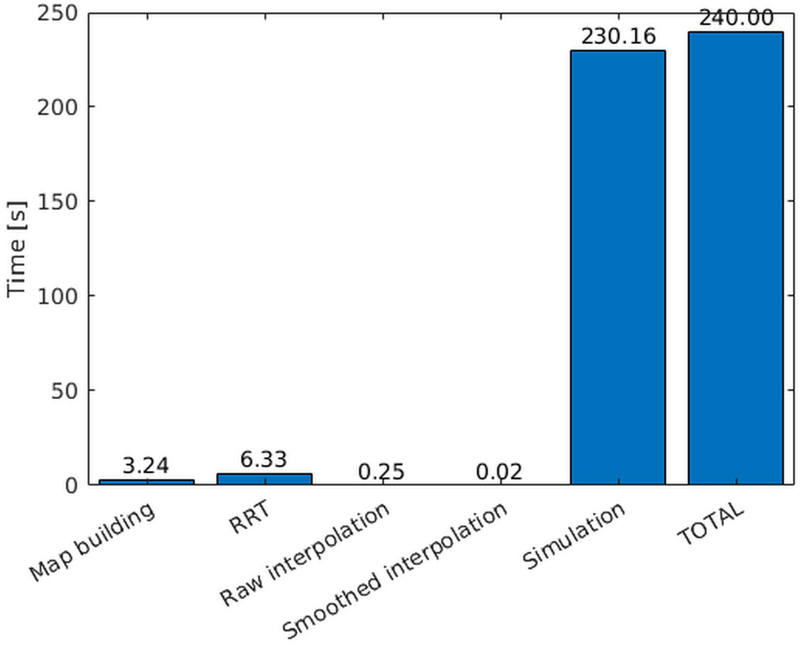


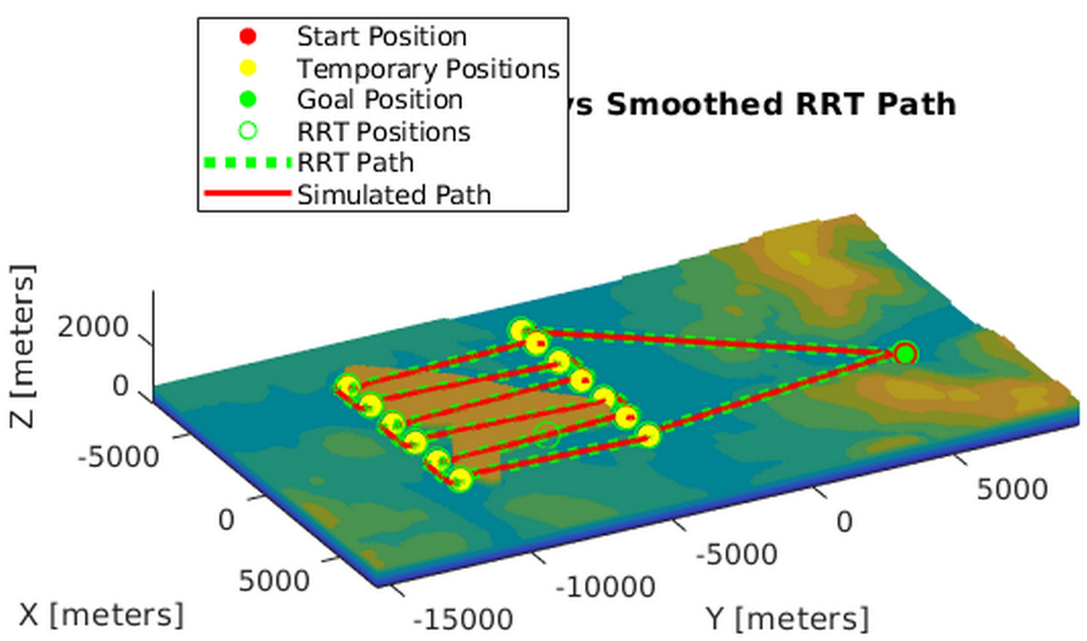


		Computation Time [s]	Path Length [m]	Path Nodes	Smoothness
1	**Raw RRT**	9.3731	5.7901e+04	33	3.3882e-06
2	**Smoothed RRT**	9.3510	5.3493e+04	10	2.5550e-07
3	**Simulated**	162.1081	5.3493e+04	'N/A'	'N/A'

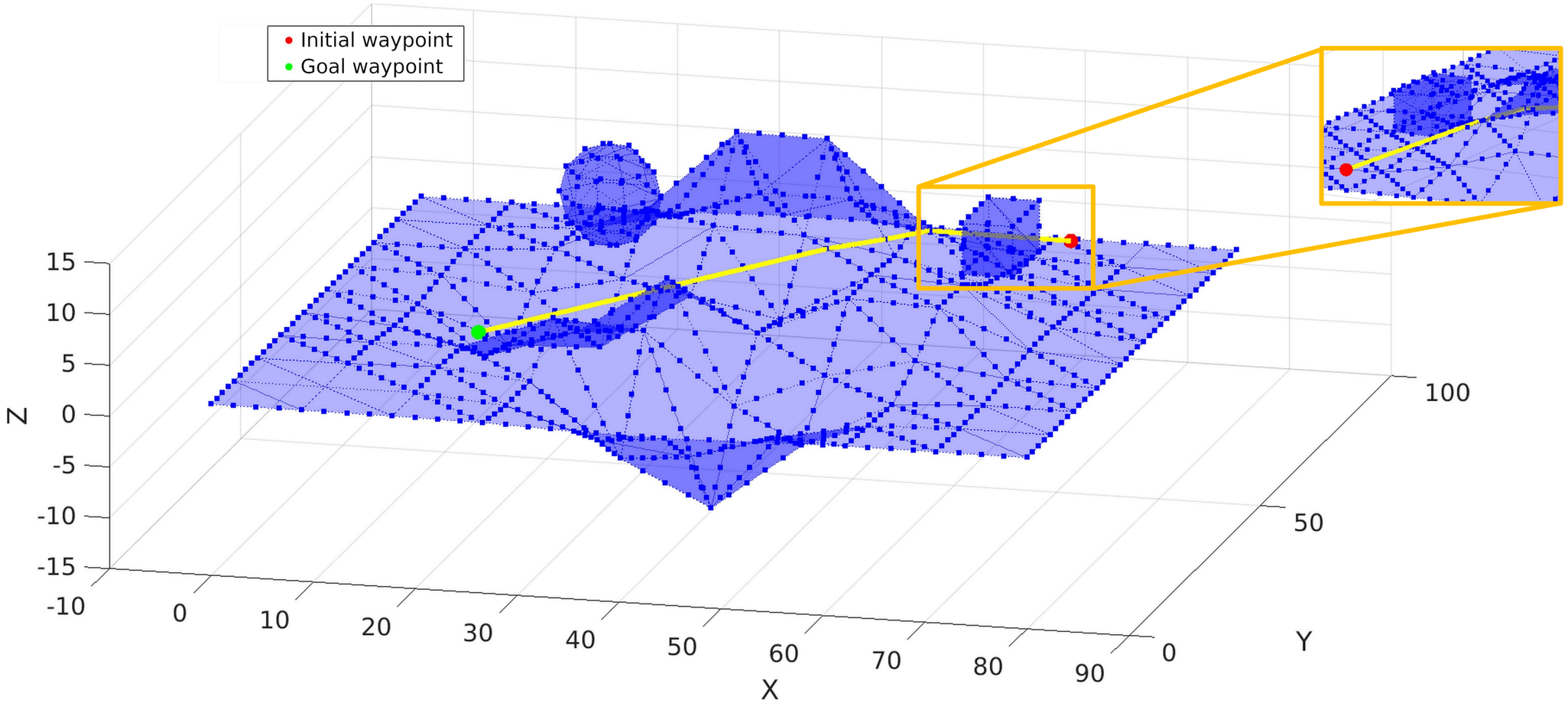
Early concept: Horizontal profiling



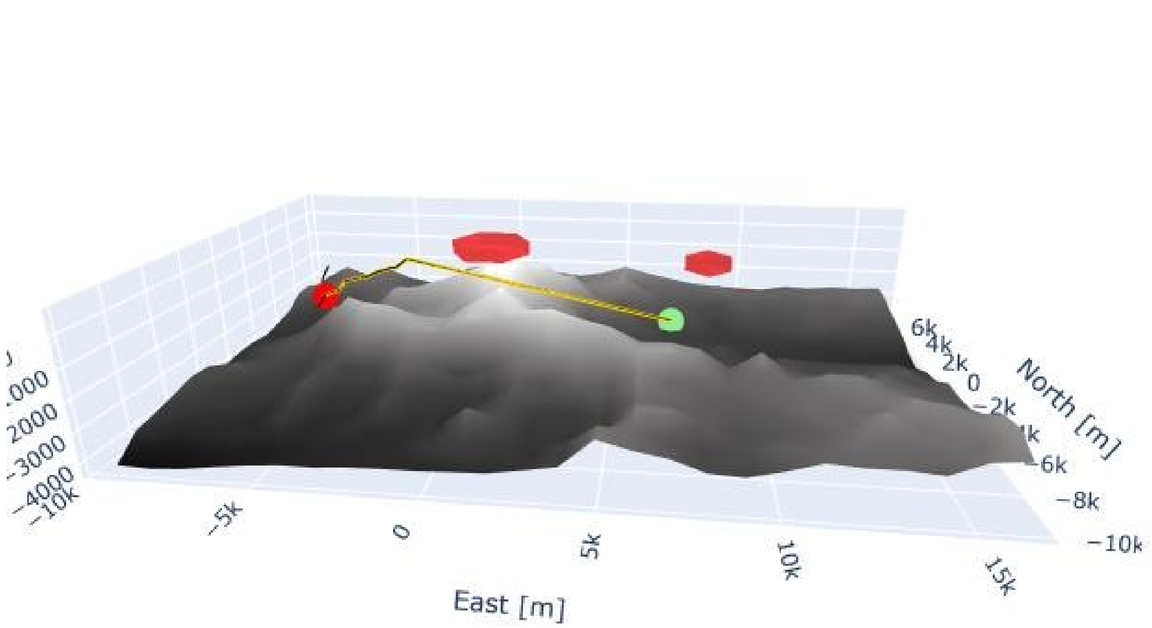




Alternative: 3D Visibility Graph LPP in MATLAB

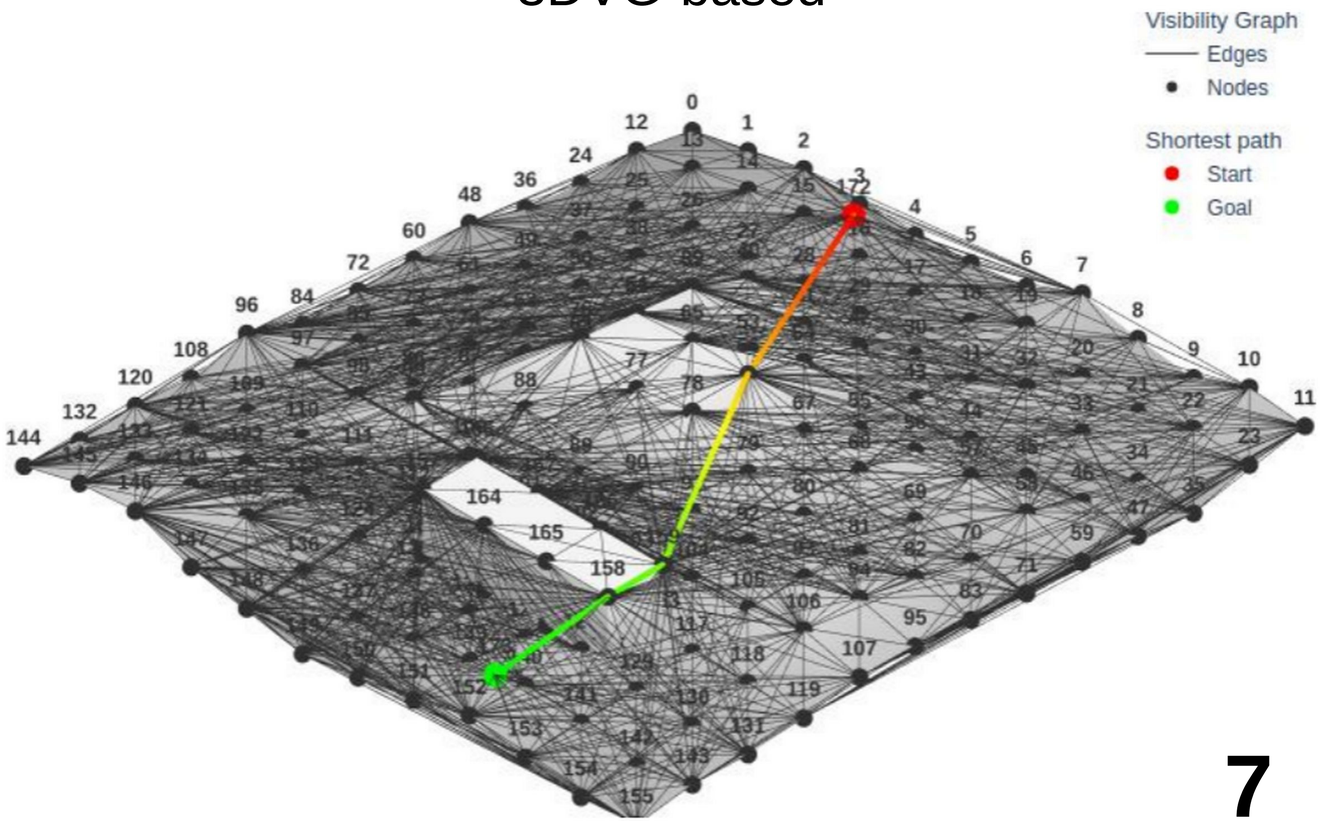


Embedded: LPP tests on Raspberry Pi 4B (Python)

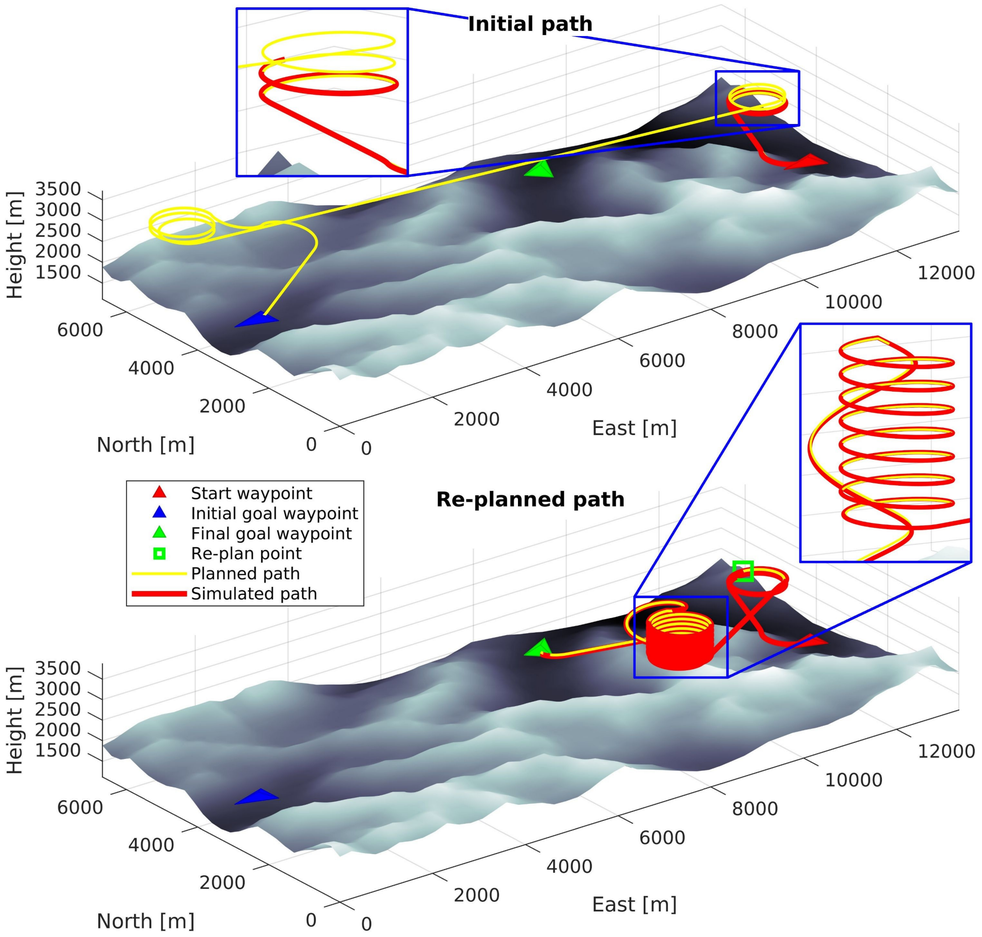


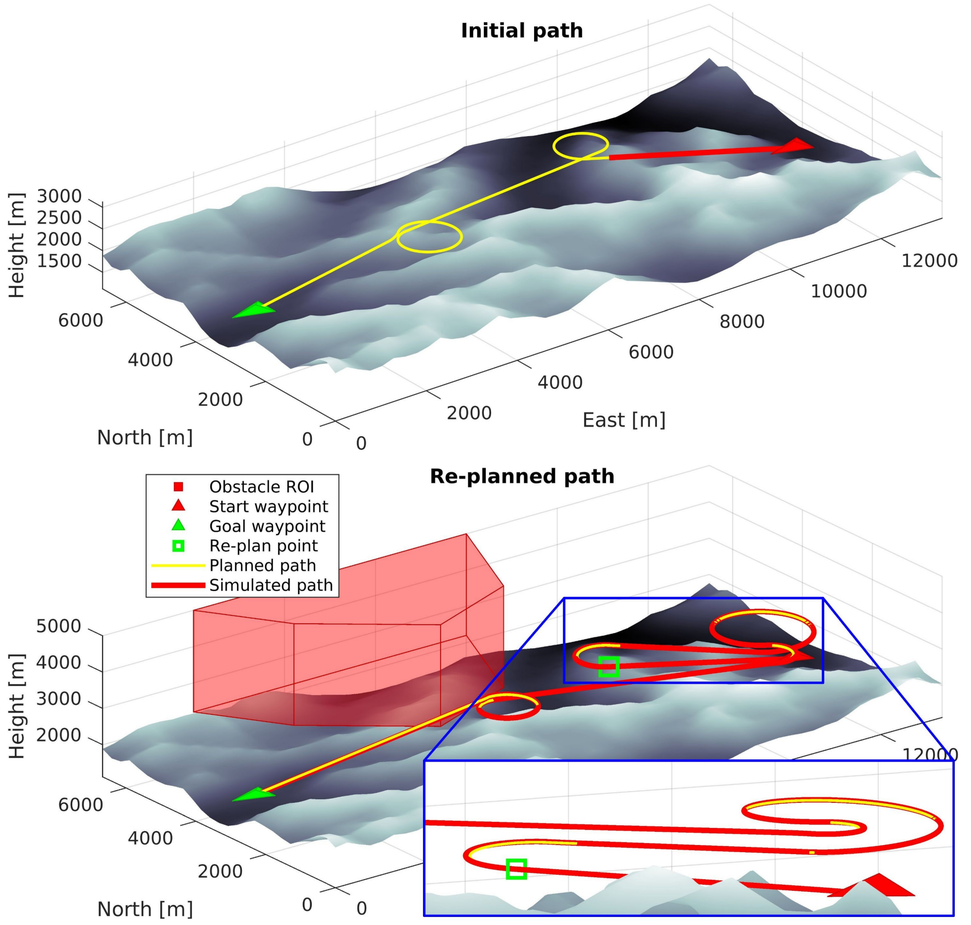
RRT-based

3DVG-based

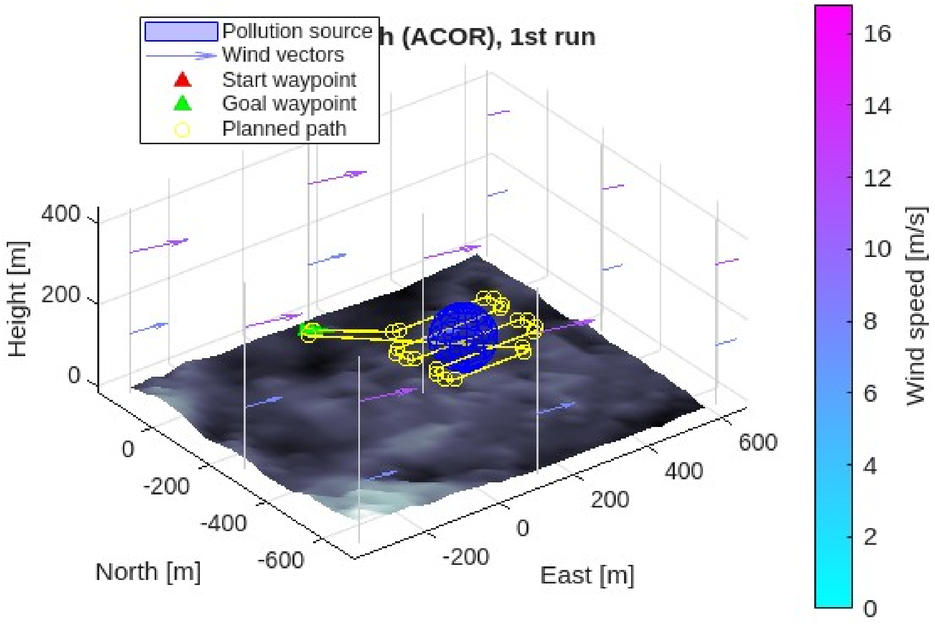


Final: Dynamic local re-planning

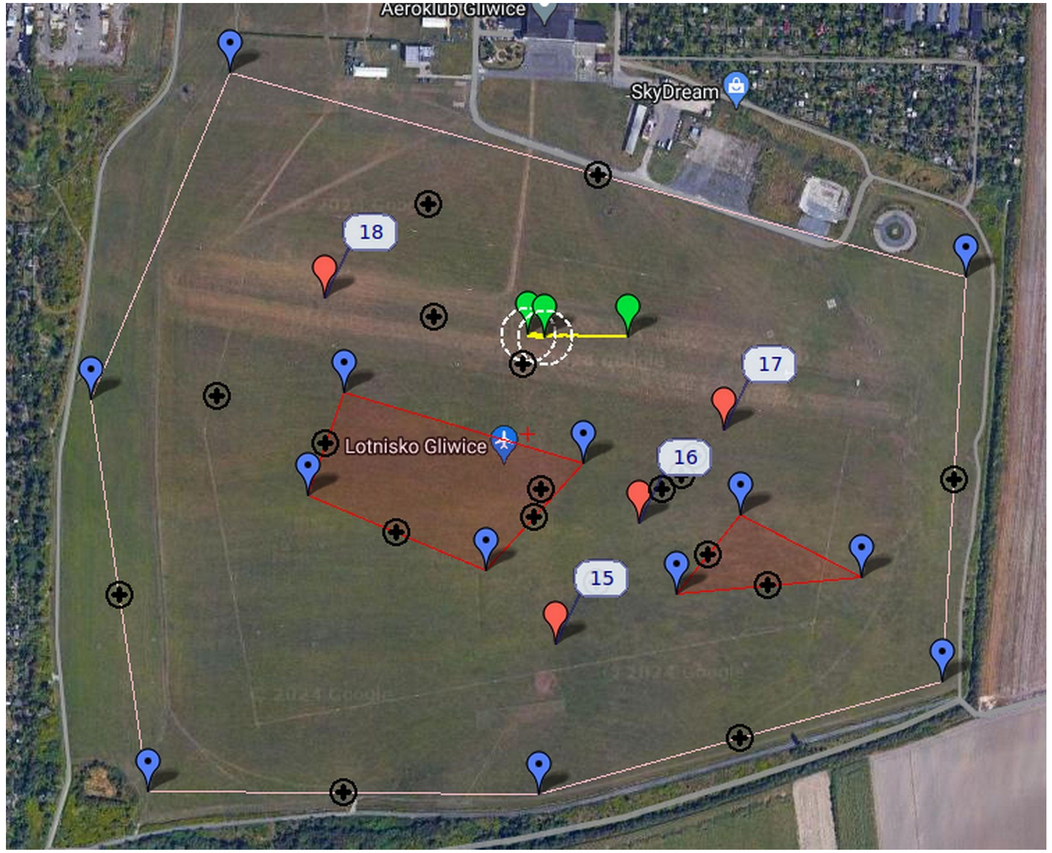


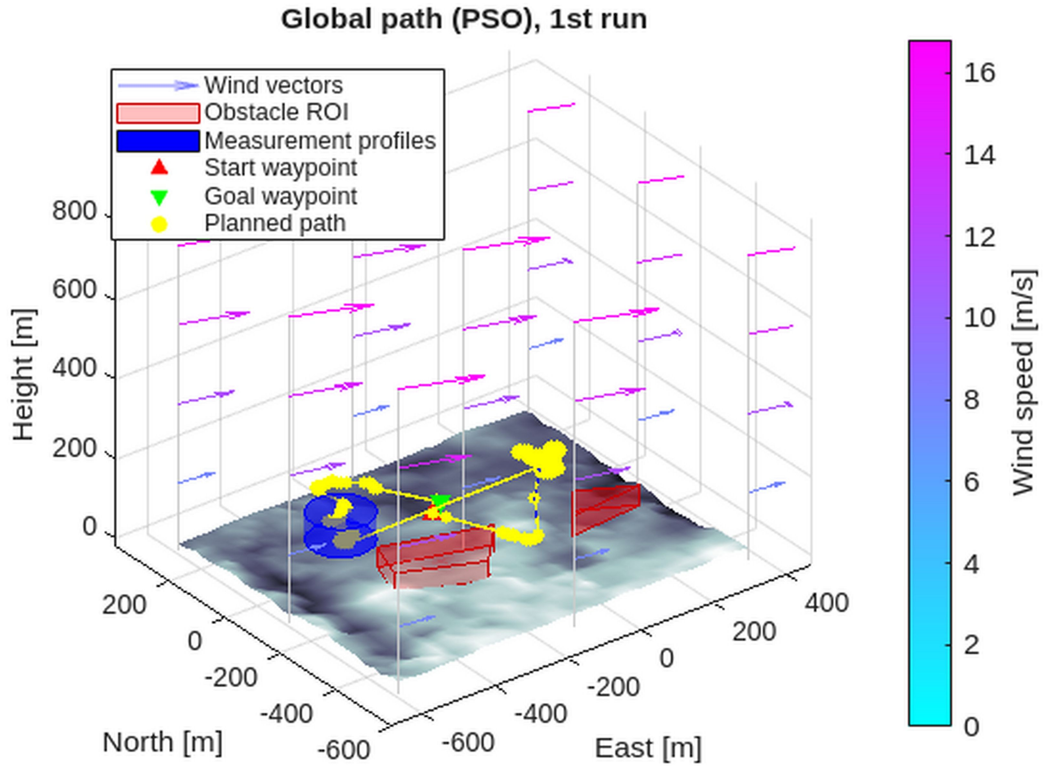


Final: APP integration with TS110



Final: APP integrated with Mission Planner





Summary & conclusions

- APP was successfully integrated with ArduPilot Mission Planner and validated on a real UAV
- Elevation map is more efficient than 3D occupancy map
- Visibility Graphs present an interesting option, but in their current 3D implementation are computationally intensive
- Stochastic RRT algorithms are fast, but in limited time provide non-repeatable solutions
- ACO_R & PSO were found optimal for global planning (multi-criteria optimization) and RRT* for local planning

Related publications

- **Kosior** M.: *Model-Based Adaptive Path Planning Algorithm for Unmanned Aerial Vehicles*. PhD thesis. Silesian University of Technology, Faculty of Mechanical Engineering, 2022.
- **Kosior** M., **Przystałka** P., **Panfil** W.: *Wind Forecast Map for Adaptive Path Planning with an Unmanned Aerial Vehicle*. Metody komputerowe - 2022. Student scientific conference. Silesian University of Technology, 2022, pp. 69-72.
- **Kosior** M.: *A Glimpse into the Adaptive Path Planner for a UAV*. Proceedings of the 3rd Polish Conference on Artificial Intelligence. Gdynia Maritime University, 2022, pp. 94-77.

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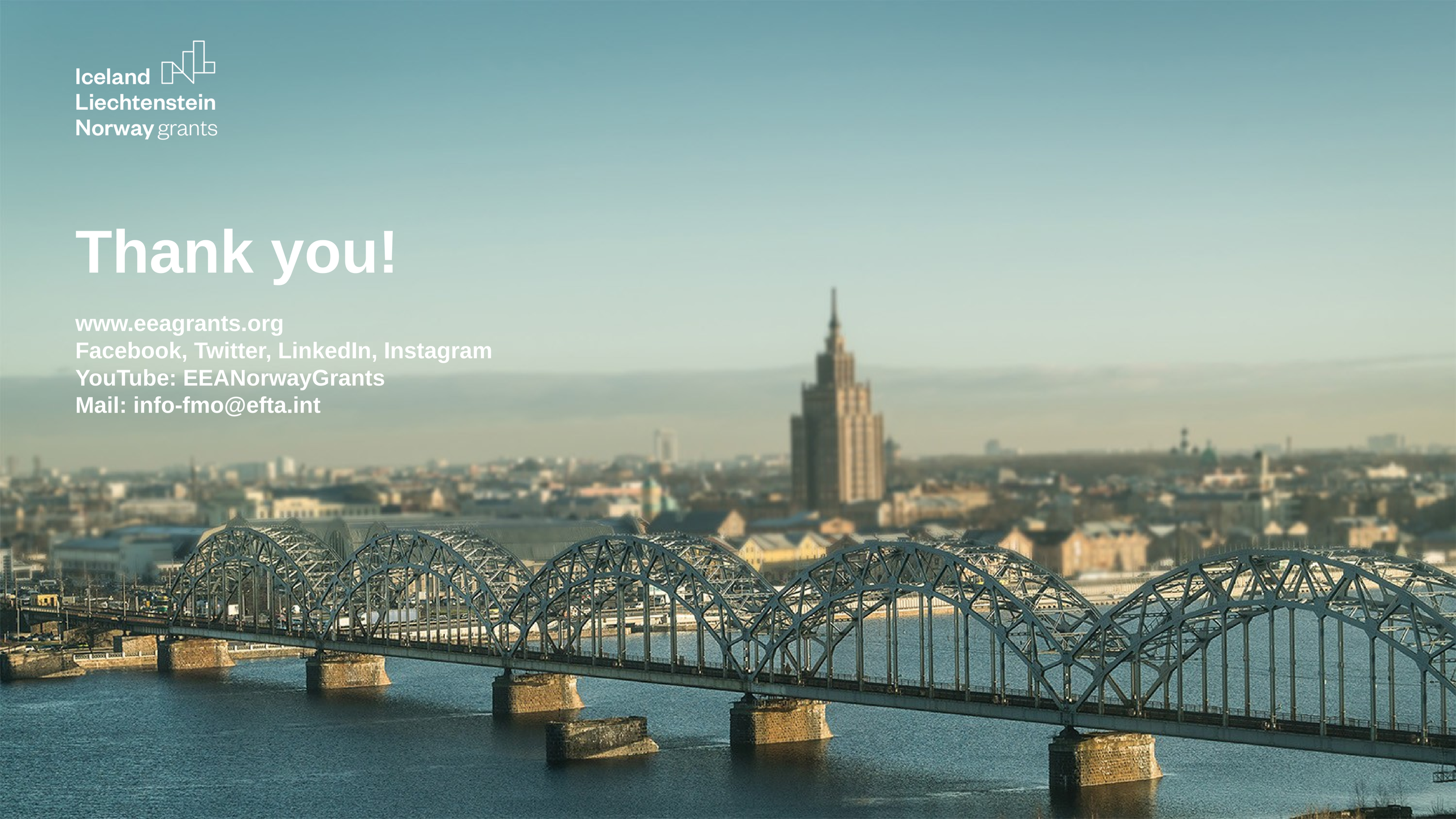
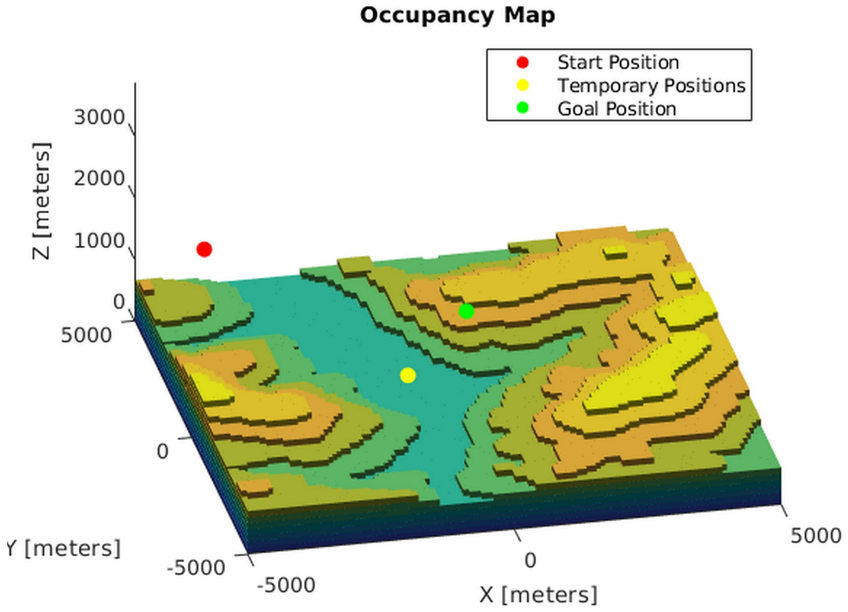
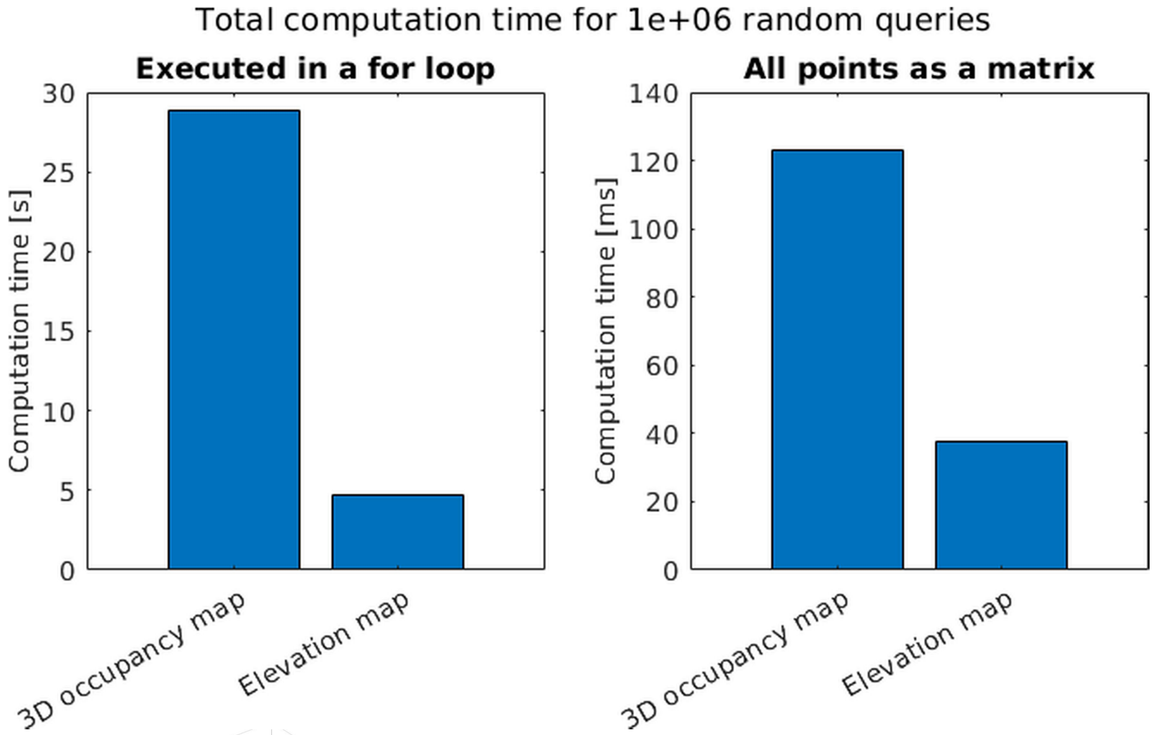
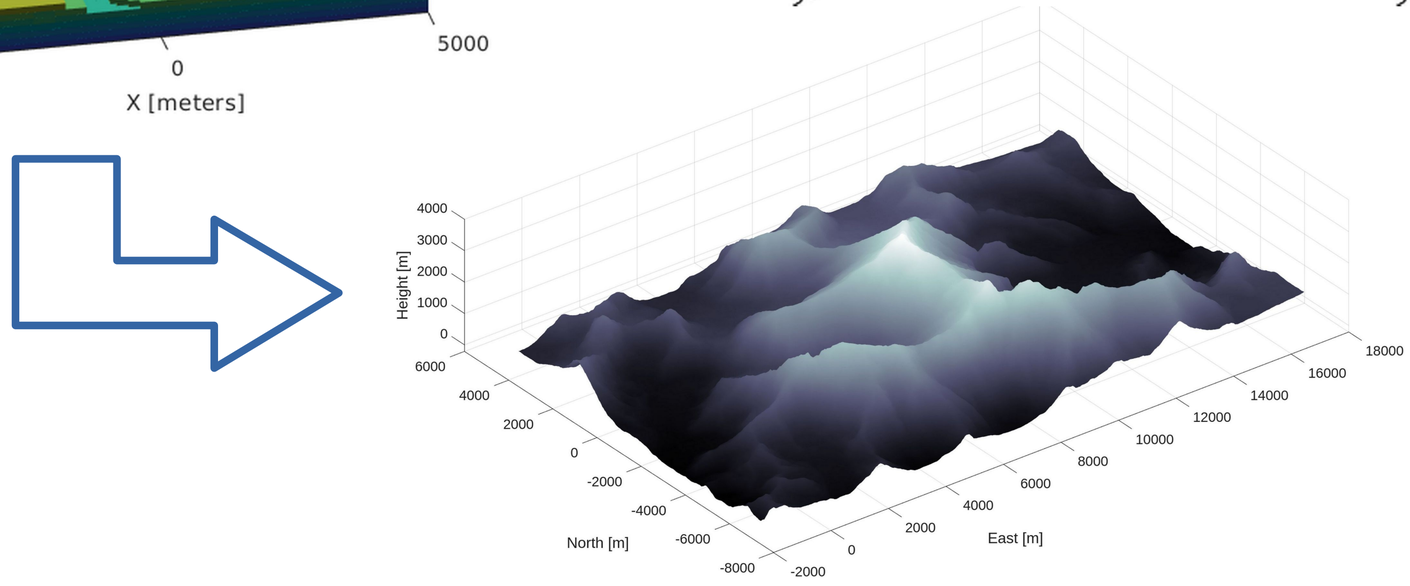


Environment modeling

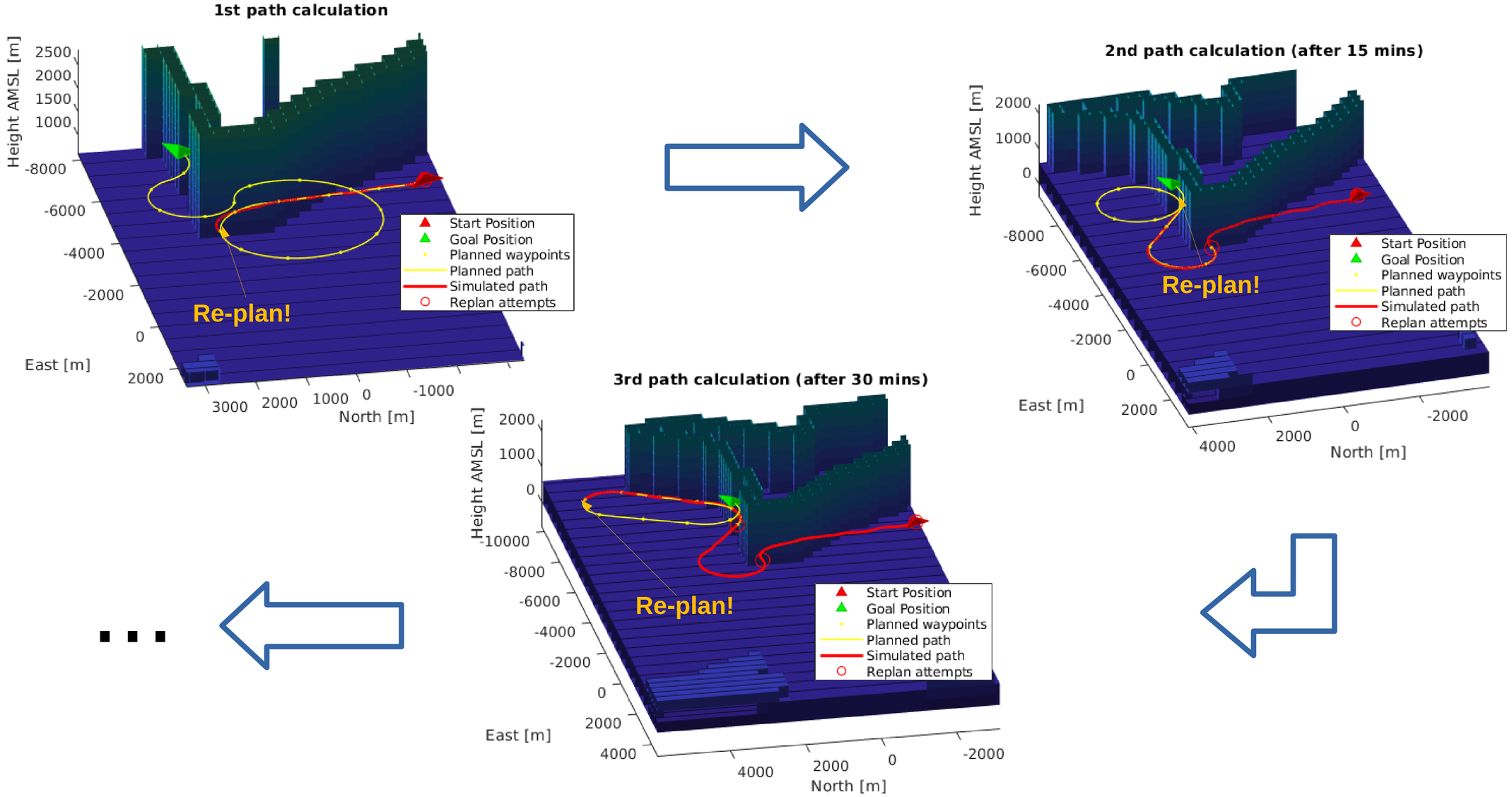






A

Early concept: Dynamic local re-planning



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