

ADA – Adaptive automation Face Drilling

Project leader

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Partners

Boliden Minerals, Örebro Universitet, Algoryx och Epiroc

Project duration

2022-03-01 to 2025-02-28



Partners & Scope



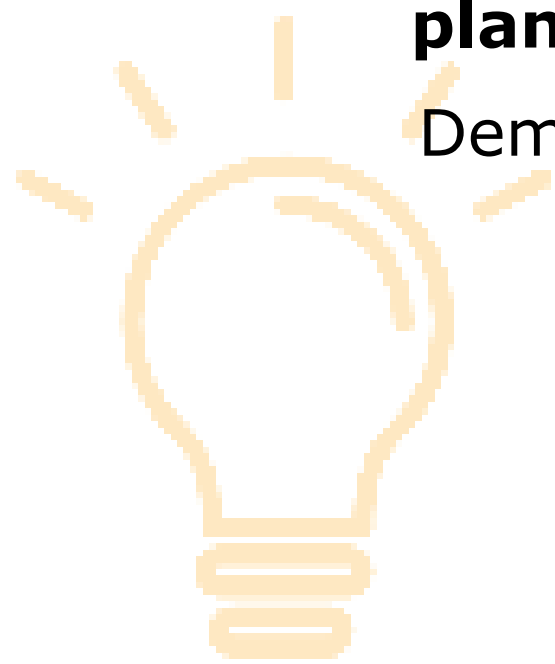
The project aimed to advance underground drilling automation by developing and integrating key components towards a partly autonomous drilling cycle.

- Technology development and acceleration of lidar-based navigation for precise rig localization, perception algorithms for detecting anomalies such as rock bolts, and adaptive drill plan adjustment capabilities.
- Development of a simulator platform, served as a digital twin of the Epiroc Boomer E20 rig and mine environment, enabling rapid prototyping, algorithm testing, and domain randomization for AI training.
- Technologies validated through pilot demonstrations in Garpenberg mine, showcasing automated scanning, enabling drill plan adjustments, and execution without operator intervention.

Project Goals & values

Enable stepwise automation of the underground drilling cycle, reducing human presence in hazardous environments. This improves operator safety by minimizing exposure to dangerous conditions while increasing process consistency and efficiency.

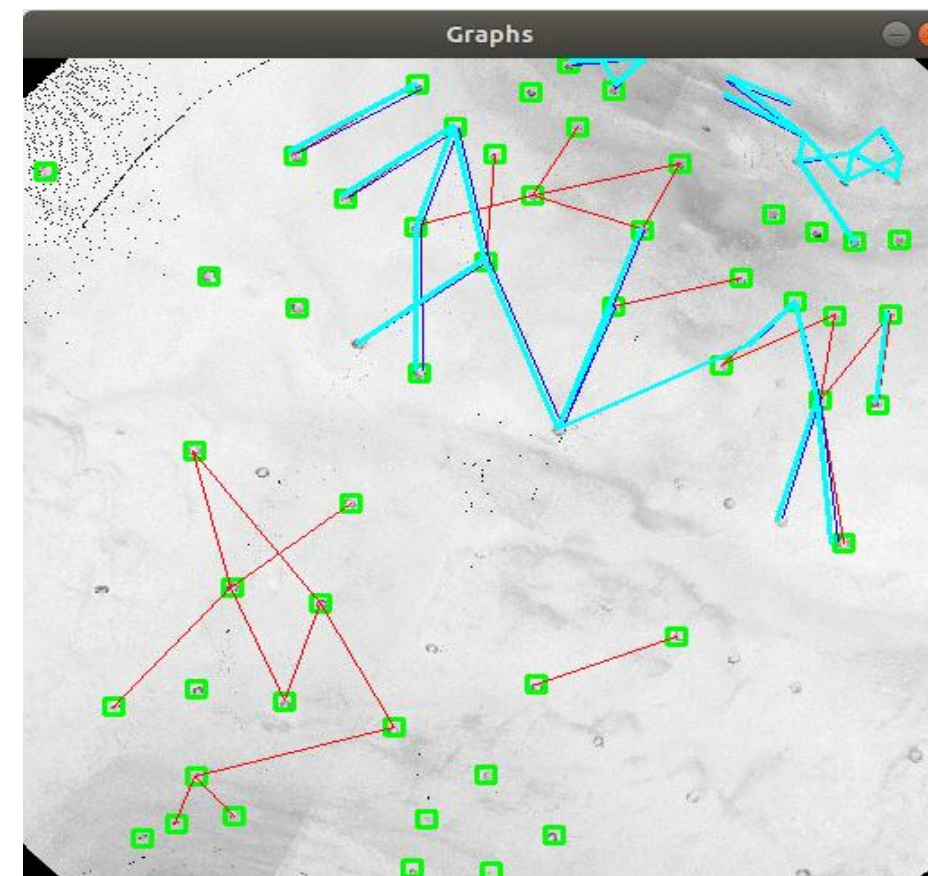
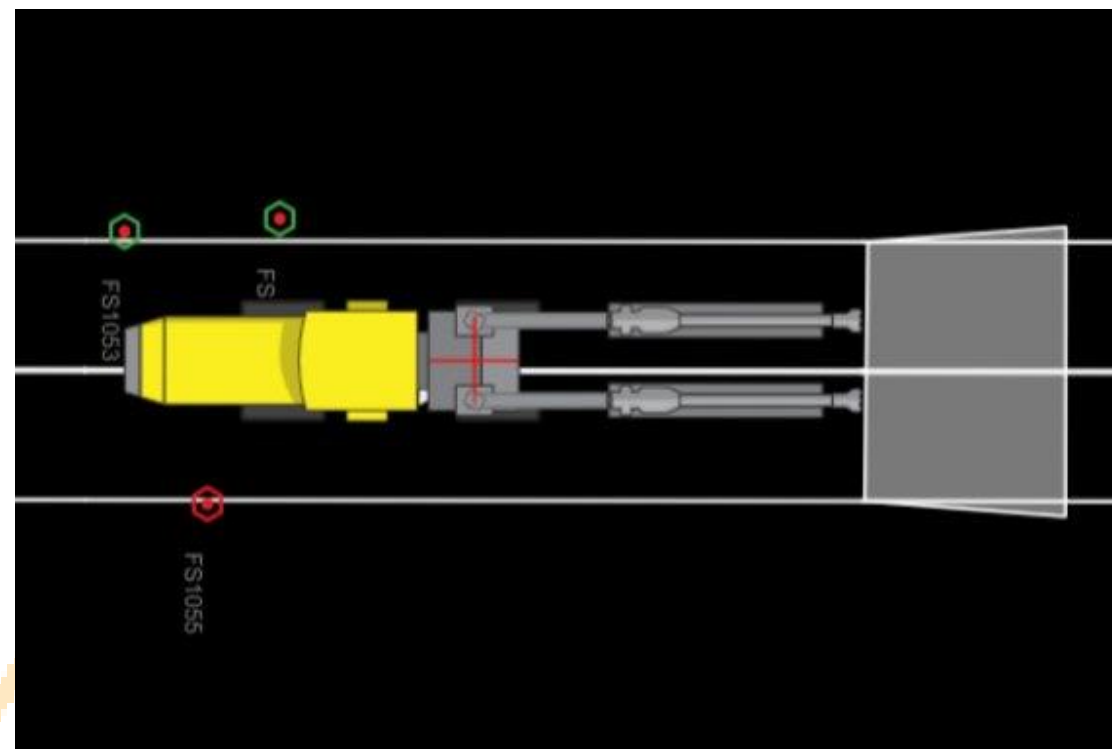
- **Advanced boom kinematics and collision-free route planning, supported by a centralized auto controller for dynamic scheduling and execution.** These innovations optimize drilling sequences, prevent equipment collisions, and increase overall productivity.
- **Develop a simulator platform as a digital twin for rapid prototyping, algorithm testing, and AI training.**
The simulator accelerates development cycles, reduces testing costs, and ensures robust validation before deployment in real mines
- **Lidar-based navigation for accurate rig localization and point cloud mapping for quality assurance.**
Precise positioning enhances drilling accuracy, reduces errors, and supports high-quality tunneling outcomes.
- **Create perception algorithms to detect anomalies such as rock bolts and angled surfaces for adaptive drill plan adjustments.**
Real-time anomaly detection enables dynamic adaptation of drill plans, improving reliability and reducing manual intervention.
- **Validate all technologies in real mining conditions through pilot demonstrations, proving automated scanning, drill plan generation, and execution without operator intervention.**
Demonstrating functionality in operational environments builds confidence for industrial adoption and future scaling.



Results

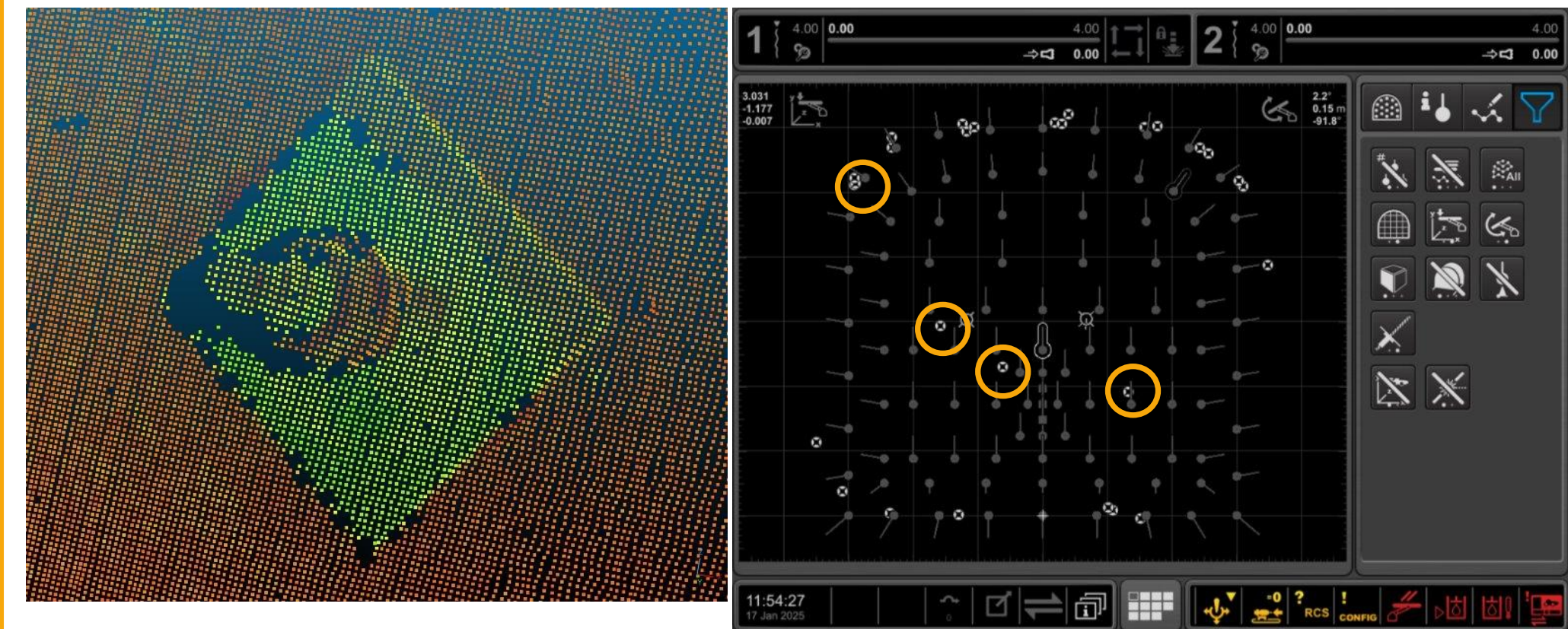
Scanning with high definition lidar

- Rigg navigation
 - Using reference spheres
 - Using installed rock bolts
- Quality indication (over/under-break)



Drill plan adaptation

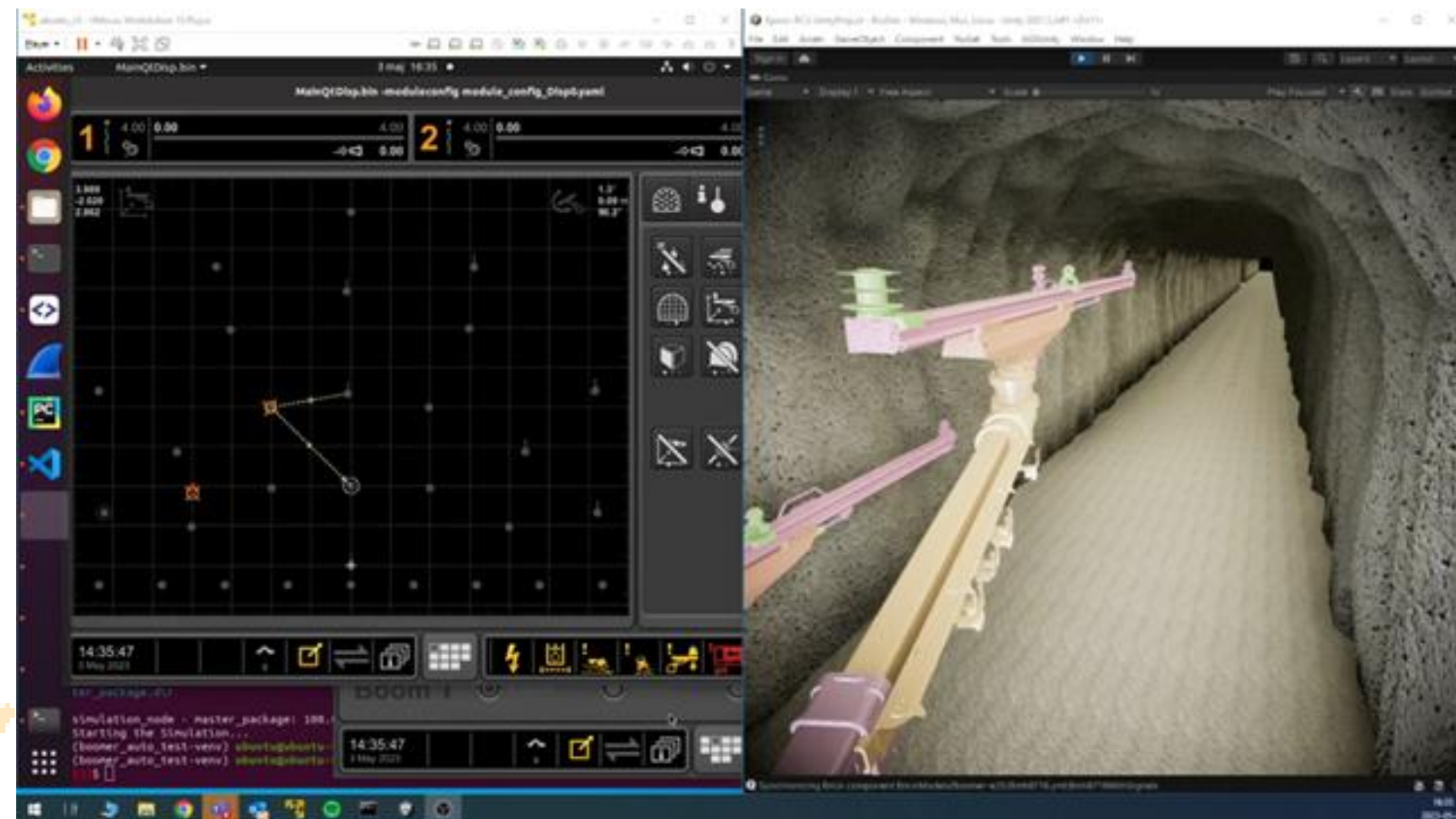
- Identify and adapt drill plan to anomalies and real geometry
 - Demonstration of finding bolt POC
- Detection of rock bolts in Lidar point cloud.
- Presentation of found rock bolts on operator panel



Results

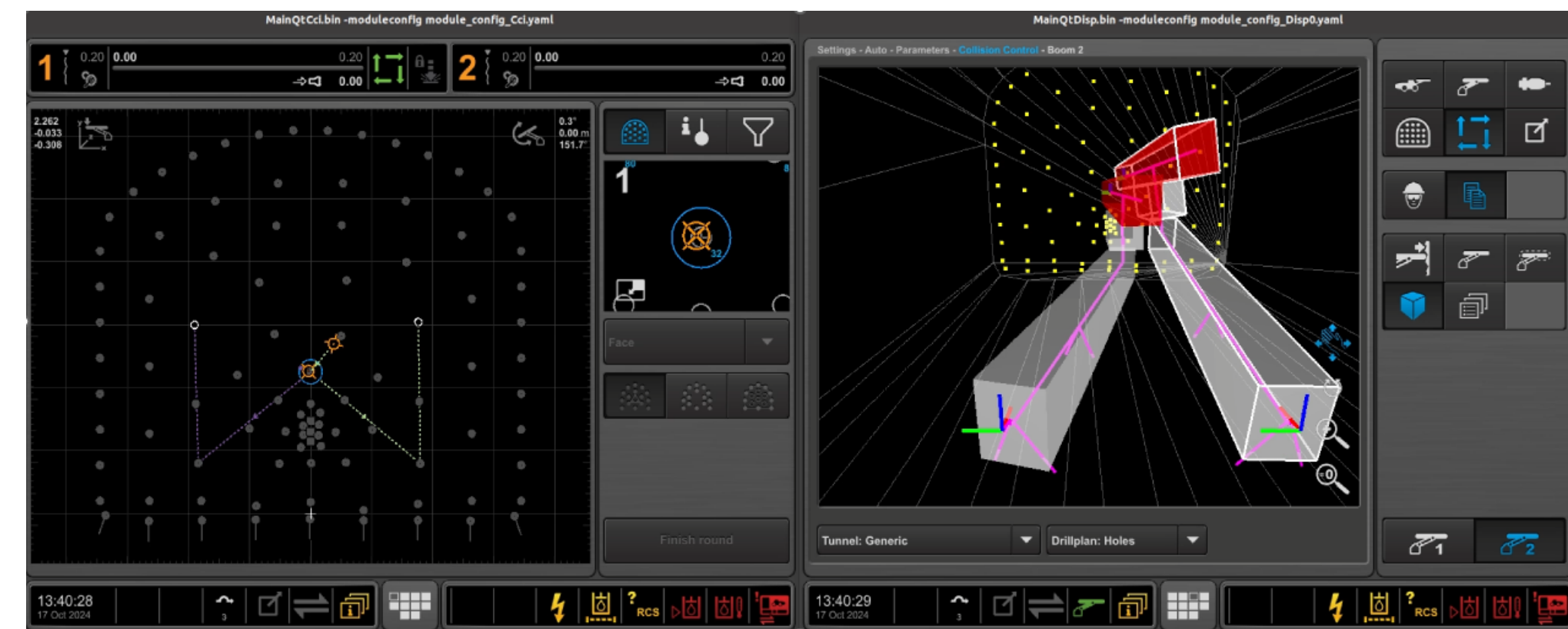
Simulation tools

- **Digital twin** with RCS to accelerate development and testing
- Virtual scan to enable navigation simulations



Auto drilling using state of the art robotics

- Implement modern robotics into RCS to enable new auto drilling features
- New boom route planning
- Architecture for multi-boom planning
- Demonstration of Boom conflict solver



Project outcome and Upcoming activities

- Industrialization – A boost for the Epiroc automation program for drill rigs
- Results transferred into proposal Horizon program filed September 2025
- New development of simulation tools for Epiroc by Algoryx
- Publications, External communication for instance as Article in “Mining & Construction”
- Master thesis: “Localizing Drill Holes in Underground Mining”



Mining innovation for a sustainable future