



FORCE TECHNOLOGY NORWAY AS

Evert Stensholm
NDT Engineer

Offices worldwide

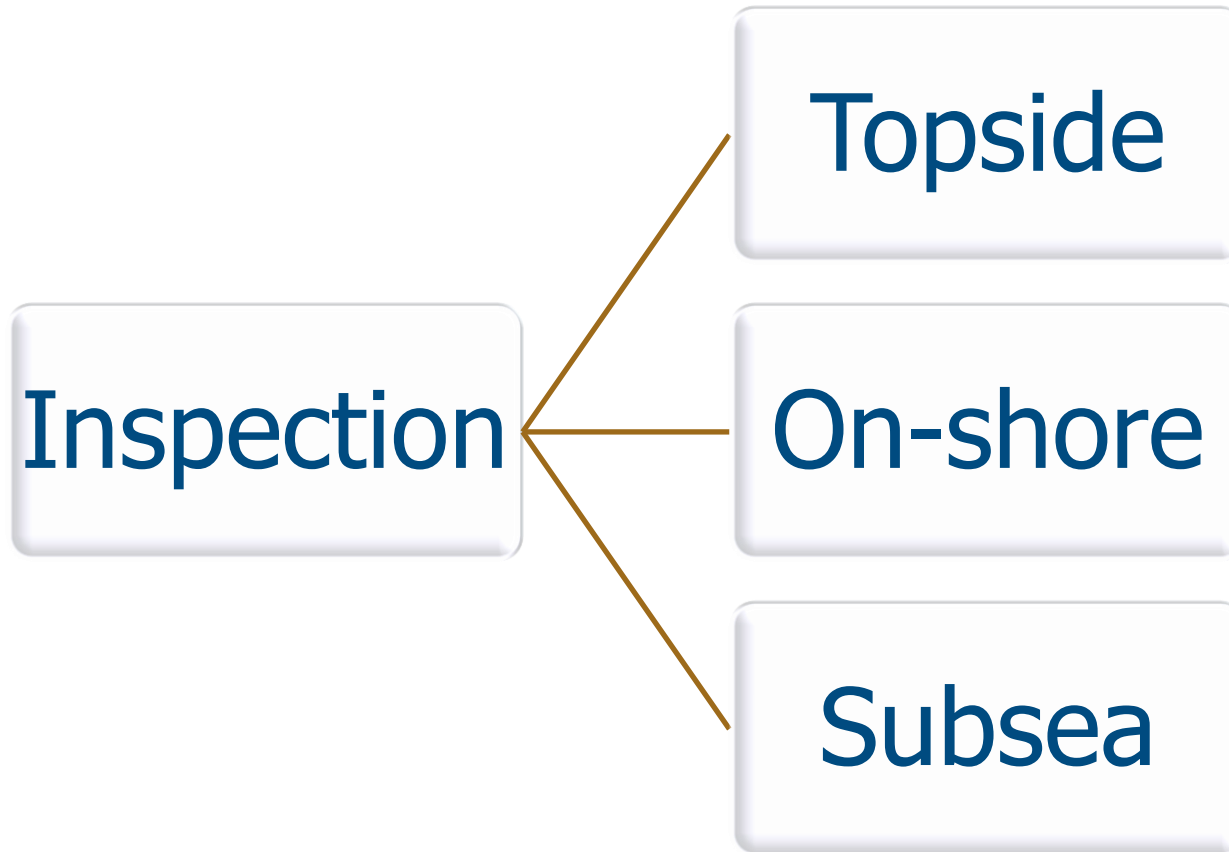


Offices in Norway



- ✓ Hvalstad
- ✓ Kristiansand
- ✓ Stavanger
- ✓ Bergen
- ✓ Trondheim
- ✓ Harstad
- ✓ Tromsø
- ✓ Hammerfest

- Structural design
- Monitoring
- Inspection
- Integrity management
- Training



Subsea inspection



GRIM: Two in one

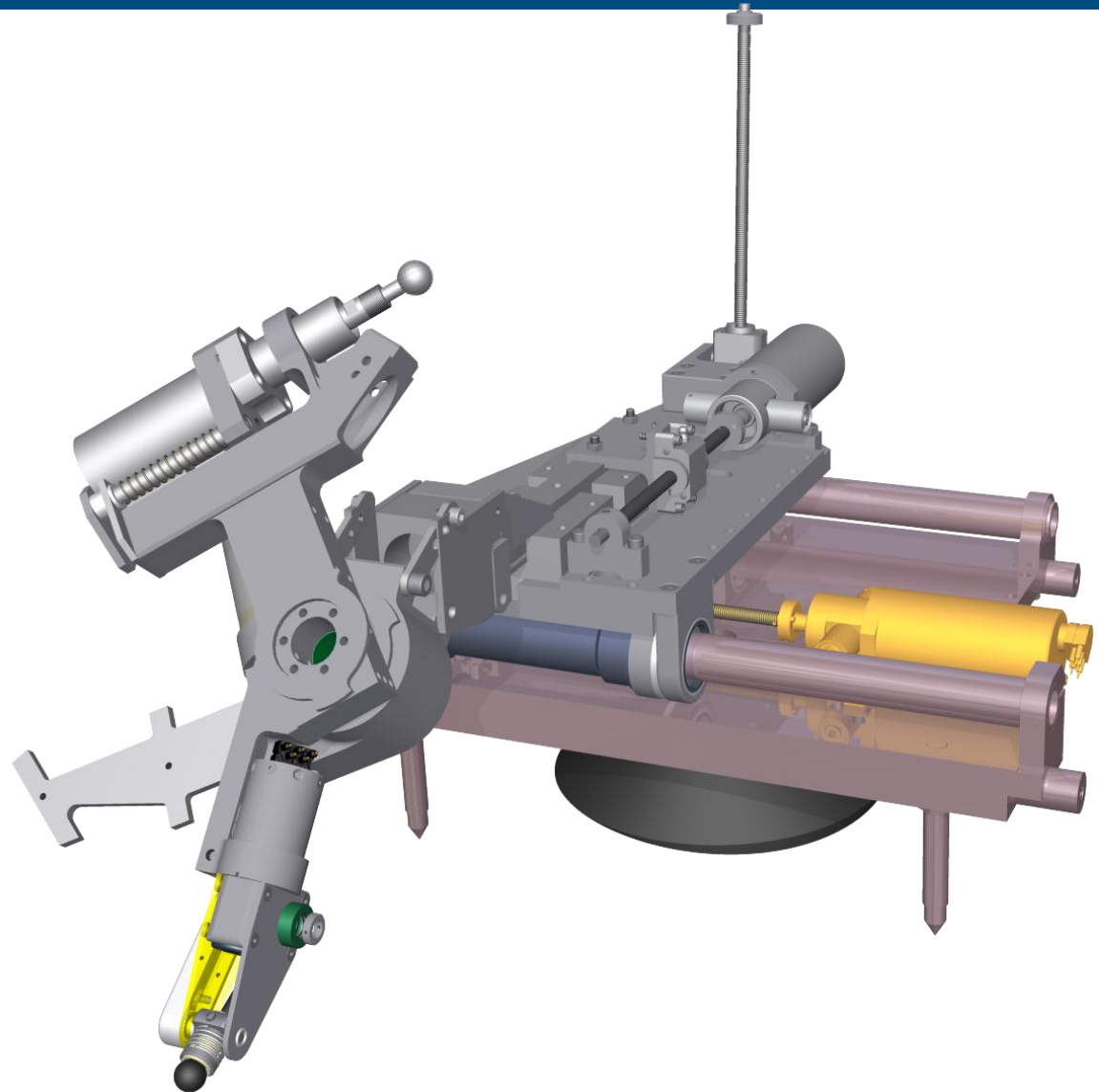


Grinding

Repair

Inspection

Machine

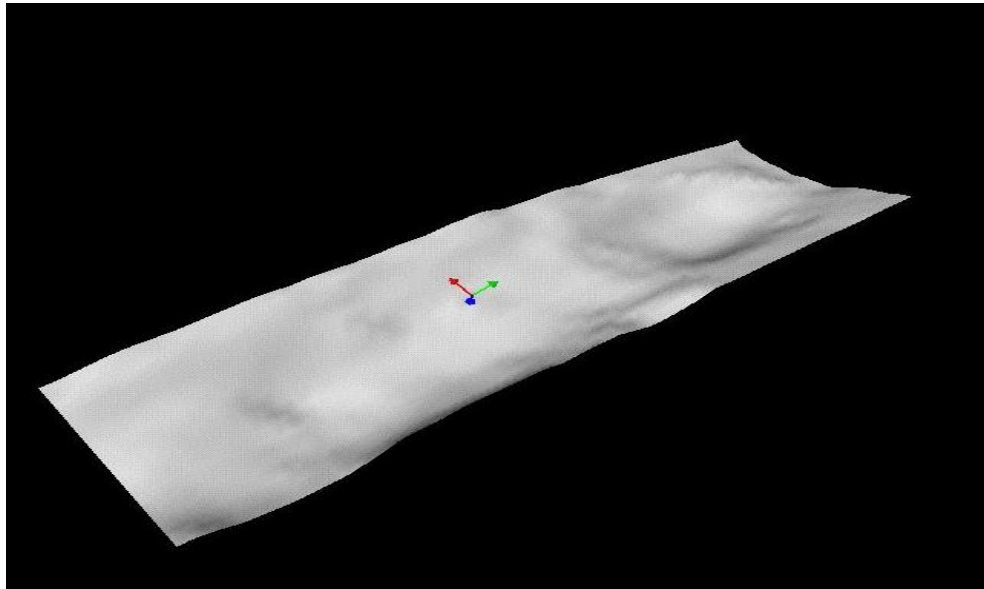


GRIM

MAIN FEATURES

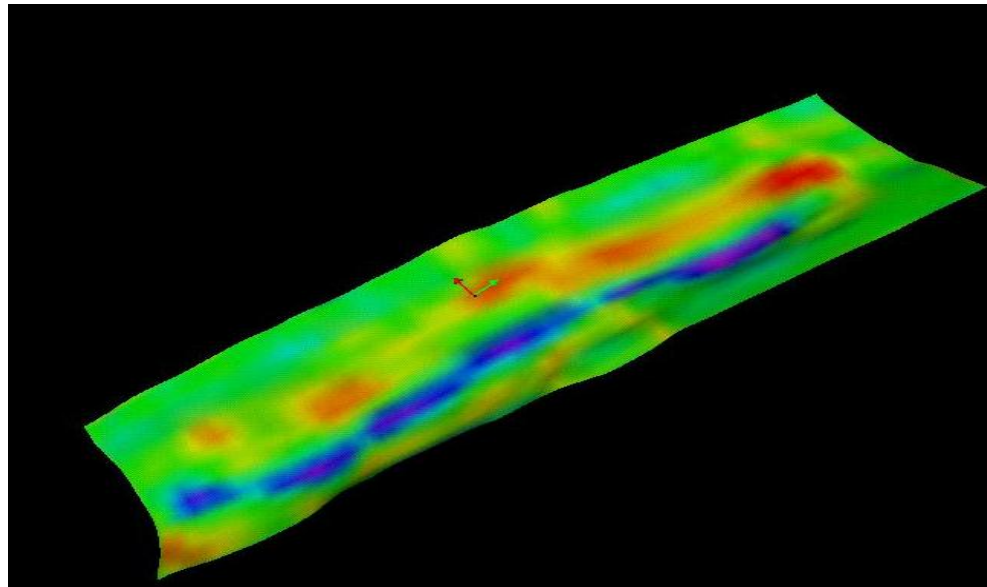
GRIM: Main features

- ✓ Surface mapping of topography in 3D



GRIM: Main features

- ✓ Surface mapping of topography in 3D
- ✓ Eddy current inspection



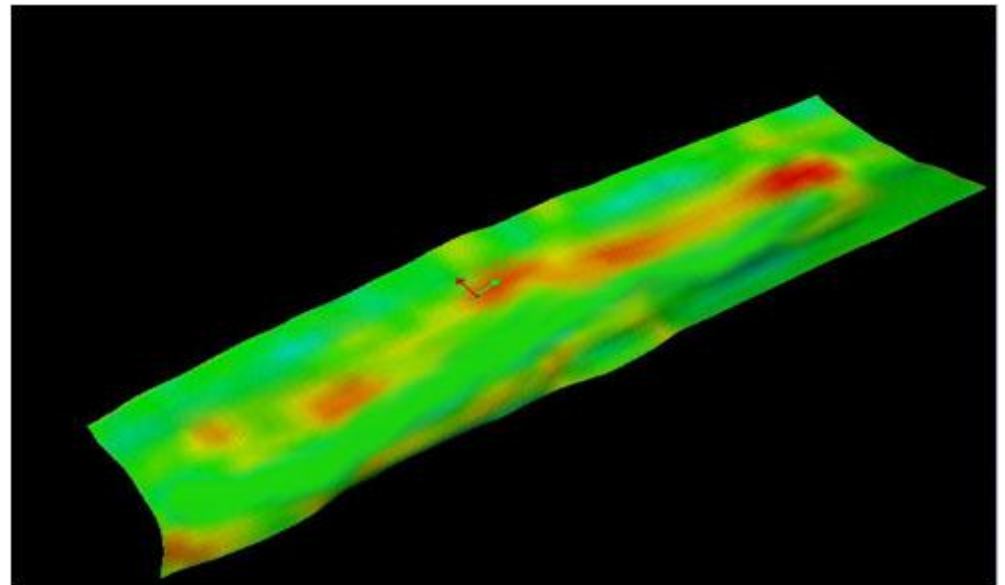
GRIM: Main features

- ✓ Surface mapping of topography in 3D
- ✓ Eddy current inspection
- ✓ Grinding of surface cracks

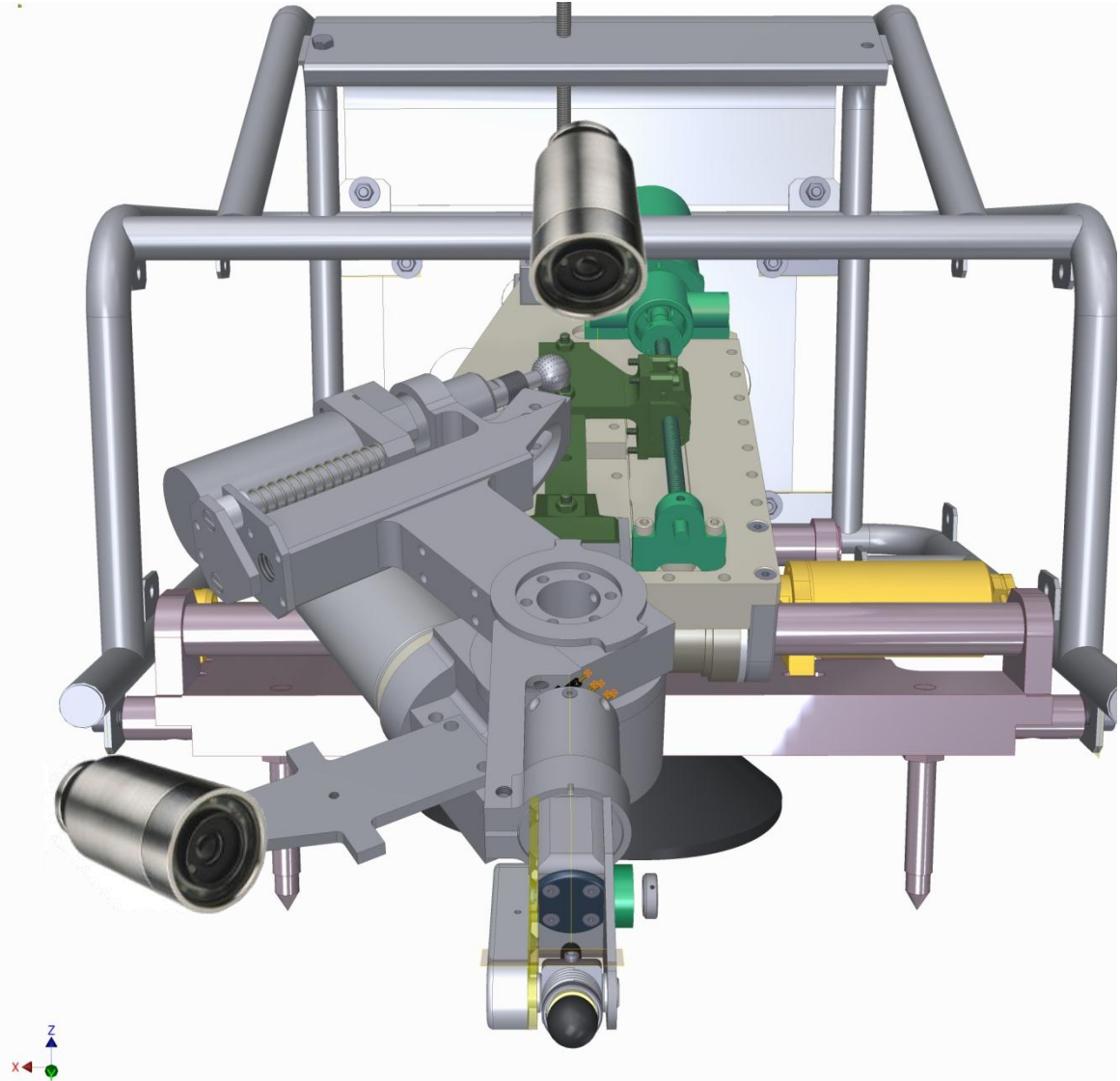


GRIM: Main features

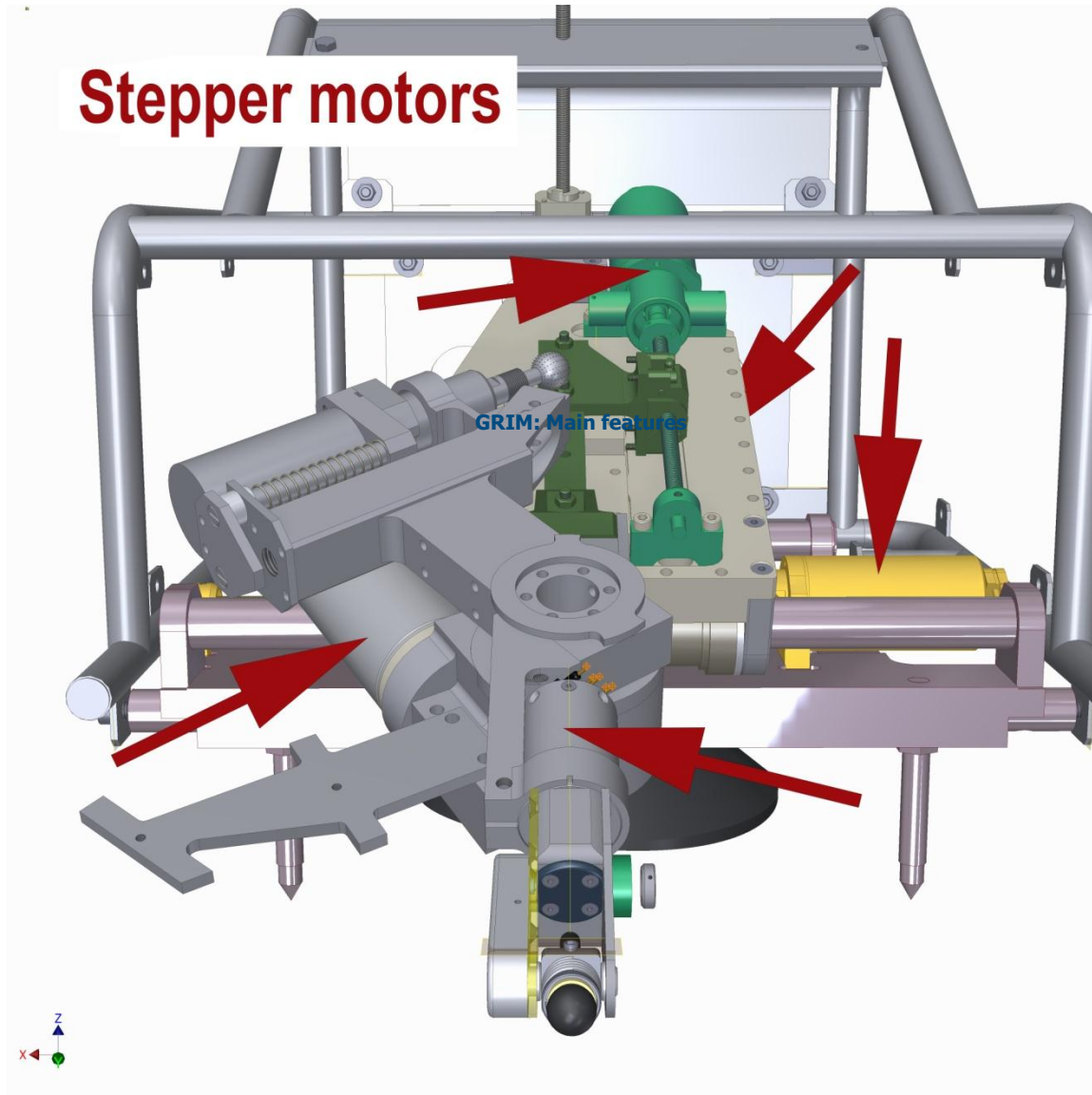
- ✓ Surface mapping of topography in 3D
- ✓ Eddy current inspection
- ✓ Grinding of surface cracks
- ✓ Verification of crack removal

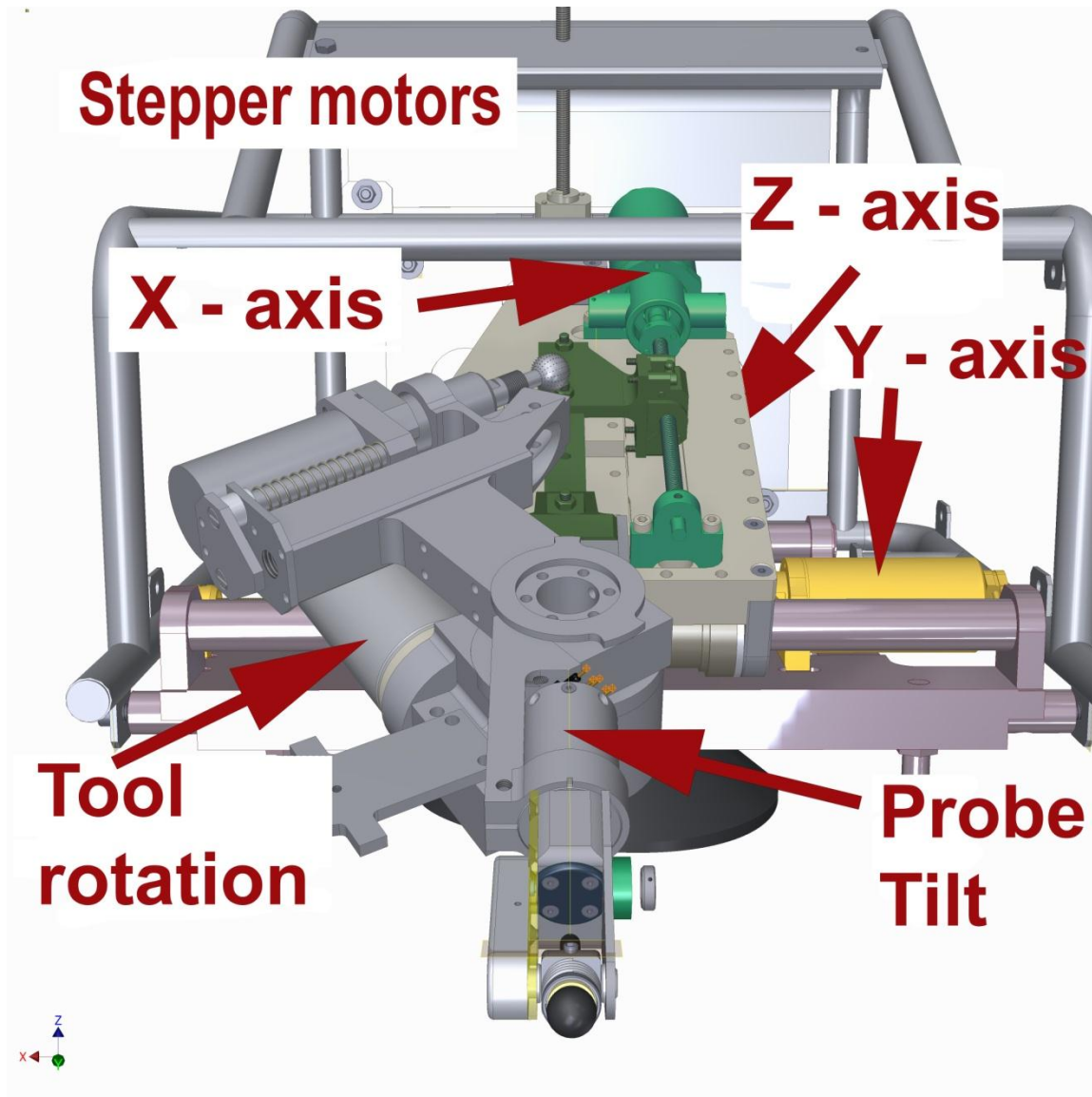


GRIM: Setup

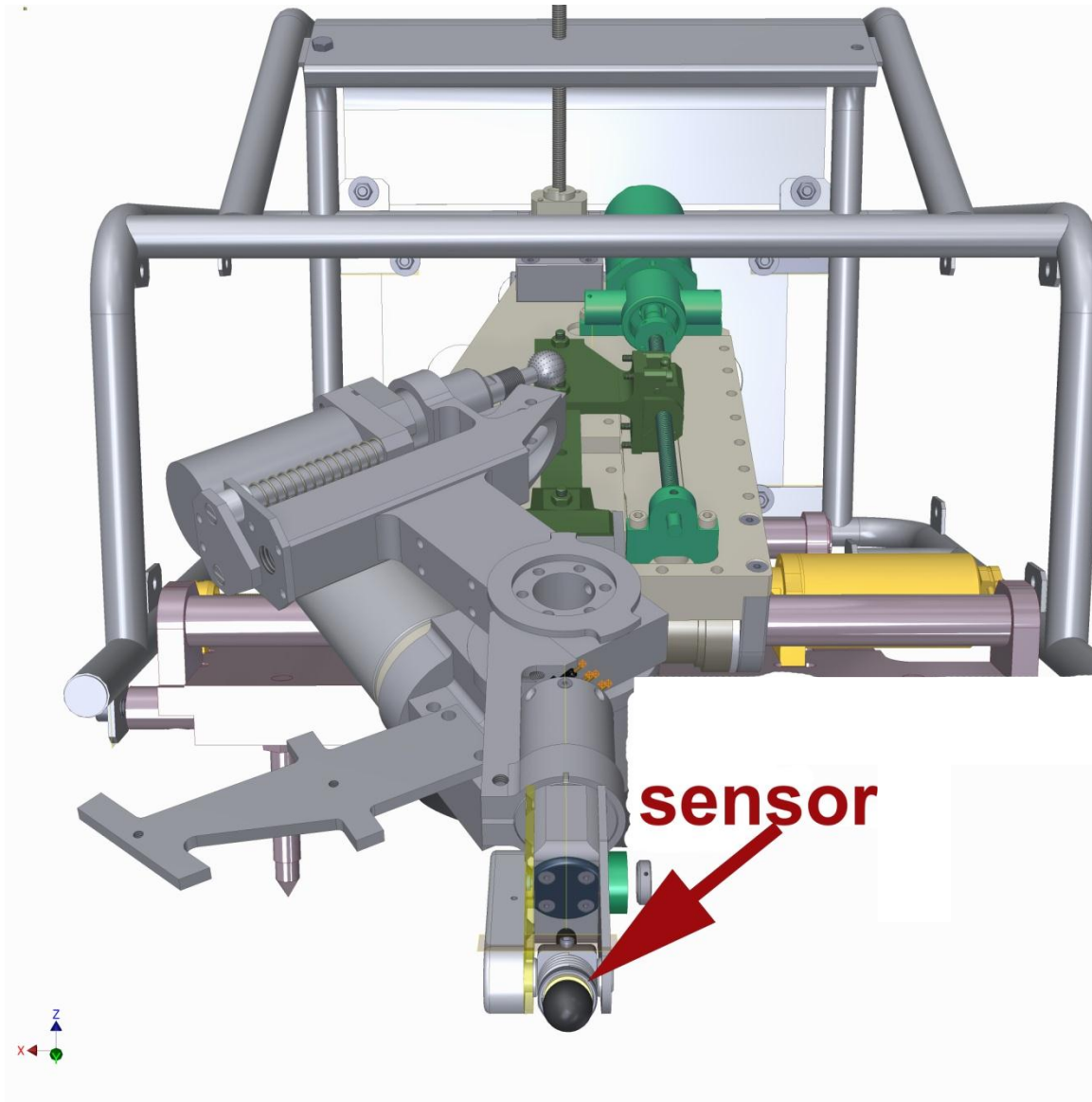


GRIM: Setup

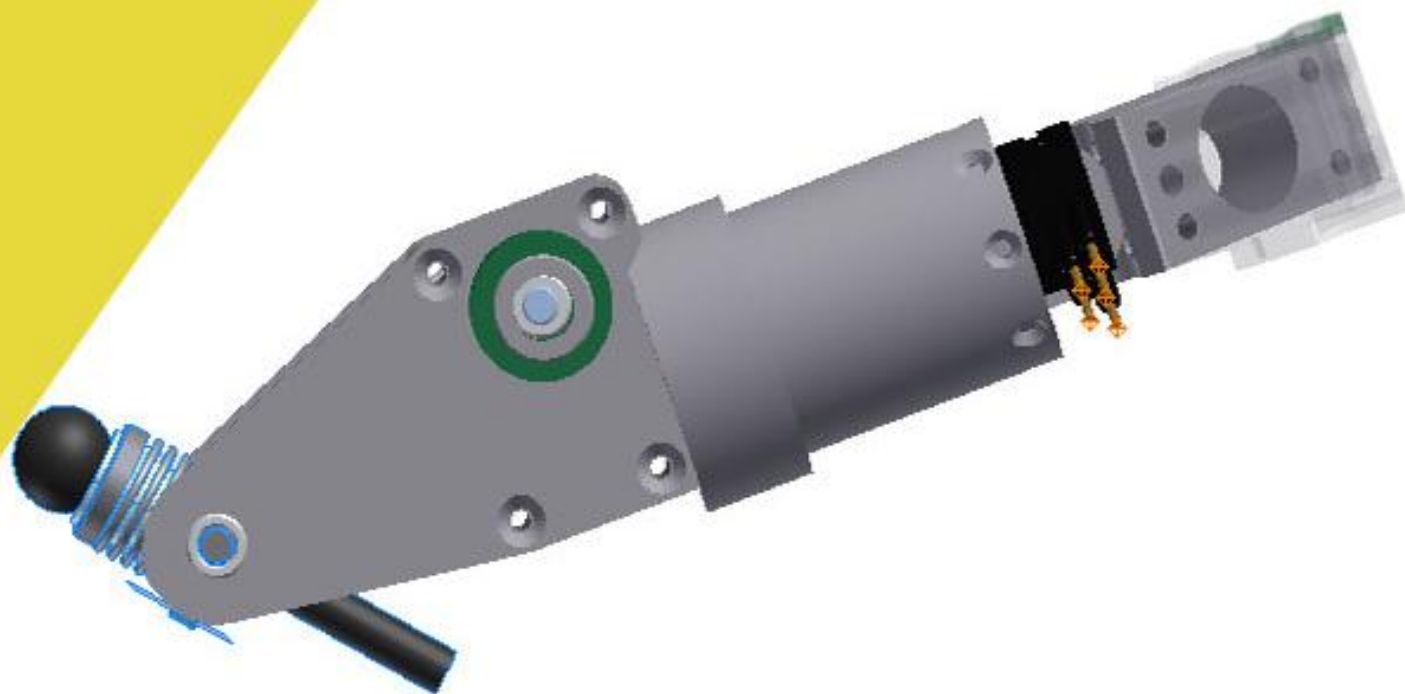




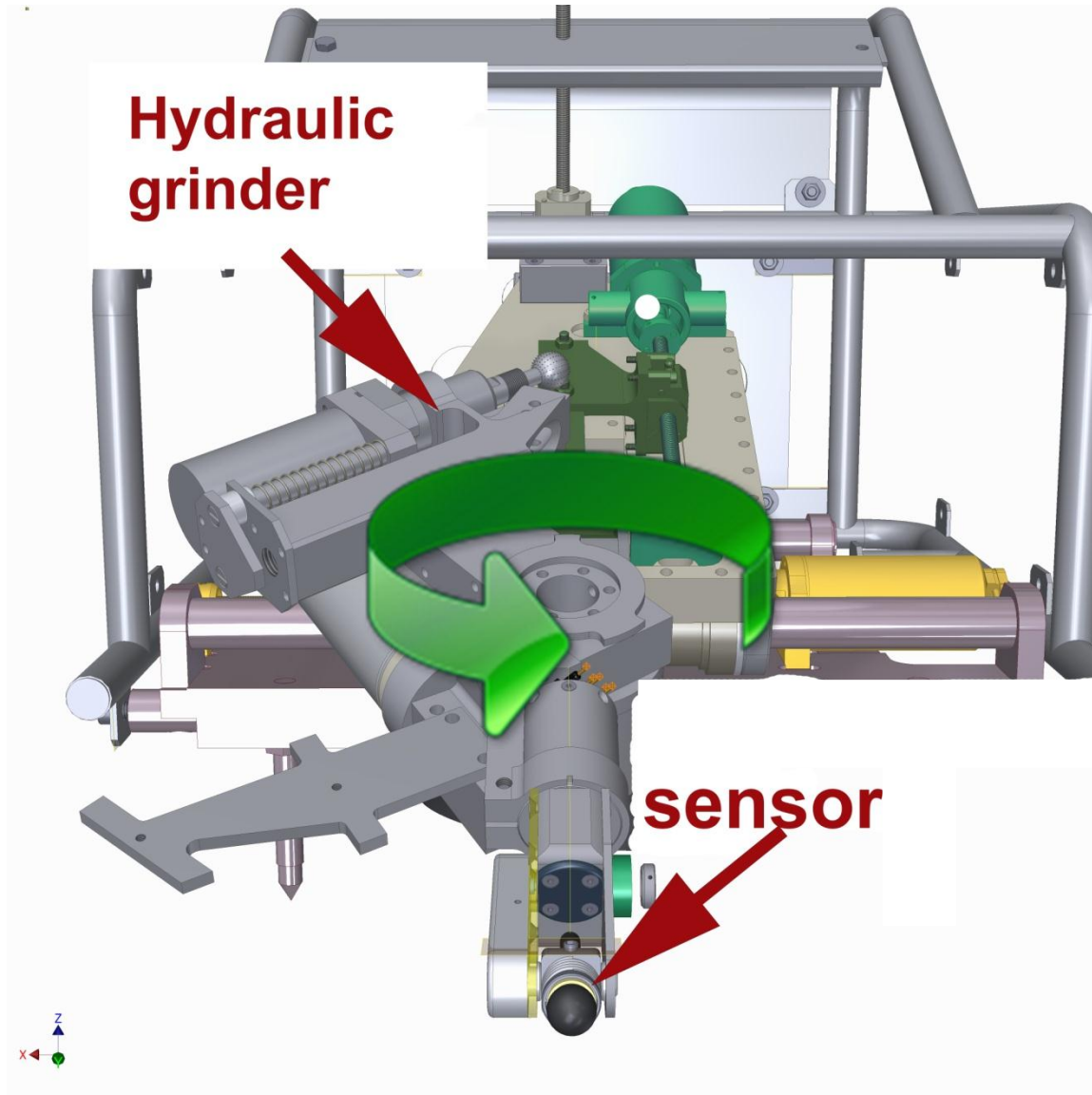
GRIM: Setup



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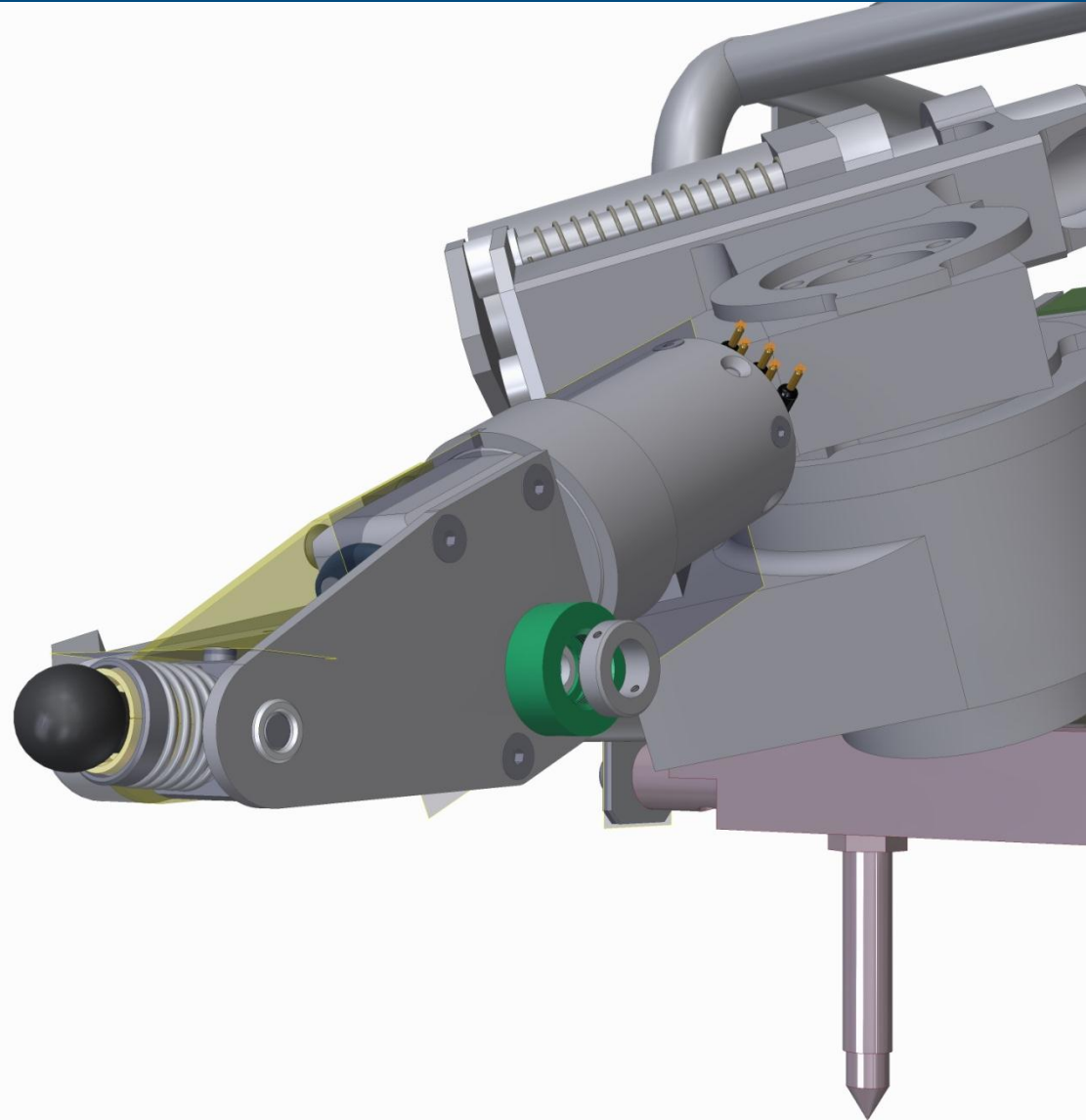
GRIM: Setup



1. Test of accuracy/precision of geometry mapping
2. Test of adequate detection and sizing capability
3. Test of adequate grinding capabilities

GRIM: Functionality

- ✓ Proximity Sensor
- ✓ Eddy Current Probe



GRIM: Accuracy



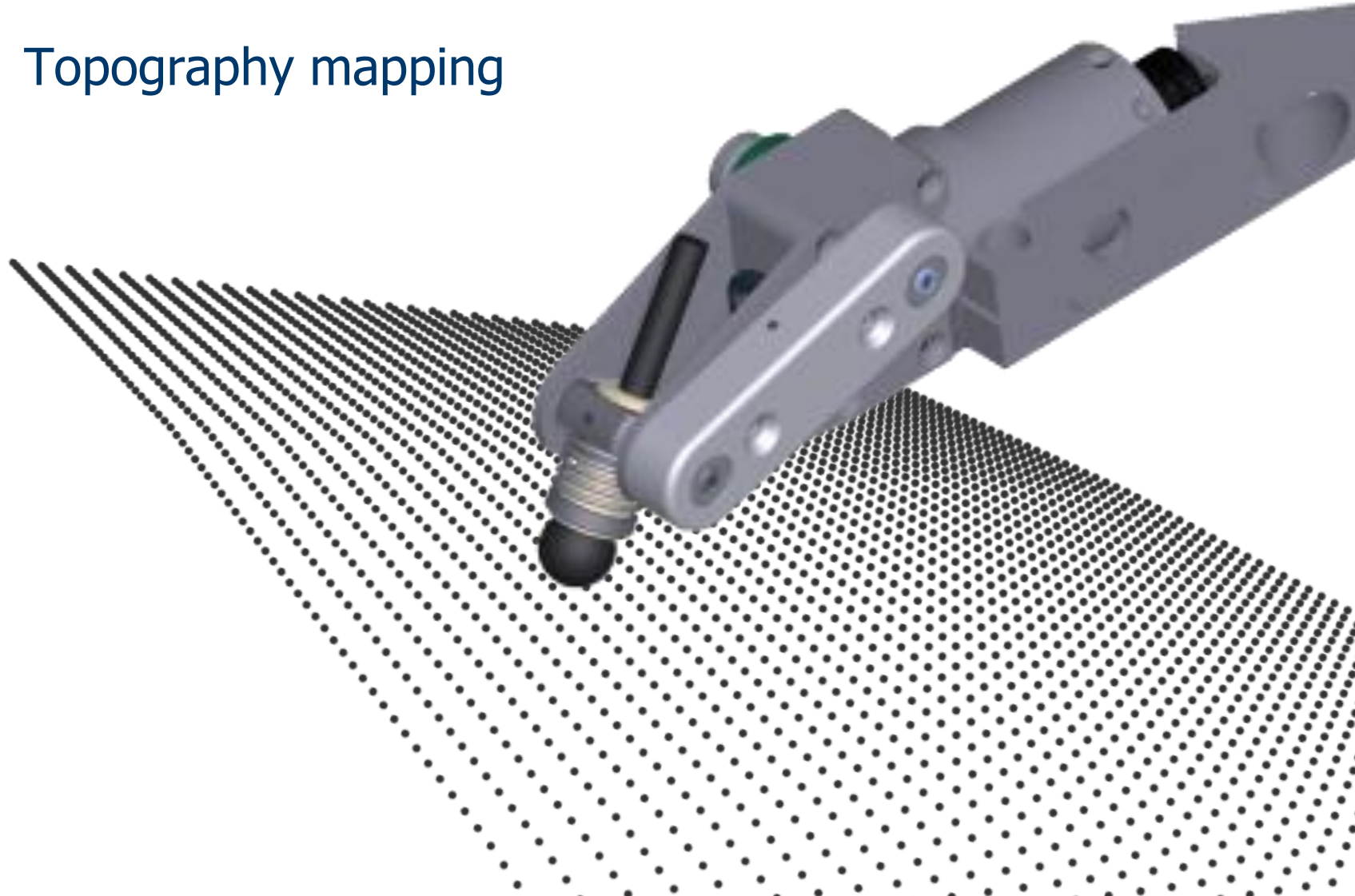
- ✓ Crack length and depth
- ✓ Topography Mapping



GRIM: Proximity mode



- ✓ Topography mapping



GRIM: Proximity mode



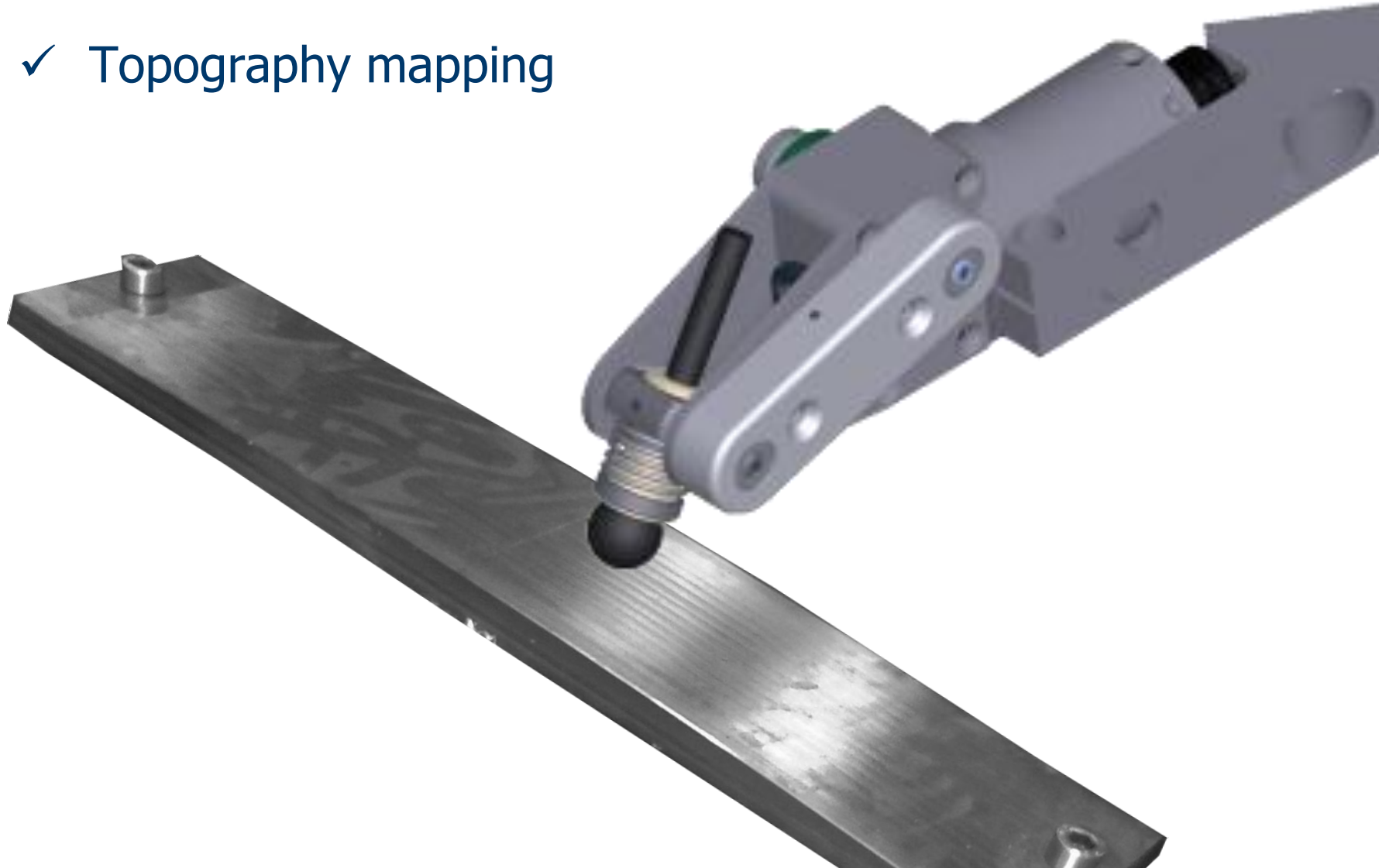
- ✓ Topography mapping precision



GRIM: Sensor precision

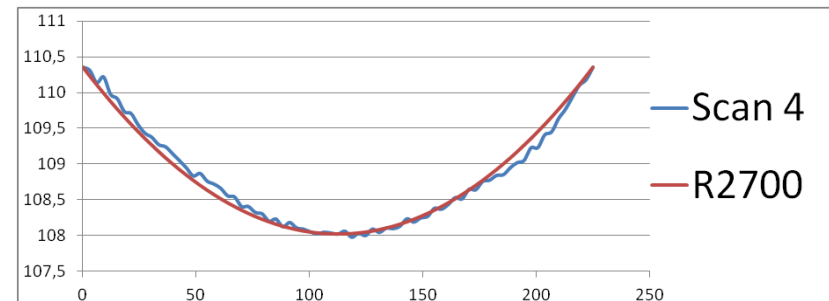
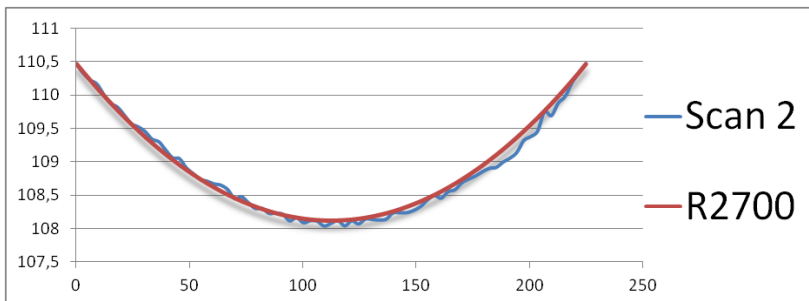
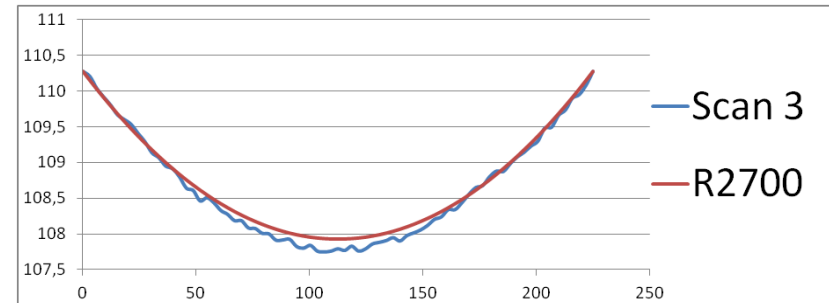
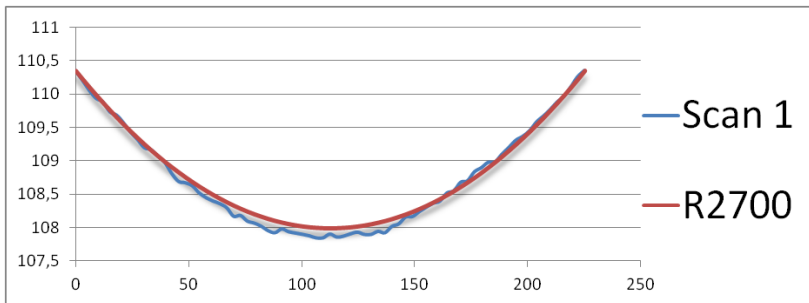


- ✓ Topography mapping



Sensor accuracy

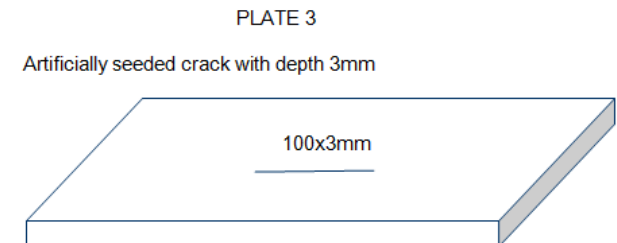
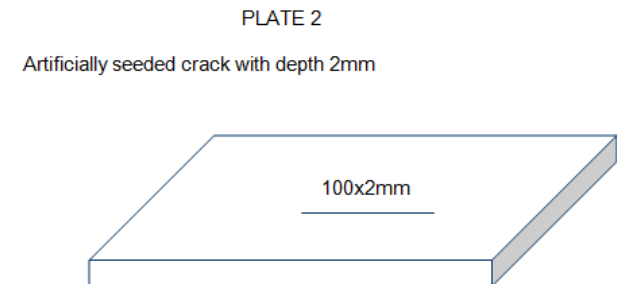
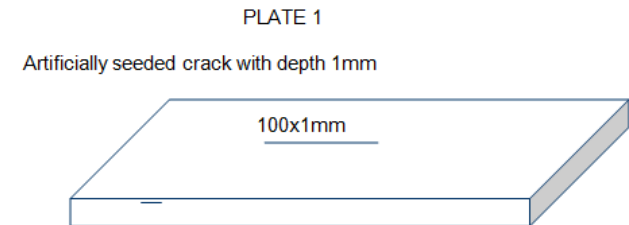
Accuracy: 0.30 mm
Repetability: 0.20 mm



✓ Crack length measurement

Measured crack length (mm)

Crack depth/length [mm]	Test 1 crack length	Repeat 1 crack length	Repeat 2 crack length	Repeat 3 crack length	Repeat 4 crack length
1/100	97.9	98.3	97.3	98.0	97.1
2/100	99.5	99.5	99.5	99.8	99.4
3/100	100.1	99.2	99.5	99.5	99.2



GRIM: Eddy Current precision



✓ Crack depth

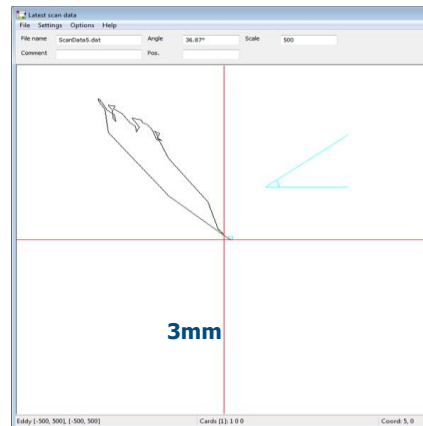
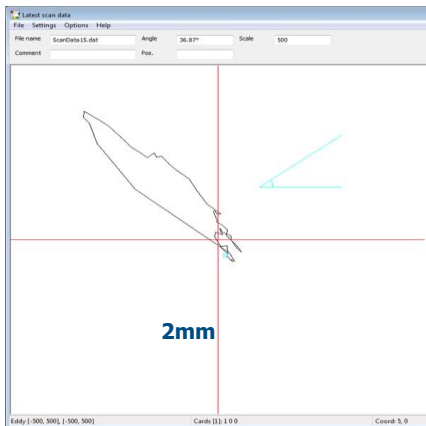
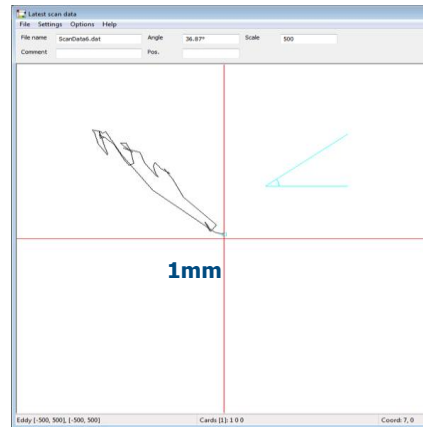
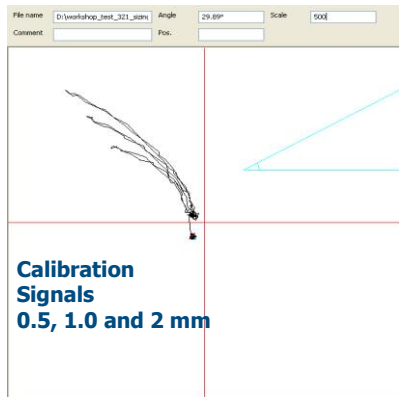


PLATE 1

Artificially seeded crack with depth 1mm

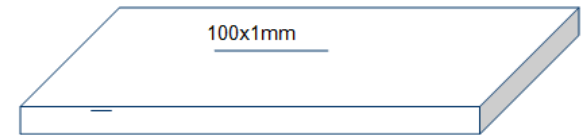


PLATE 2

Artificially seeded crack with depth 2mm

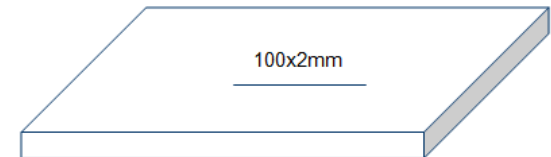
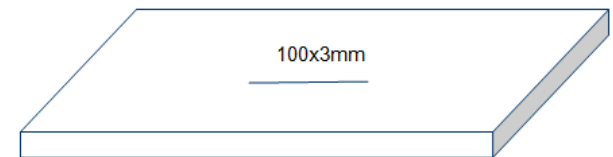


PLATE 3

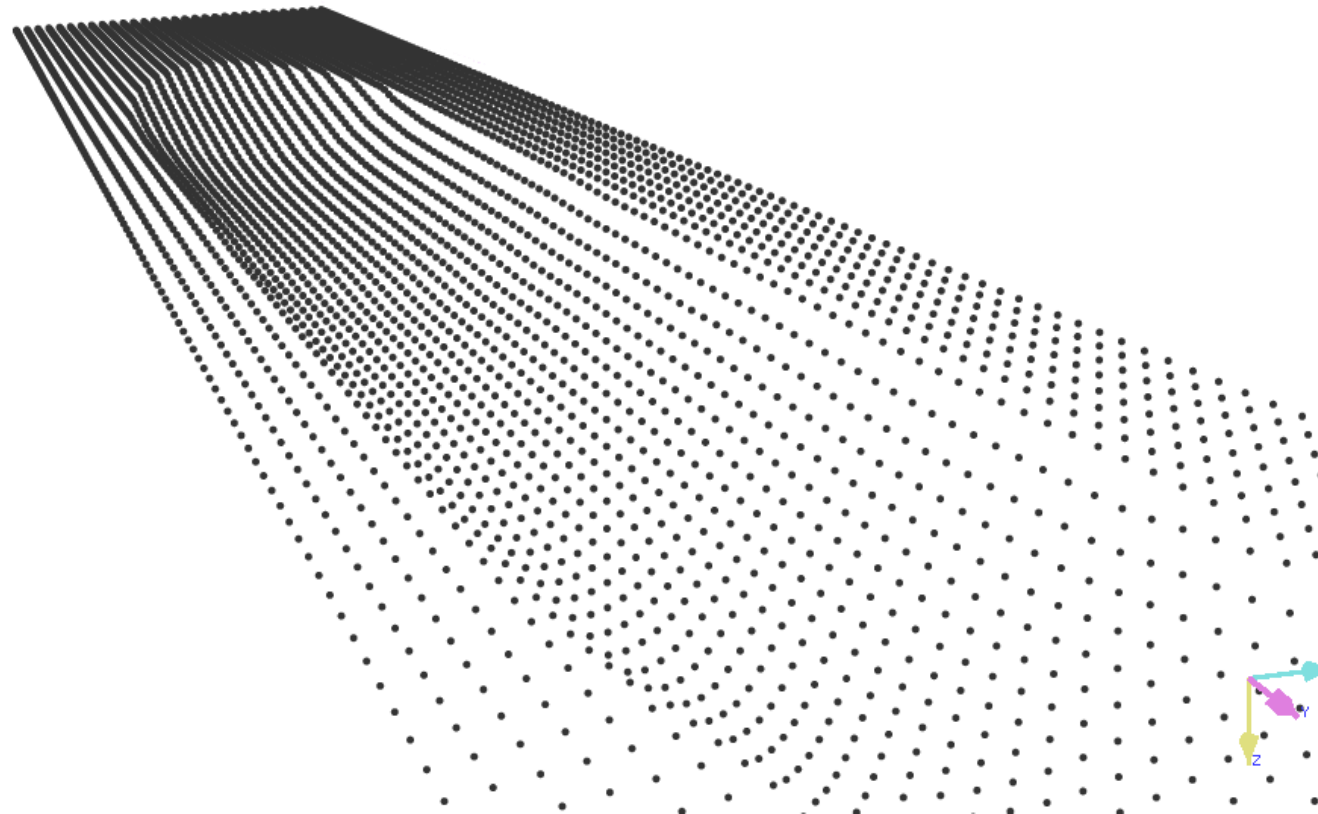
Artificially seeded crack with depth 3mm



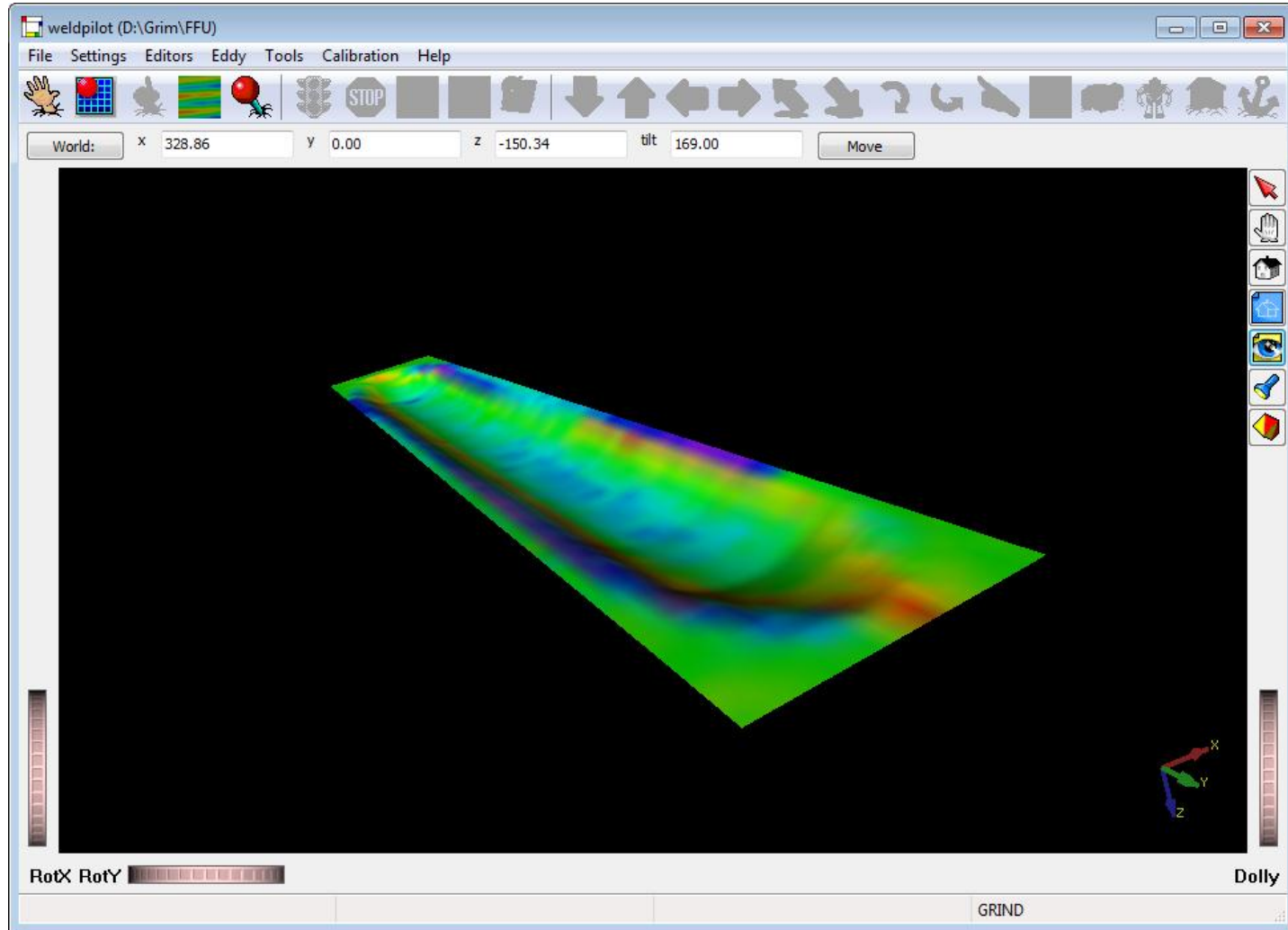


Topography Mapping

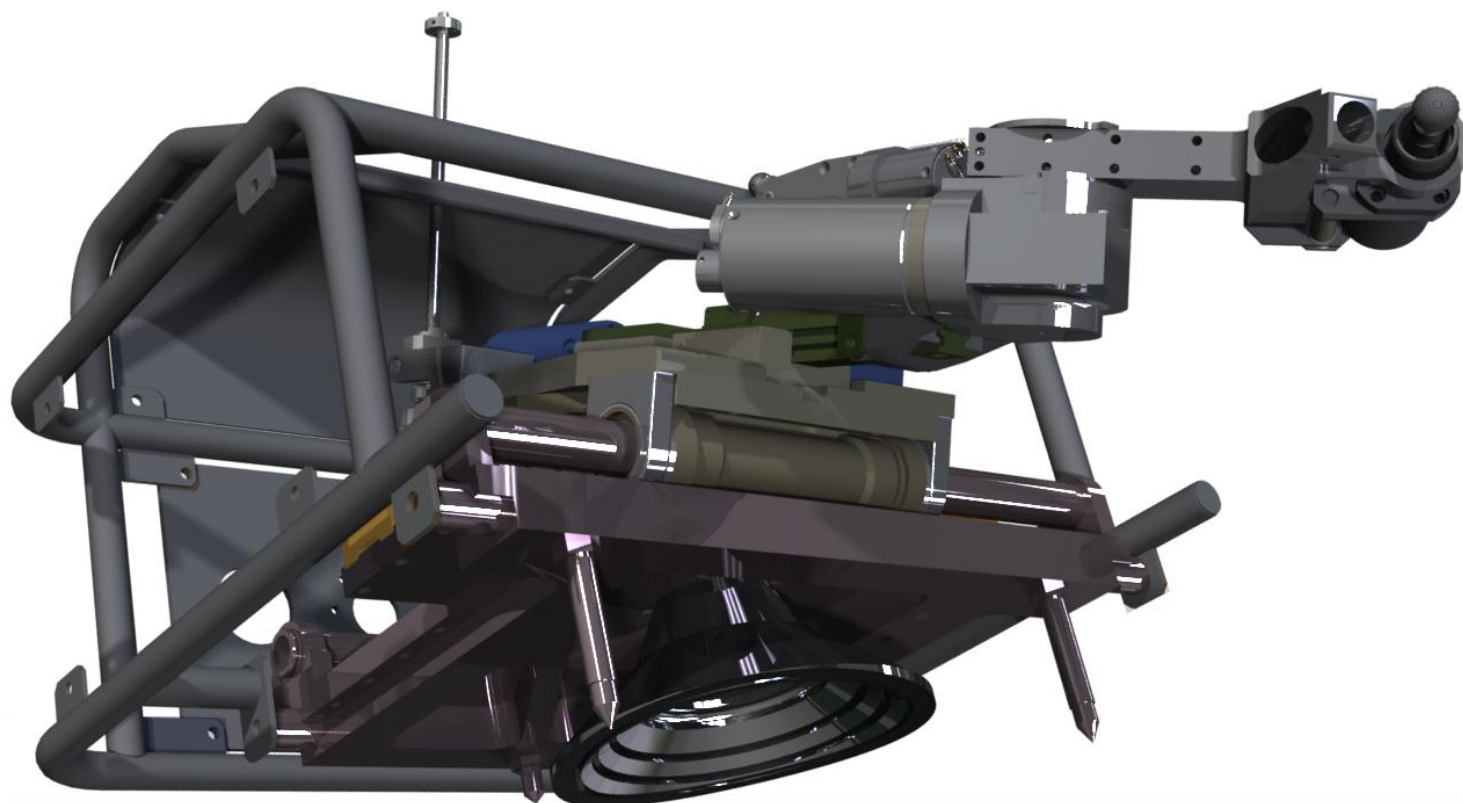
Verifying crack removal

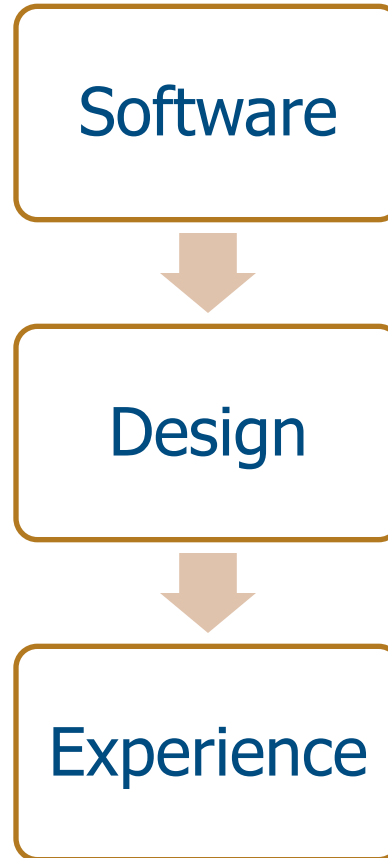


GRIM: Verification



GRIM: Stability





GRIM: History



Design
complete
in 1995

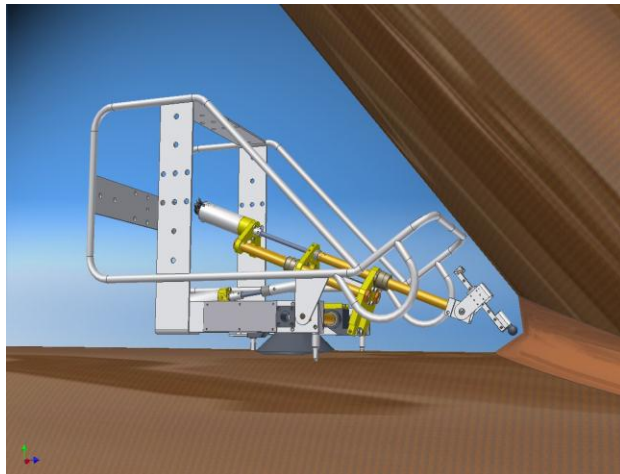
Software
and re-
design
complete
in 2014

Testing,
verification
and FAT
completed
in 2014

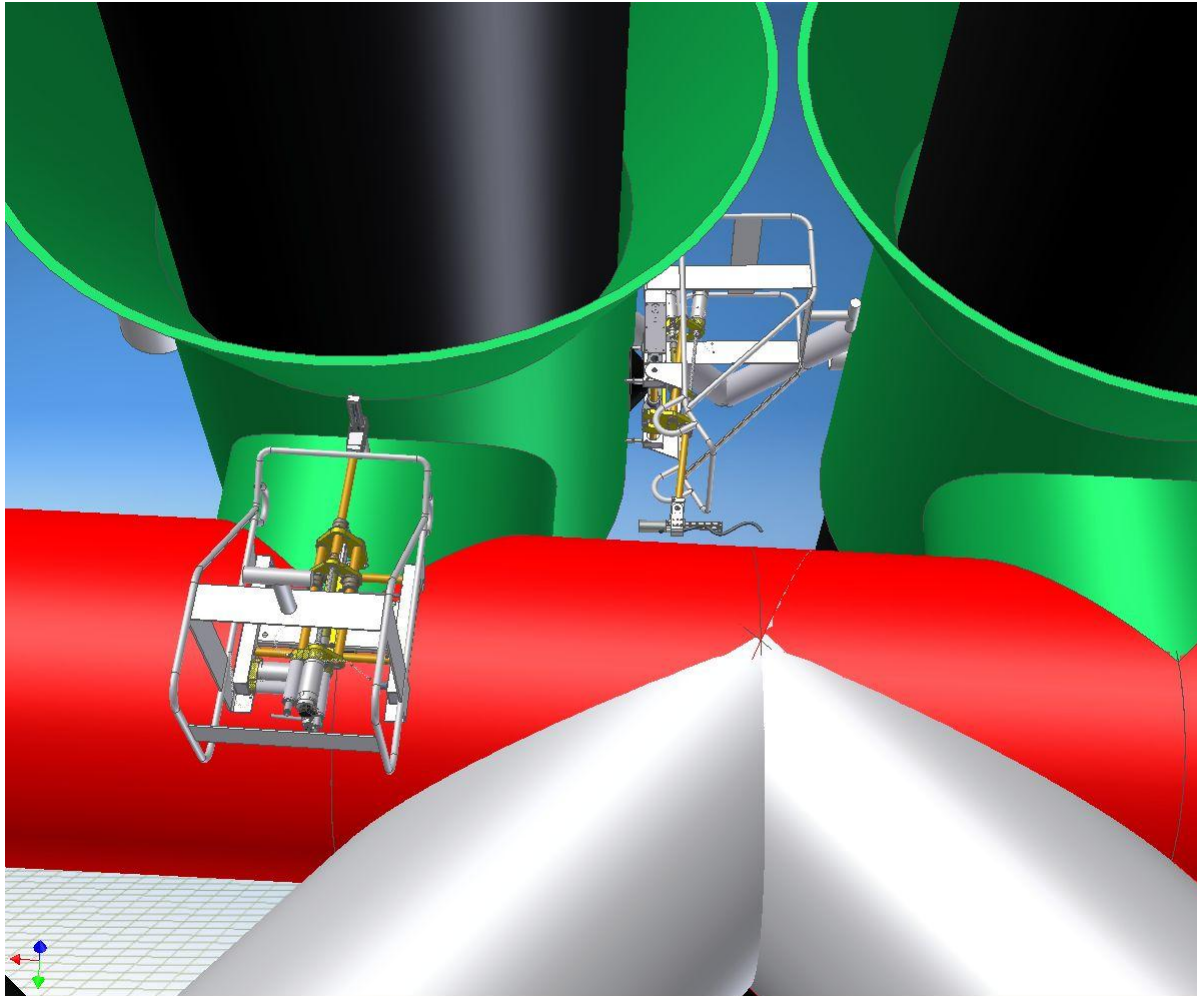
FORCE Inspection

OTHER TOOLS AVAILABLE

- ✓ X-, Y-, Z scanner
- ✓ Scans an area with setting/learning points along the inspection line in e.g. welds

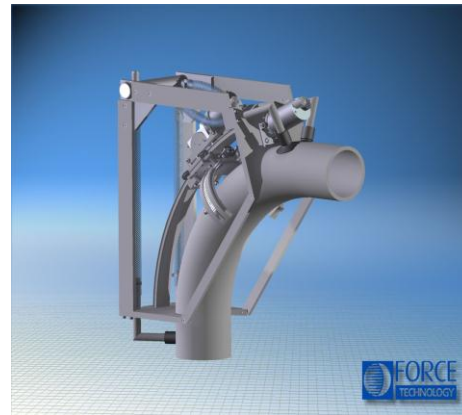


EIM: Access simulation

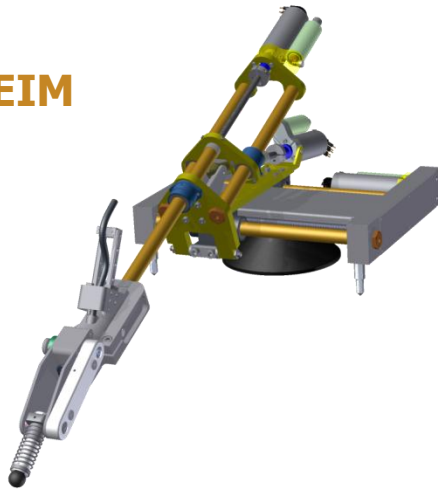


NDT tools for subsea inspection

Bend Scanner

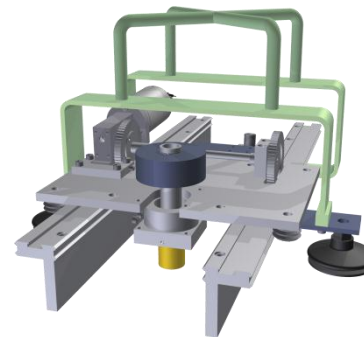
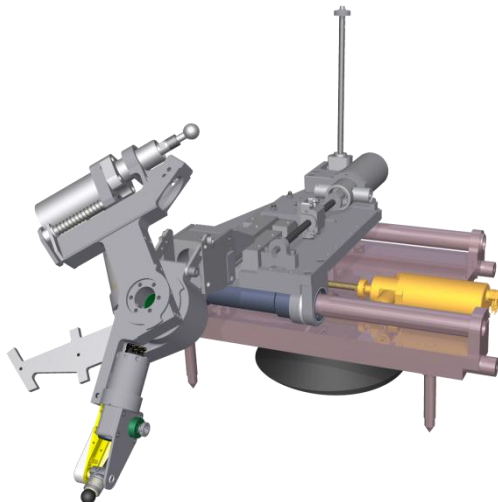


EIM

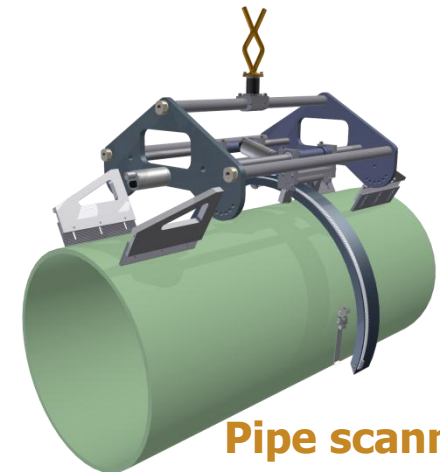


P-scan / AUS-4

GRIM



Level measurements



Pipe scanner

Summary



- ✓ Extensive experience within inspection, materials technology, design and simulation
- ✓ A wide range of different scanner solutions for a variety of operations
- ✓ Proven technology and standardised components
- ✓ Highly skilled and trusted offshore personnel who understand the importance of the operation

FROM KNOWLEDGE TO VALUE

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