A NEW DYNAMOMETER FOR TESTING ICE CORE DRILL MOTORS AND GEARS.

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Motivation

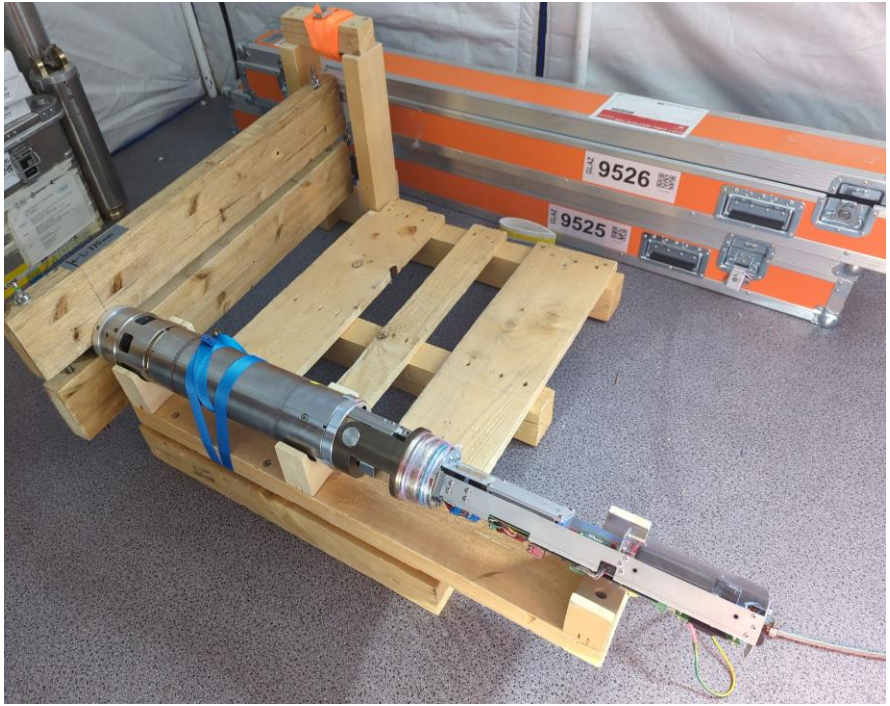
- Failed to provide working motor with sufficient torque for BEIO drilling
- Failure not detected early:
  - Ambitious goals and
  - Missing full system testing capabilities

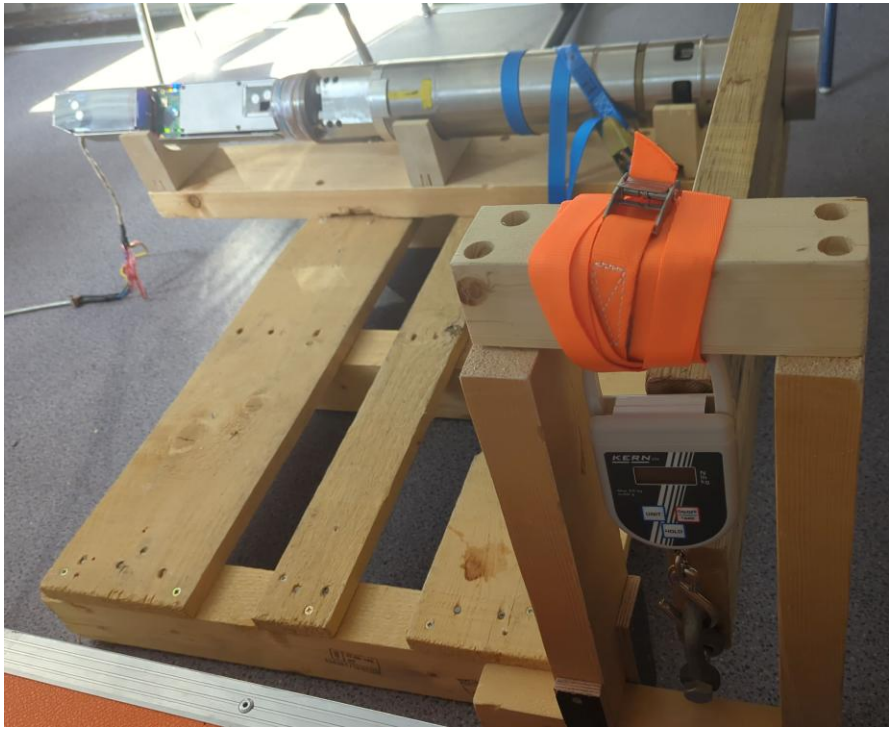
Existing Test Stands

- Testing Motor on drill cable:
  - Without mechanical load
  - Peak torque, blocking
  - Break module

- Testing in the Field
  - Break module was build for testing in EDML Borehole

Makeshift Test stands





Envisioned Use cases

- Evaluation of current drill motor limitations
- Testing current motor with new gear
- Potential new motor designs
- Comparison testing between ice core drill motors

Design Goals

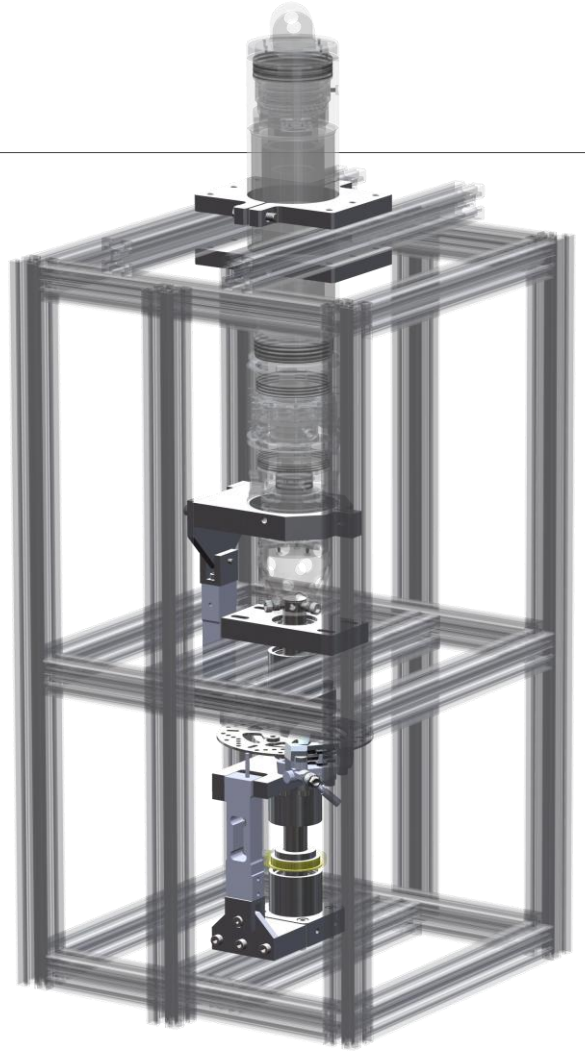
- Dynamometer for workshop at AWI
- Simulating of full coring run duration
- Break Torque ~ 0 – 100 Nm
- RPM ~ 0 – 200 1/min
- Measuring torque and RPM

- If possible simulate different torque path:
  - Internal: Pump / Chip transport
  - External: Drill head / Ice cutting

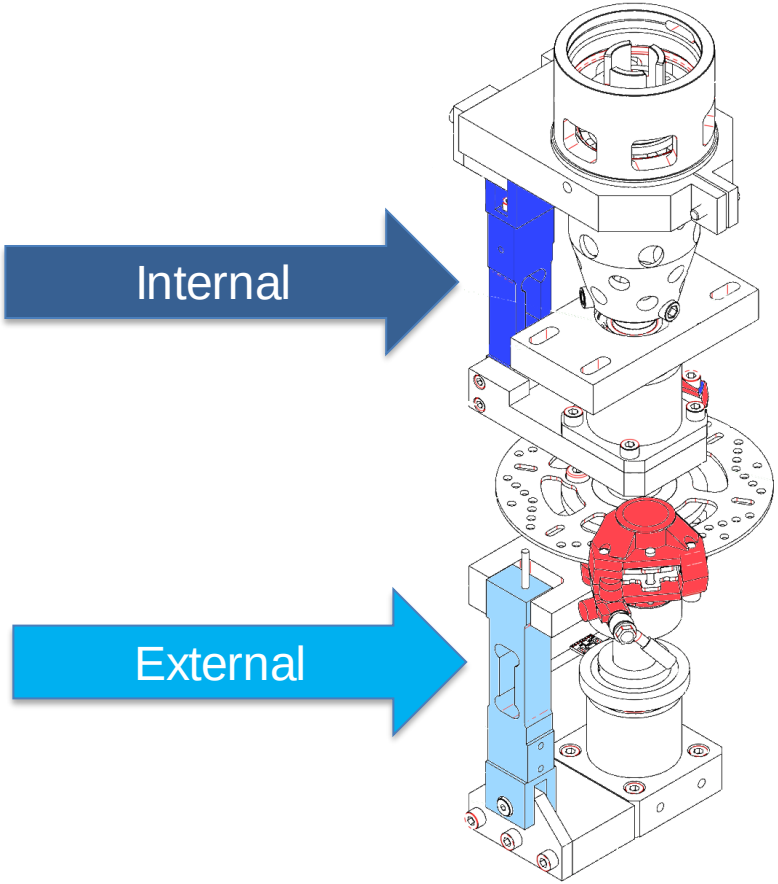
Mechanical Setup

- Off-the-shelf disk break
- Existing incremental encoder
- Cheap load cells
- Reuse drill parts
- Aluminum extrusion frame

- Manual hydraulic breaks
- Optional Break control



Internal / External Break



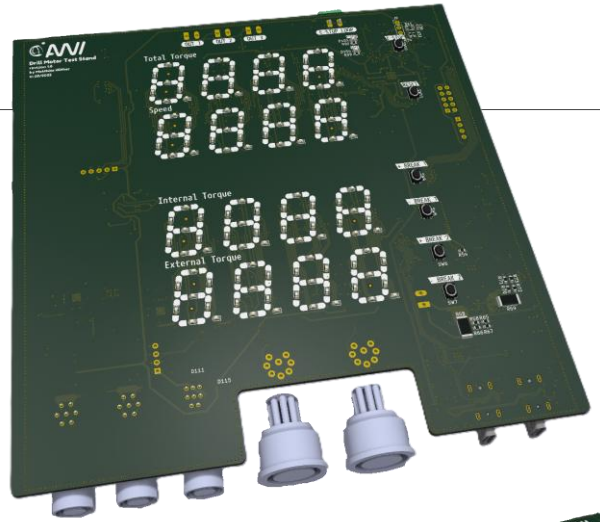
- Single Disk
- Two Breaks
- Two Load Cells

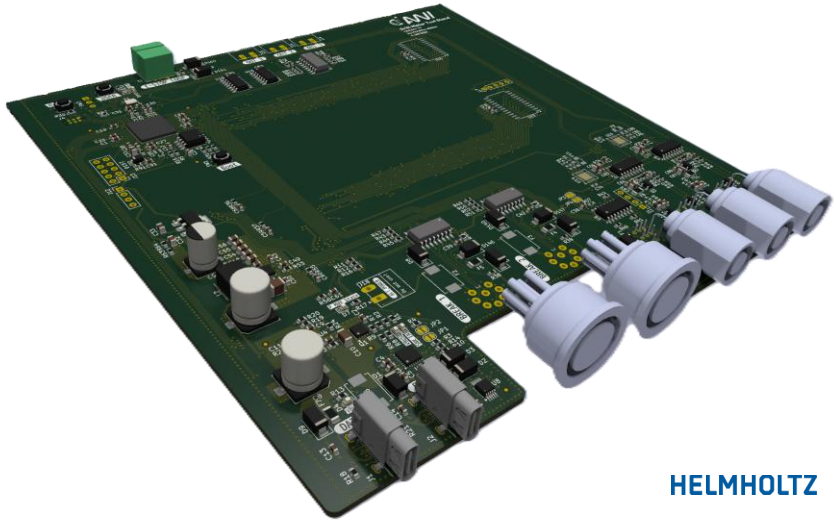
Electronic

- Single PCB
- Support for two load-cells
- Encoder interface
- Standalone displays

- USB Serial for “fast” live Data
- USB DP as power supply

- Two stepper motor interfaces
- Buttons and E-stop





Current State

- Mechanics mostly assembled
- PCB v1.0 in production
- Firmware feasibility studied

Next step:

- Testing electronics
- Firmware implementation of sensors

Missing Capabilities

- Motor / gear not submerged
- Limited temperature and pressure simulation
- Unknown dynamic behavior / drill characteristics

Questions

Thanks for your attention.

Any questions?

Abstract

Specialised test equipment is frequently required during the design and verification phases of a project. However, this equipment is often expensive, not always readily available at the time, or just time-consuming to use. This can result in reliance on systems that have not been adequately tested prior to field campaigns. This may lead to system failures or substandard designs.

This newly designed dynamometer is intended for use in testing motors and gears of ice core drills. The aim is to resolve the issue of a missing test facility by using off-the-shelf components in its construction, with a relatively small and user-friendly form factor.

This presentation will introduce the design concept and its intended use cases.