

H2020 - ROBOMINERS

ROBOMINERS RM1 - Production tool for full-scale prototype

Dr. Michael Berner / University of Leoben



- Analysis and guideline of applicability of excavation methods.
 - Applicability for different scenarios (Research, analytical studies,..).
 - Numerical simulations of excavation processes (Dynamic models, FEM simulation).
- } Definition of
- **application limits (UCS, machine mass, power,...).**
 - **requirements (technologies, infrastructure,...).**
- Concepts of future production tools for mobile mining robots.
 - Development and testing of production for full-scale prototype.

Drilling and Blasting

Mechanical Excavation

Alternative Excavation

Combined Excavation

- **Drilling**
- **Part-face cutting**
- **Full-face cutting**
- **Impact hammer**
- **Radial-axial splitting**
- **Auger drilling**
- **Dredging**
- **Bucket wheel excavation**
- **Saw cutting**

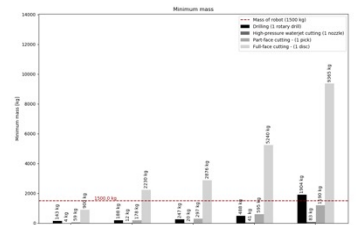
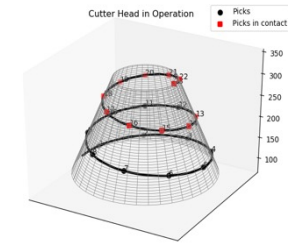
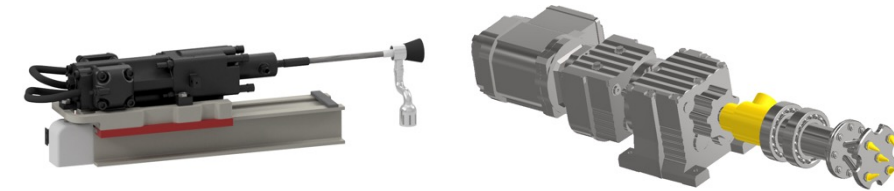
- **High-pressure water cutting**
- **Hydrofracturing**
- **Laser cutting**
- **Plasma blasting**

- **High-pressure water assisted to drilling**
- **High-pressure water assisted to cutting**
- **Microwaves assisted to cutting**
- **Ultrasonic drilling**



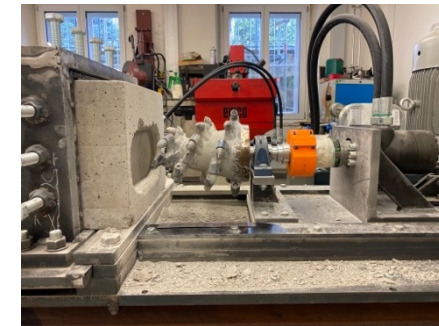
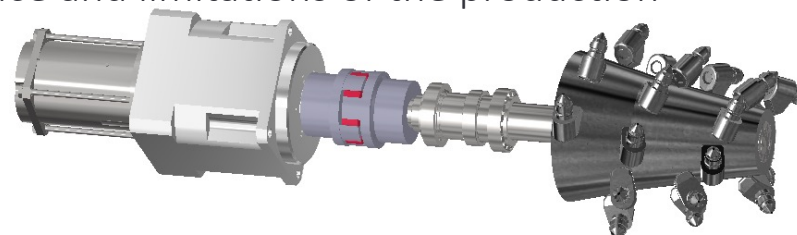
Task 6.5 Production tools conceptualization and research at TRL-3

- Analysis and guideline of applicability of excavation methods for small and mobile mining robots.
- Definition of requirements and limitations.
- Concepts of future excavation tools for mobile mining robots.



Task 6.6 Develop a small-scale excavation tool system for the selective mining demonstrator based on COTS

- Development of production tool for RM1 prototype.
- Testing of production tool in laboratory with cutter head test rig.
- Definition of expectable performance and limitations of the production tool in real mining environment.



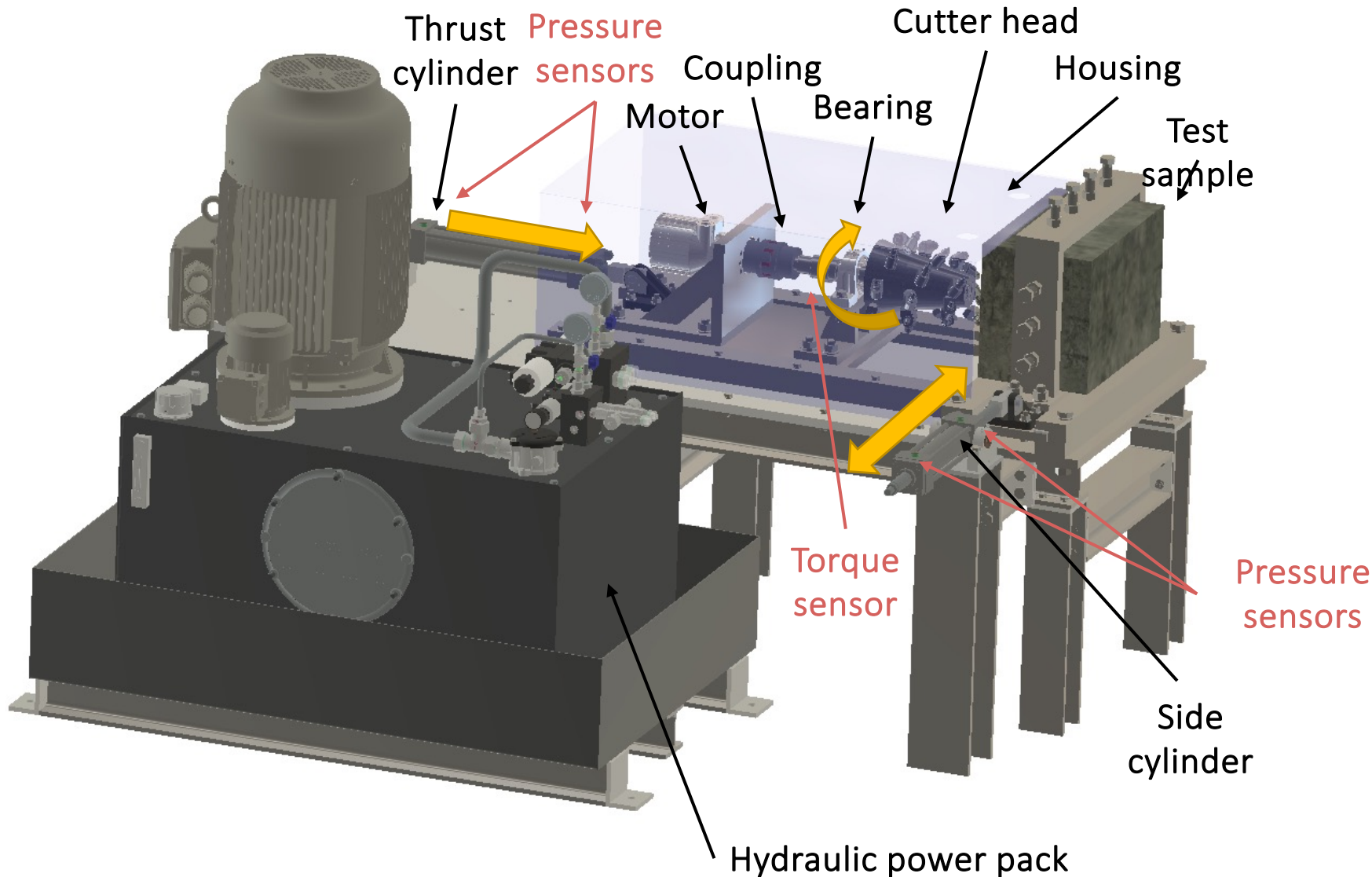


Production tool test rig

Full scale test of small part-face cutter head



PART-FACE CUTTER HEAD TEST RIG – 3D DESIGN

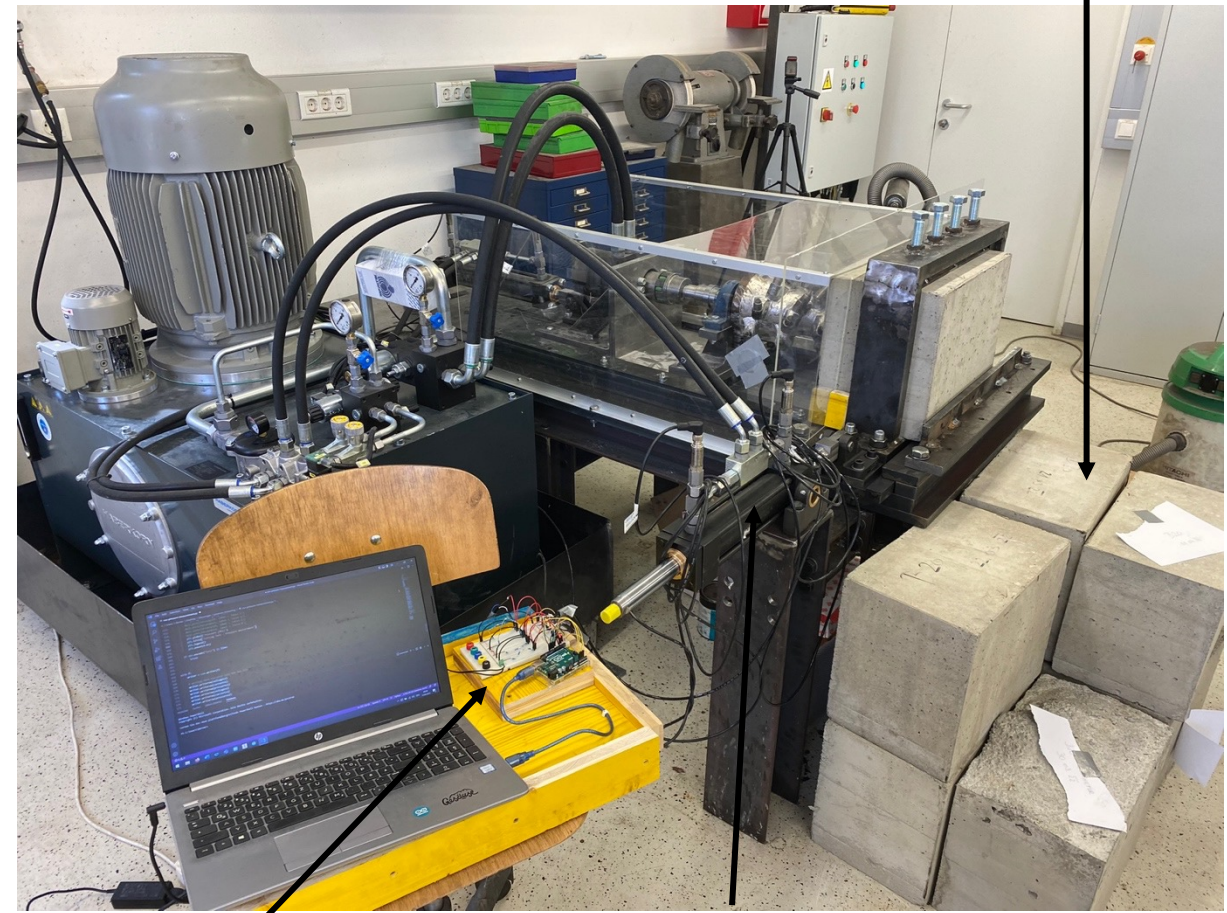


- Testing of various rock strengths.
- Measure torque and cutting forces.
- Performance assessment.

PART-FACE CUTTER HEAD TEST RIG – SETUP

Hydraulic power pack

Test samples



Vacuum cleaner

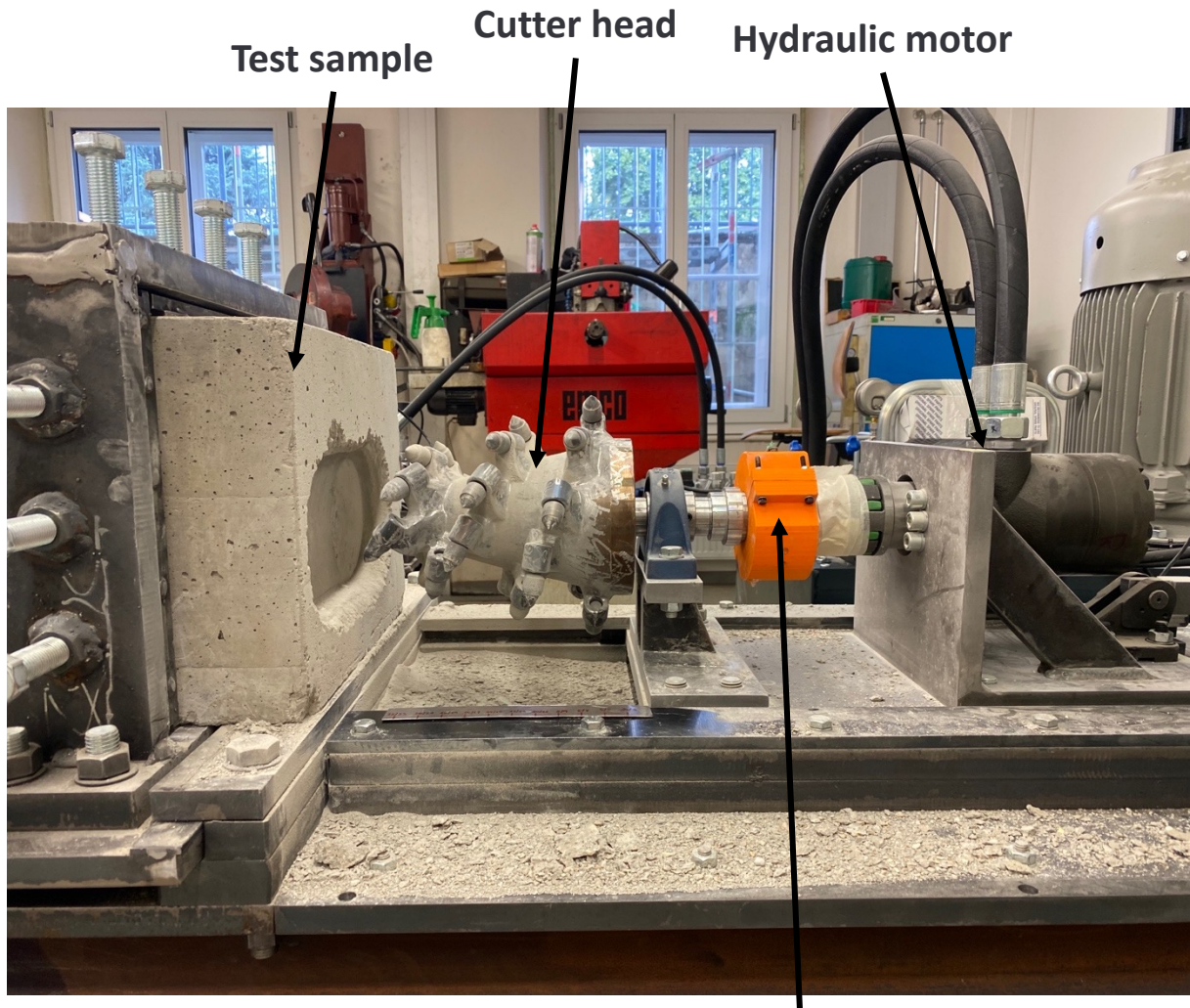
Housing

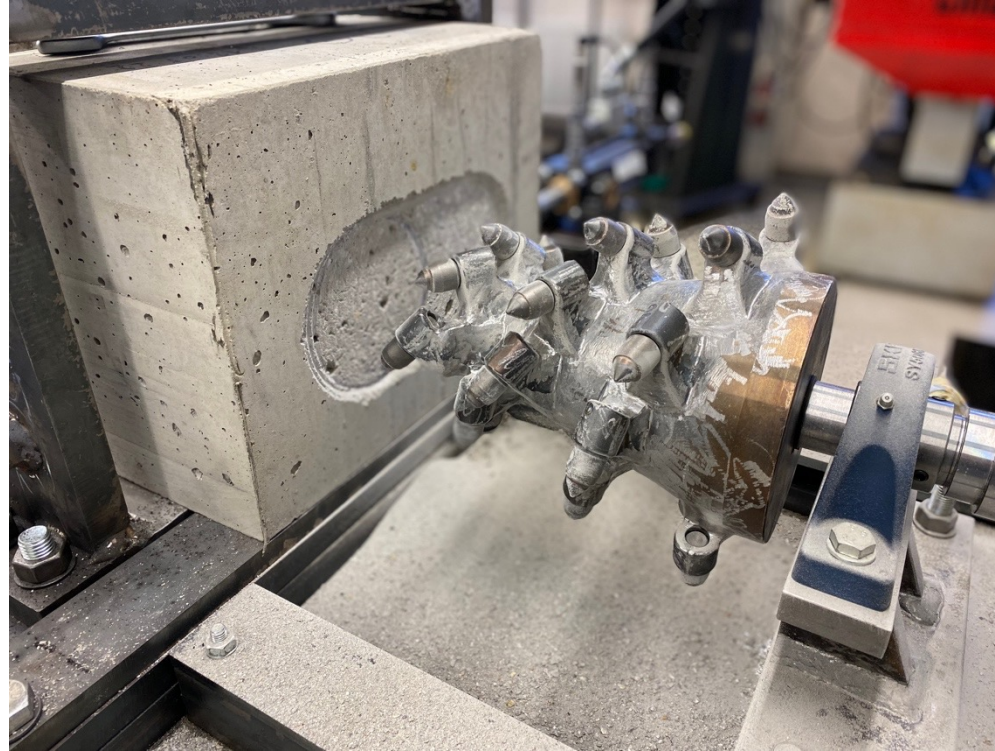
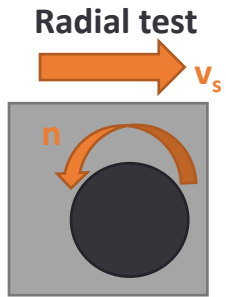
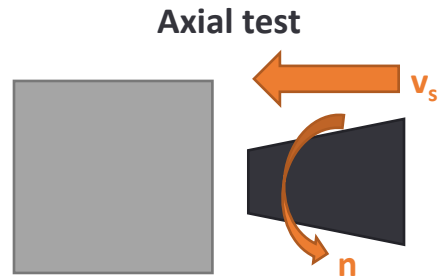
Thrust cylinder

Measurement electronics for cylinder pressures

Slew cylinder







• Tests

- Concrete – UCS: 23 MPa.
- Concrete – UCS: 30 MPa.
- Oilshale – UCS: 16 MPa.

• Measurements

- Axial force (Cylinder force).
- Radial force (Cylinder force).
- Cutting torque (Torque on drive shaft).
- Cutting force.





Very irregular grain sizes.

- Up to 30 MPa UCS (compact rock)
 - Total cutting force: 3300 N.
 - Estimated excavation rate: $0.2 \text{ m}^3/\text{h}$.
- Oilshale (16 MPa)
 - Total cutting force: 1700 N.
 - Estimated excavation rate: $< 1 \text{ m}^3/\text{h}$.
- Limestone (60-80 MPa)
 - Estimated excavation rate: $0.01 \text{ m}^3/\text{h}$.
- Max. UCS $< 40 \text{ MPa}$.





Field test

July/August 2023 - Rakvere / Estonia





Thank you
for your attention!

