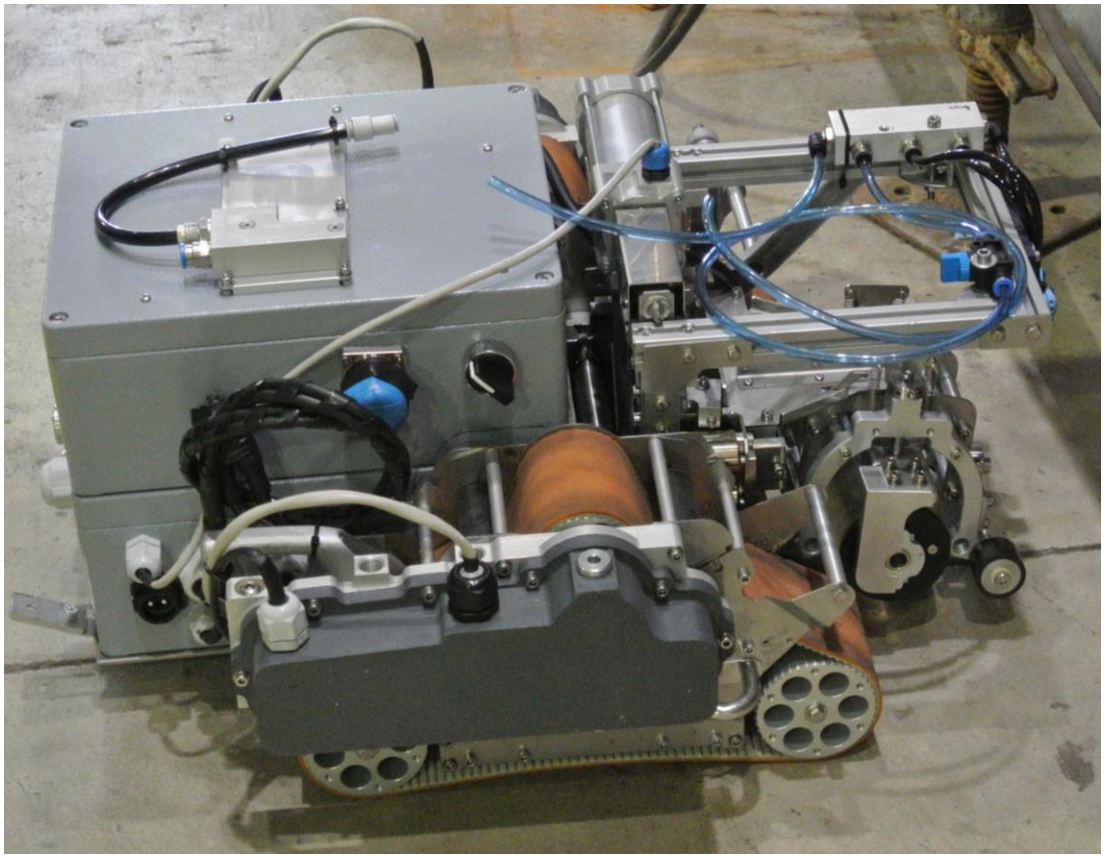
TecniTest NDT

SPECTRE-X



A fully automated laser guided inspection robot for weld defect and corrosion detection on ship hulls

Project Shiptest

- **Shiptest** is a collaborative project of 5 partners aiming to produce an NDT robotic inspection system focusing on inspecting ships' hulls.
- Shiptest follows the successfully completed **X-Scan** demonstrator robot
- SPECTRE-X is the name and logo given to the robotic NDT inspection system developed within the framework of the Shiptest project.
- Shiptest is an FTI project funded by the EU under the H2020 scheme.

The ShipTest Proposal

Carrying out:

Inspection of welded joints and corrosion mapping on ships' hulls using a robot to drive PAUT, ACFM and Laser Profilometer sensors

Employing:

Phased Array Ultrasonic Testing (PAUT)

Alternating Current Field Measurement (ACFM)

Laser profiling of the welded joint

With:

Laser guidance system to follow the welded joint and the software developed for the data capture and display of this technology.

The ShipTest Proposal

In Addition:

Using a PAUT Transducer in a Roller Probe for corrosion mapping of Ship Hull Plates

At Sea

The whole system will be manufactured according to IP 68.

THE ROBOT

Functional specifications

- The robot can be driven by an operator through a means of a joystick.
- The operator drives the robot to access the weld to be inspected.
- The robot deploys the NDT equipment on the weld upon command by the operator.
- The robot can move along the weld at a constant speed of desired value.
- The robot corrects the lateral position “error” of the NDT equipment, i.e. the offset from the centre-line of weld, based on feedback from the on-board laser profilometer.
- The robot moves vertically and horizontally on steel plates.

THE ROBOT

Functional specifications continued

- The robot moves along the weld on significantly curved surfaces. The curvature set as target was 1m radius which is significantly more compact when compared to the 2.5m that is required in most cases for hull inspection.
- The robotic system has ingress protection IP68, with 30m depth.
- The robot is able to overcome small profile obstacles such as welds in the case of cross-section and screws.
- The robot has integrated means for lifting the sensors in case the system detects that there is a possibility to damage them due to the variation of the surface where the robot operates.

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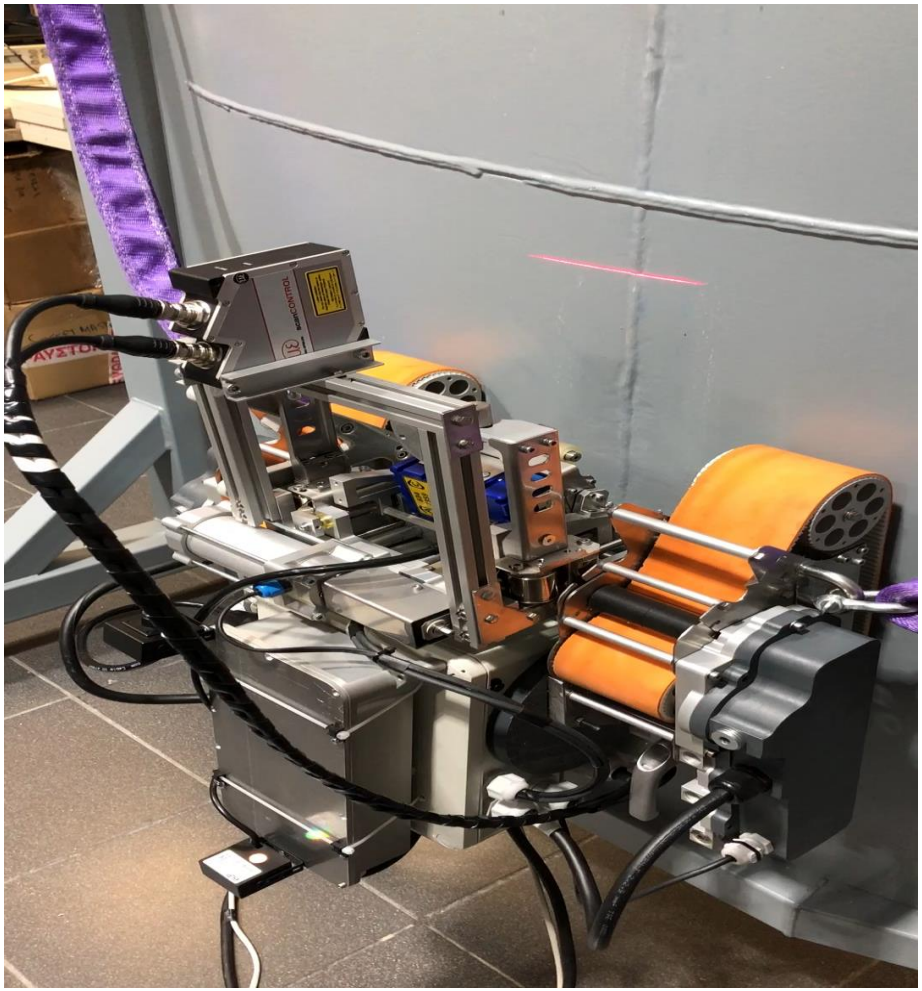
THE ROBOT

Functional specifications continued



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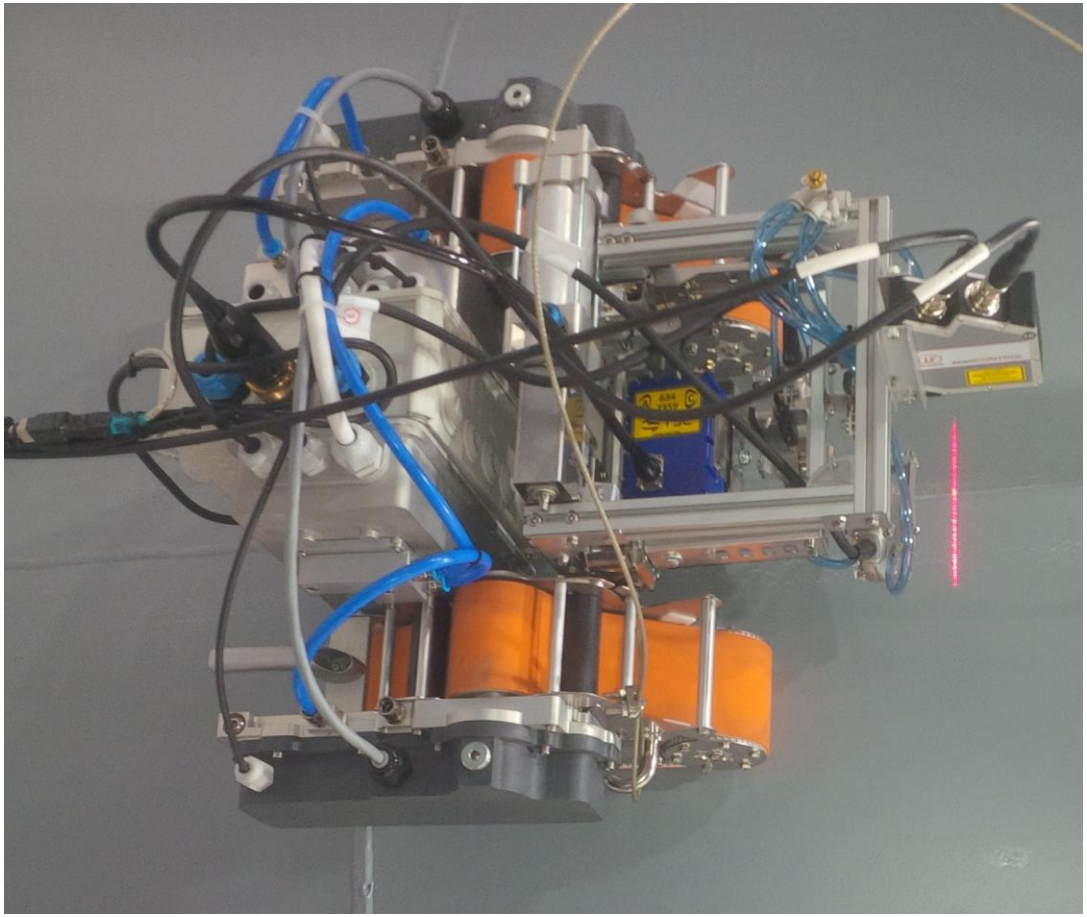
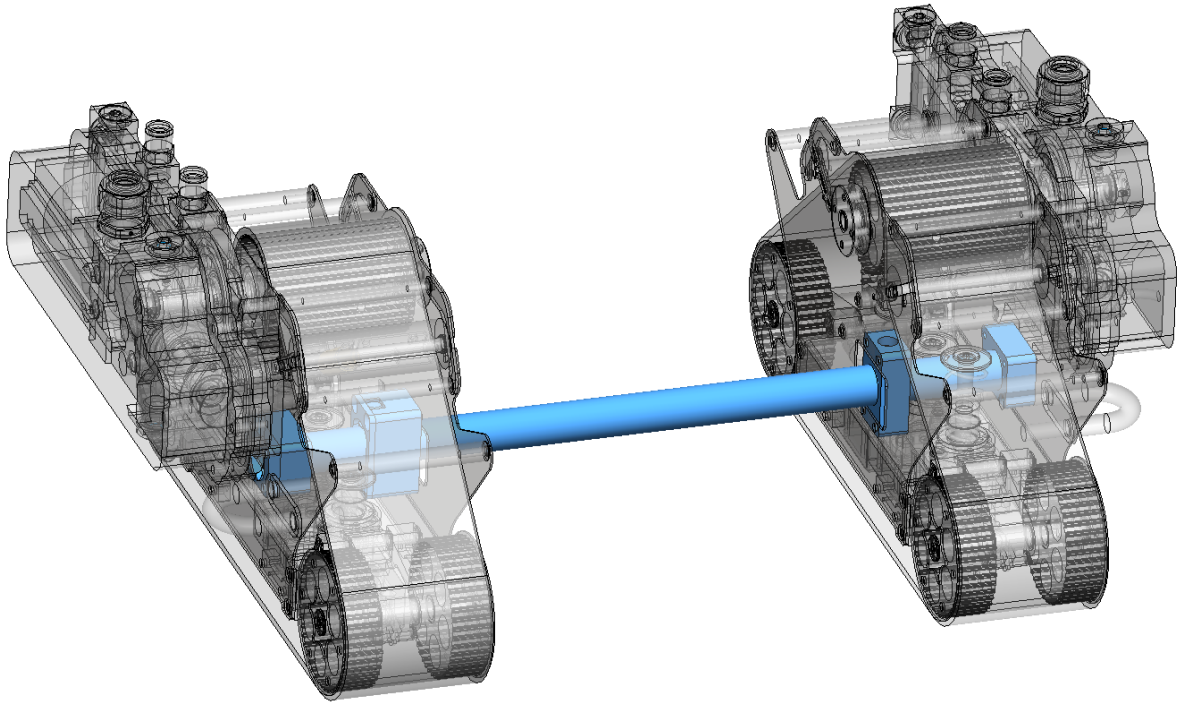
THE ROBOT

Solution

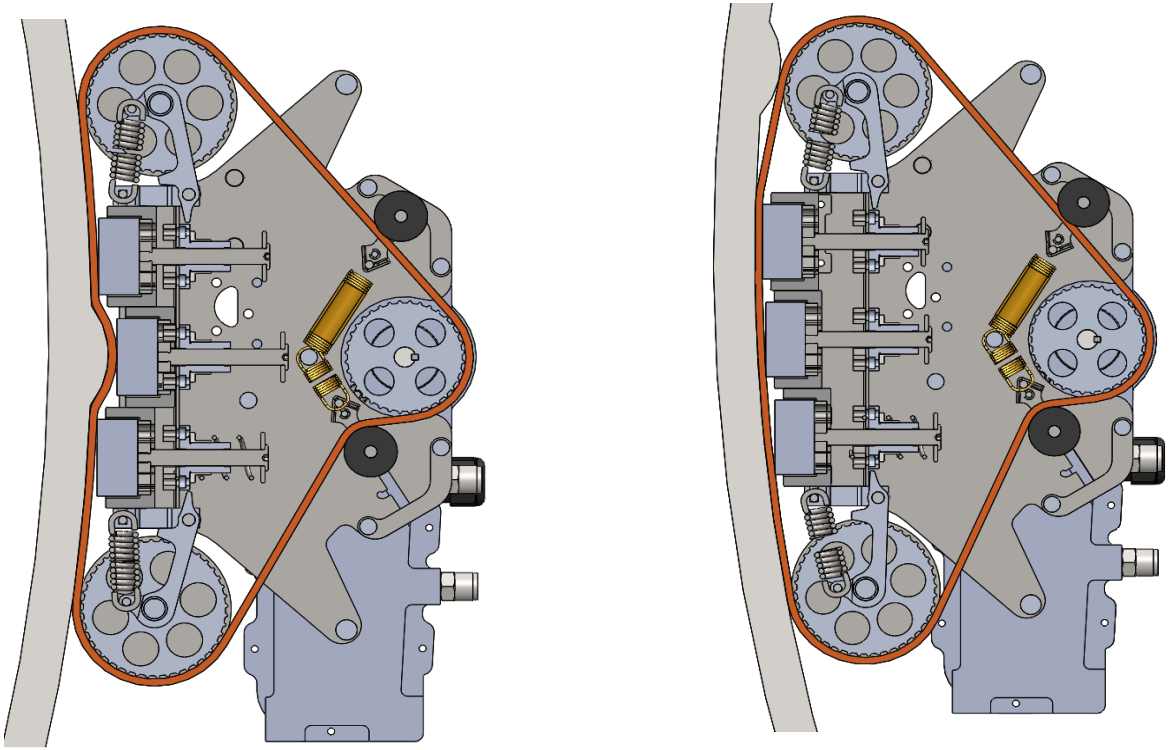


THE ROBOT CONTINUED



Maximum 5 degrees (±2.5 degrees) passive rotation between the two belt modules

THE ROBOT CONTINUED



Permanent magnets hold the crawler on convex and concave surfaces of any orientation

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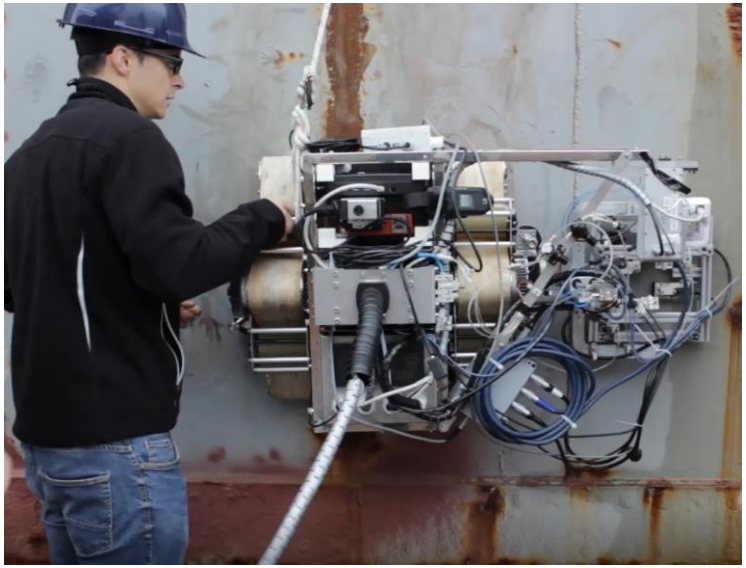
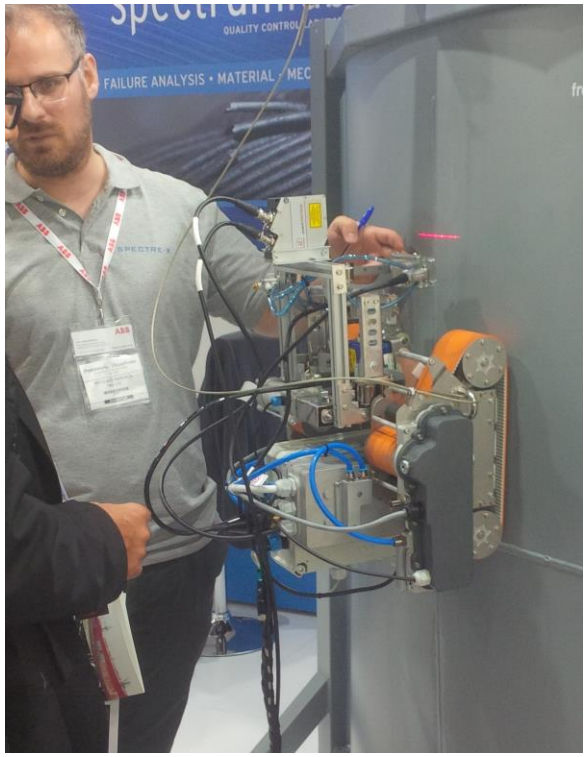
THE ROBOT - miniaturization



The old X-Scan with sensors outside the main structure



The all new Spectre-X with sensors inline with the main structure

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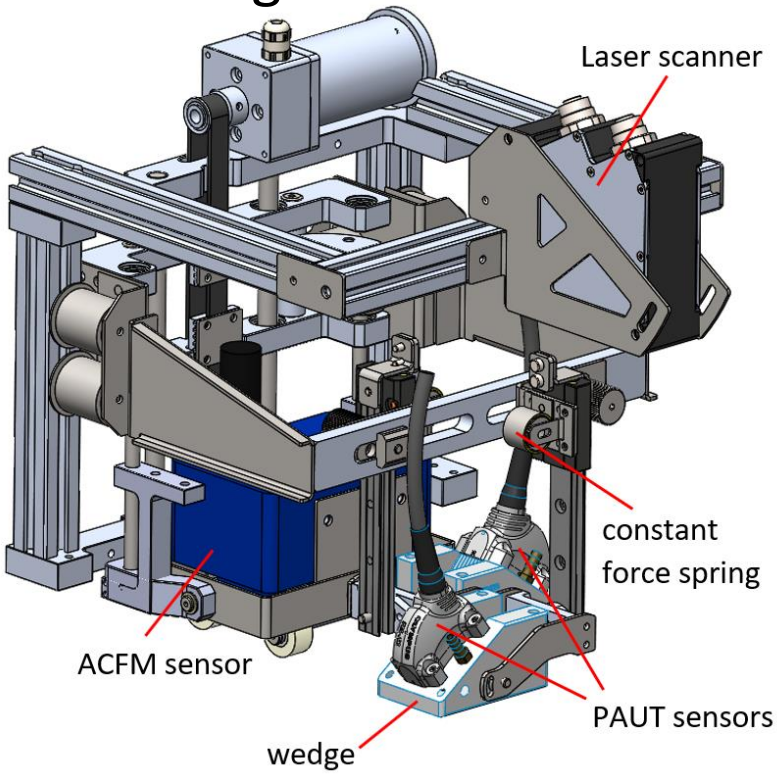
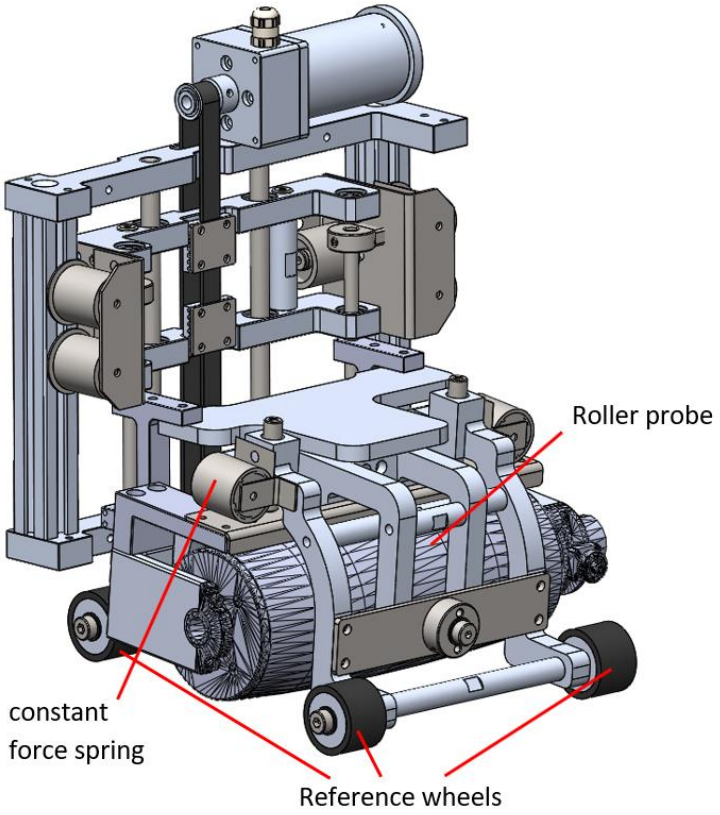
THE ROBOT CONTINUED

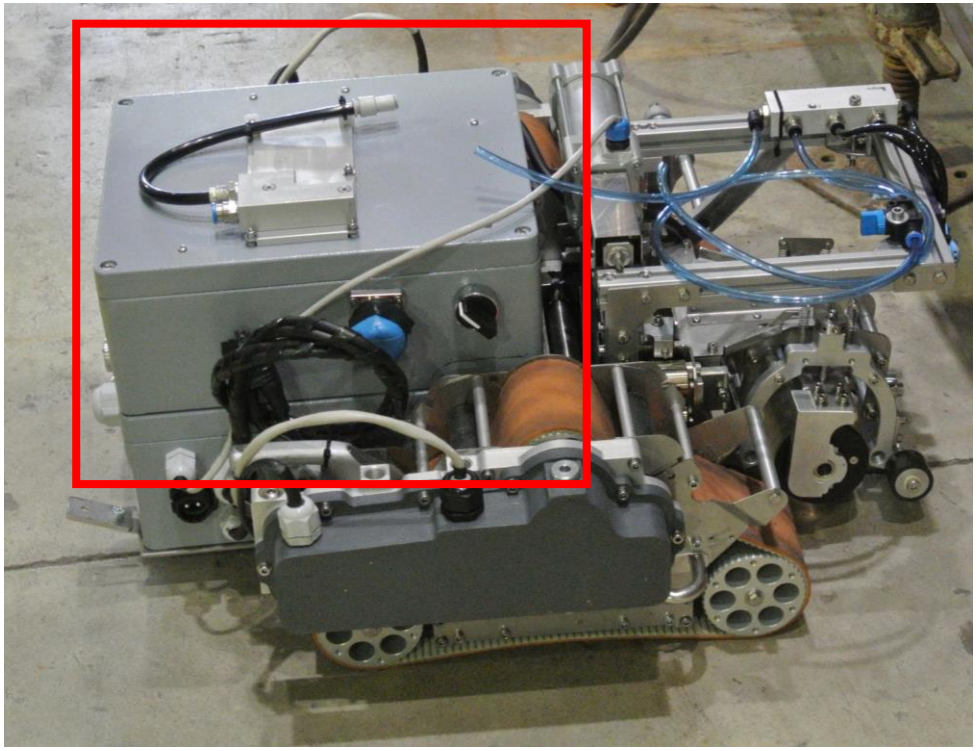
Weld inspection Configuration



Corrosion inspection Configuration



Electronic enclosures



Water Cooling for PCBs, proven to be very effective

Inspection Methods

Laser Tracking:

Laser to be used to track the weld. Keeping the Robot on track and the Sensors in the correct position for the inspection

Laser data capture to give indications of surface defects iaw EN ISO 17637

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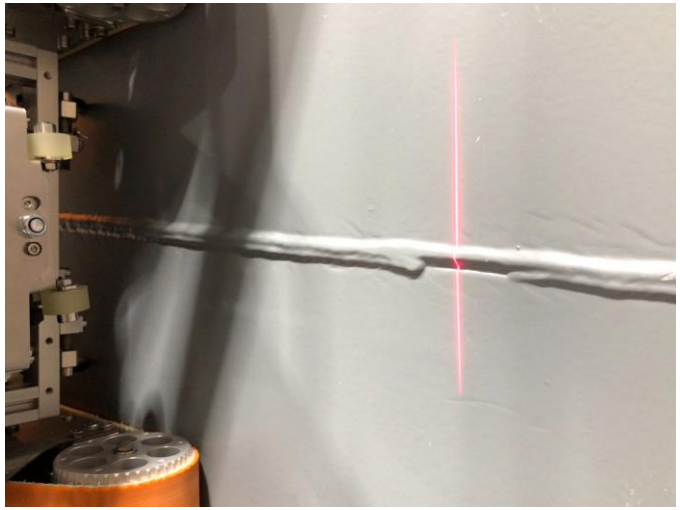
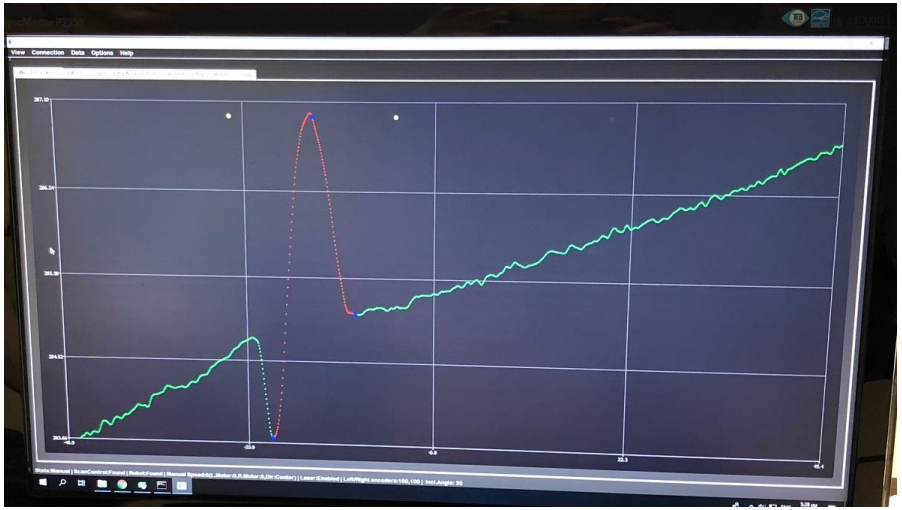
Inspection Methods

Laser Data Capture



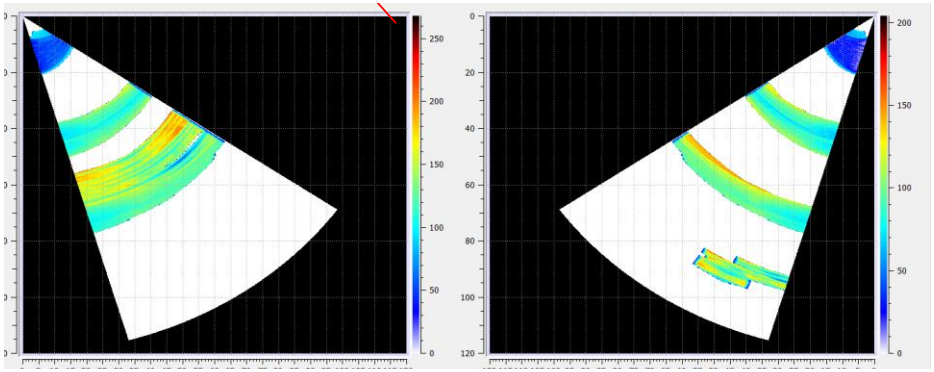


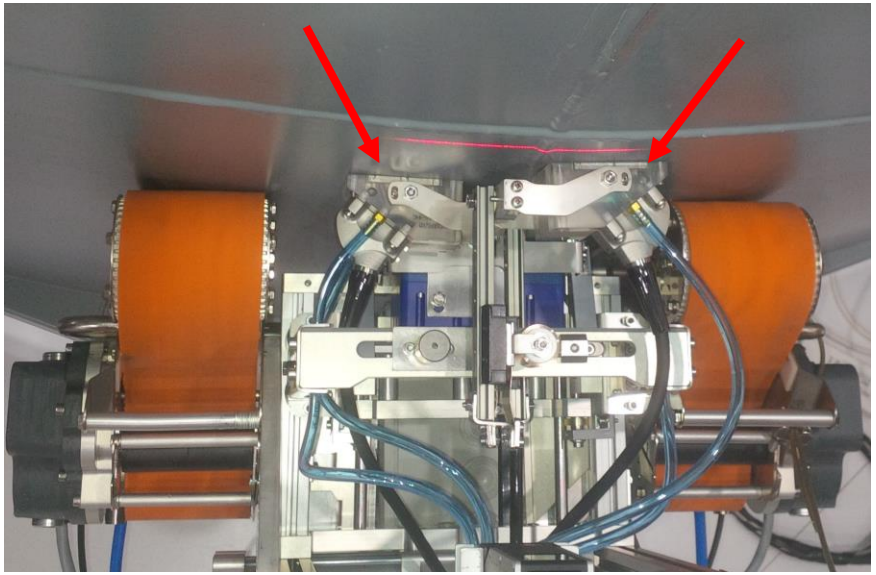
The under cut in the weld can be clearly seen in the laser profile screen

Inspection Methods

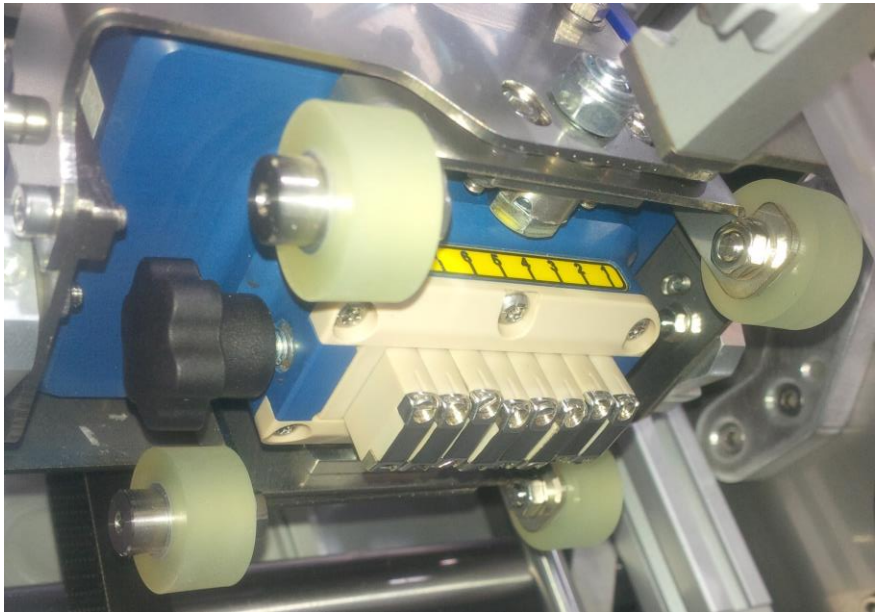
Phased Array Ultrasonics (PAUT):

- Used for the inspection of the weld for volumetric defects





Inspection Methods



Alternating Current Field Measurement (ACFM):

Used for the inspection of the Weld Cap for surface and near surface defects, cracking and porosity

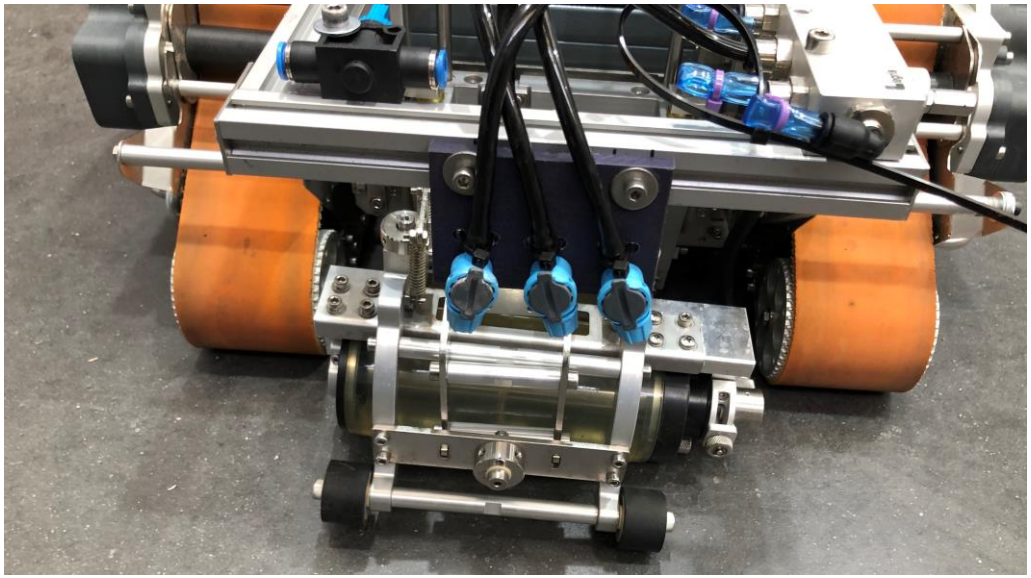
Inspection Methods

PAUT in Roller Probe:

128 element PAUT Probe.

With 3 adjustable water squirters for coupling.

Used for Corrosion mapping inspection of ships plates.



The Control

- A Base station to be placed on the dock or on the ships deck with Joystick control.
- Deployment by 2 personnel onto the hull Surface, via ramp system.
- Driven to the start of the inspection site using a Graphical User Interface (GUI)
- Laser guided system to ensure Weld always in centre of inspection, via feedback system.
- For corrosion inspection a pattern to be employed from the software.

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Graphical User Interface

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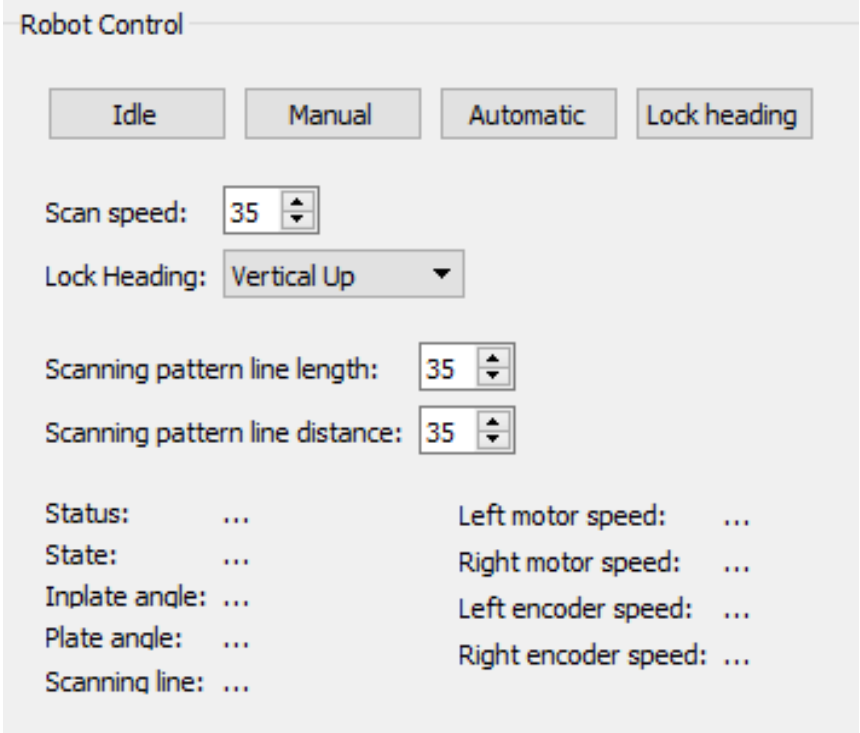
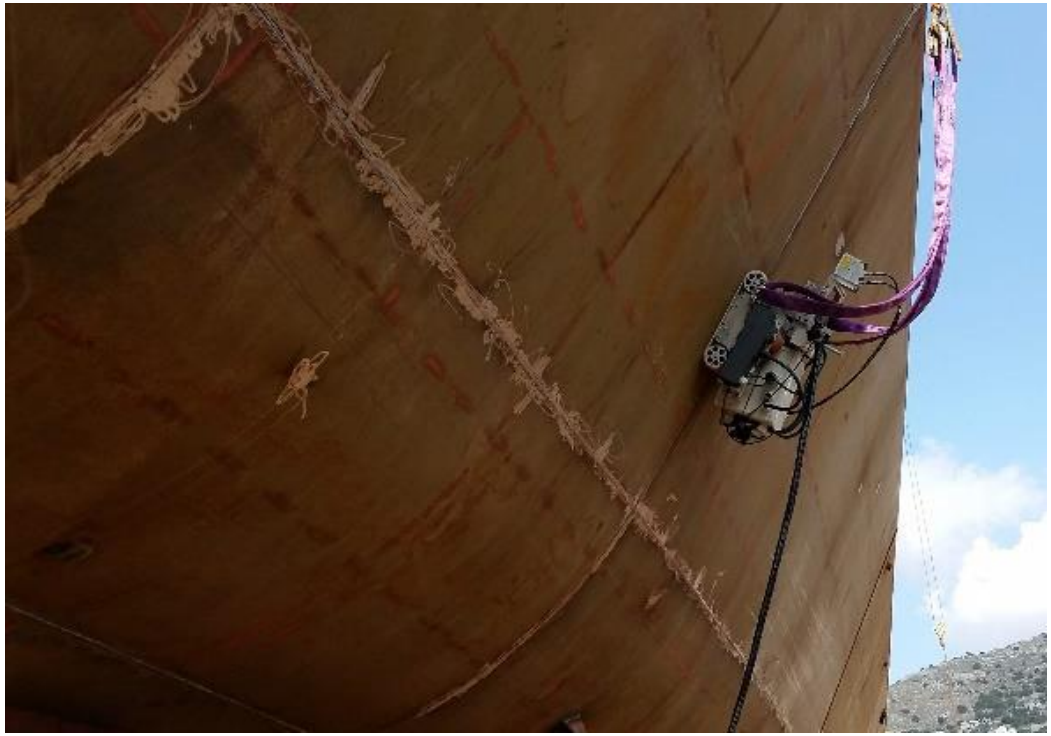
Corrosion Mapping Control

- Scan speed for automatic mode can be set for 5 to 50 mm/s.
- Scanning pattern line length
- Scanning pattern line distance
- Scanning pattern width
- Lock direction can be set Status of the robot
- Inplate angle: The angle that indicates the direction of the robot on the plate measured by the inclinometer.
- Plate angle: The angle of the plate with relation to the gravity measured by the second inclinometer.



Field Trials

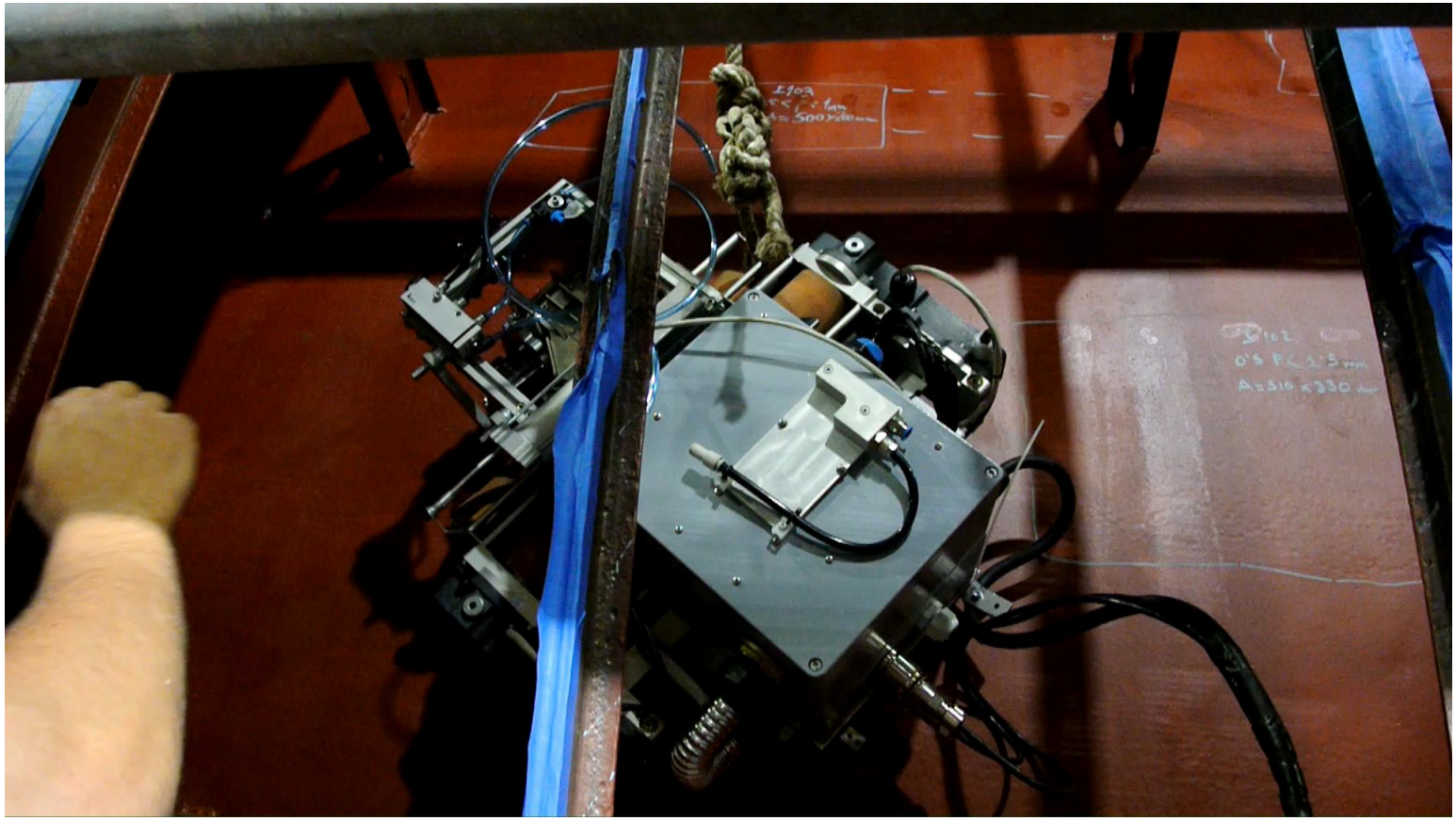


Field trials commenced in a shipyard in Piraeus, Greece.
The scope of this first test was to assess the capability of the crawler system to move on various orientations on flat and curved surfaces while trawling behind a 30m tether cable. Additionally the laser tracking function was tested

Field Trials

Trials have recently been carried out on a Submarine inner pressure hull to evaluate the detection capability for corrosión.

Field Trials



Checking the movement under the structure

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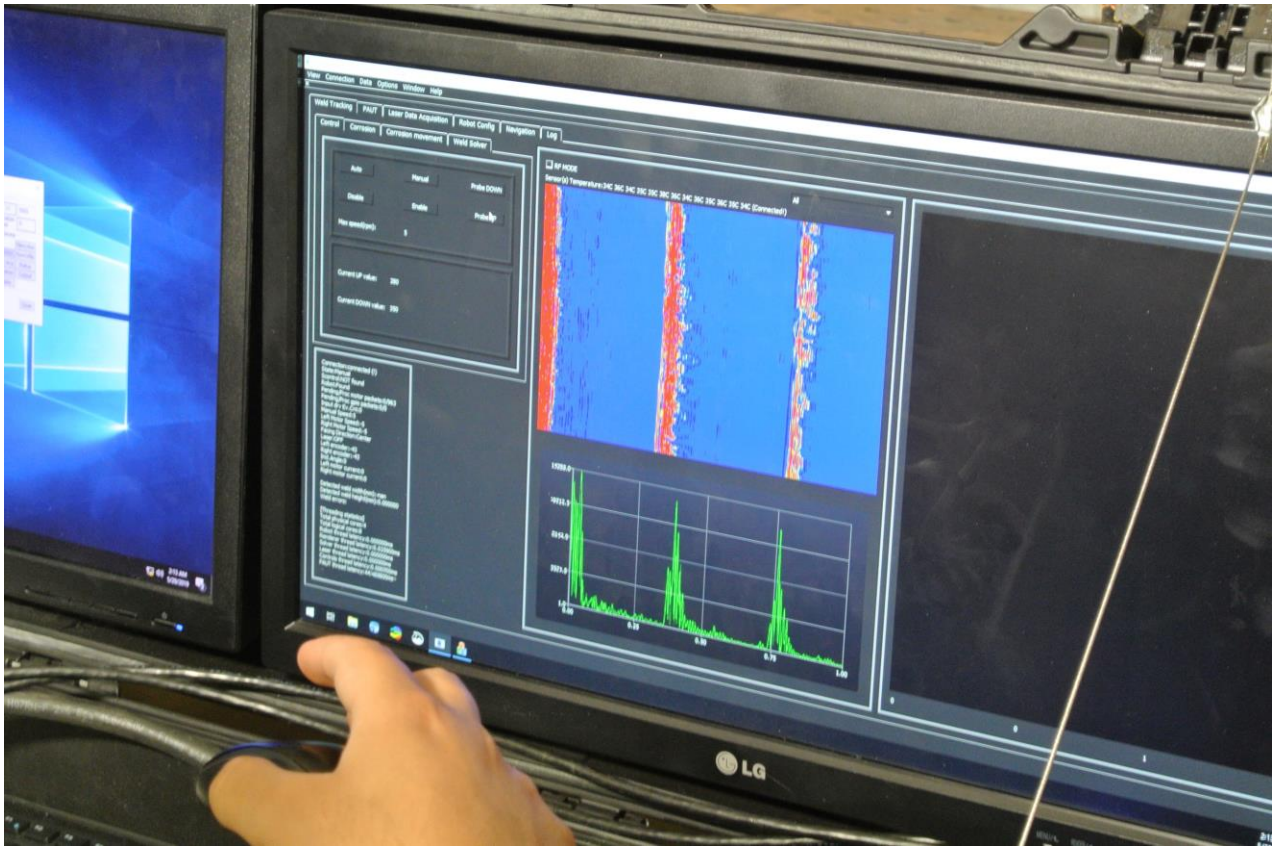
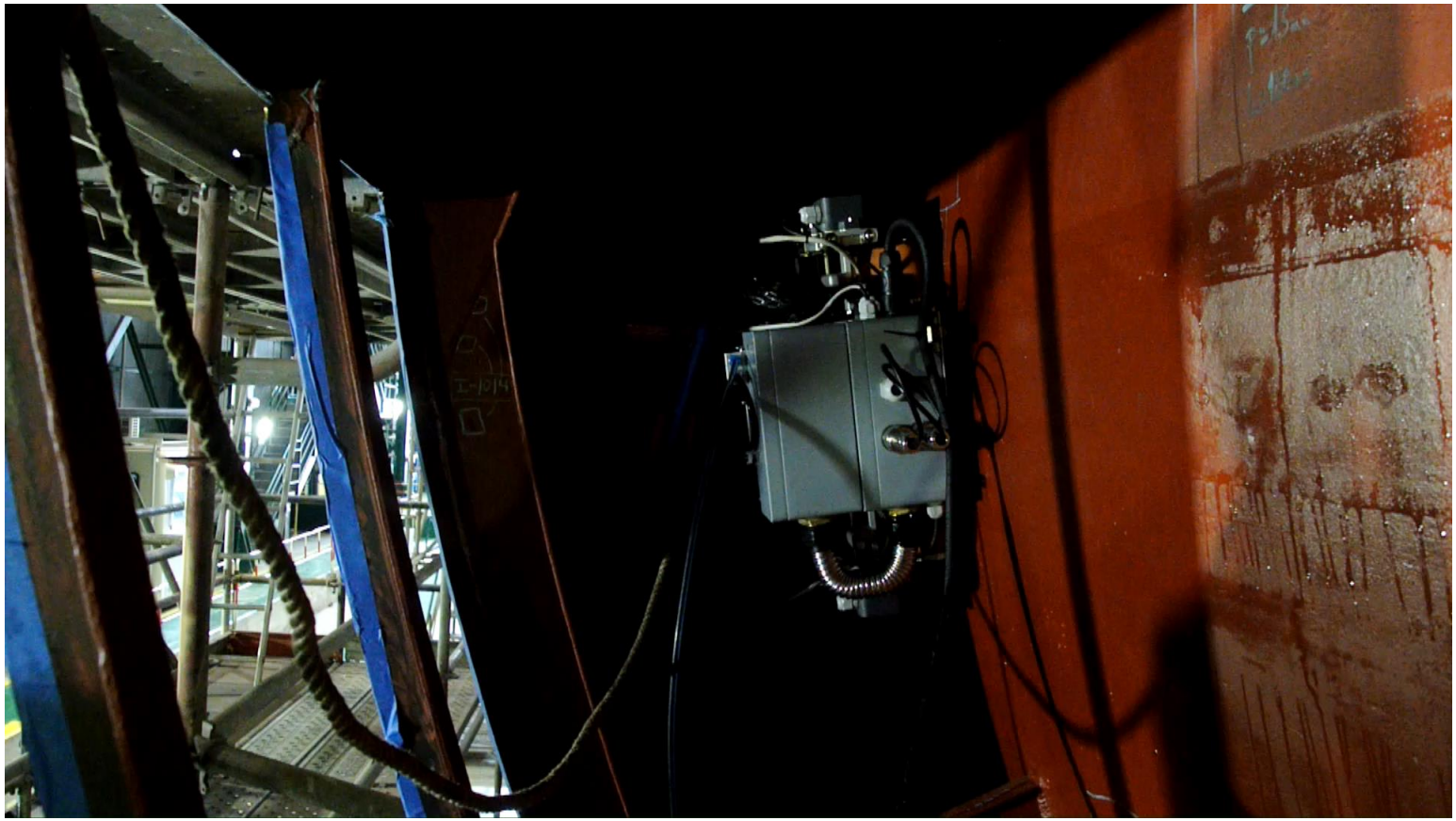
Field Trials



This image shows the roller to Surface interface, the backwall echo and the repeat of the back wall echo.

Field Trials



Into the space between the outer skin and the pressure bulk head

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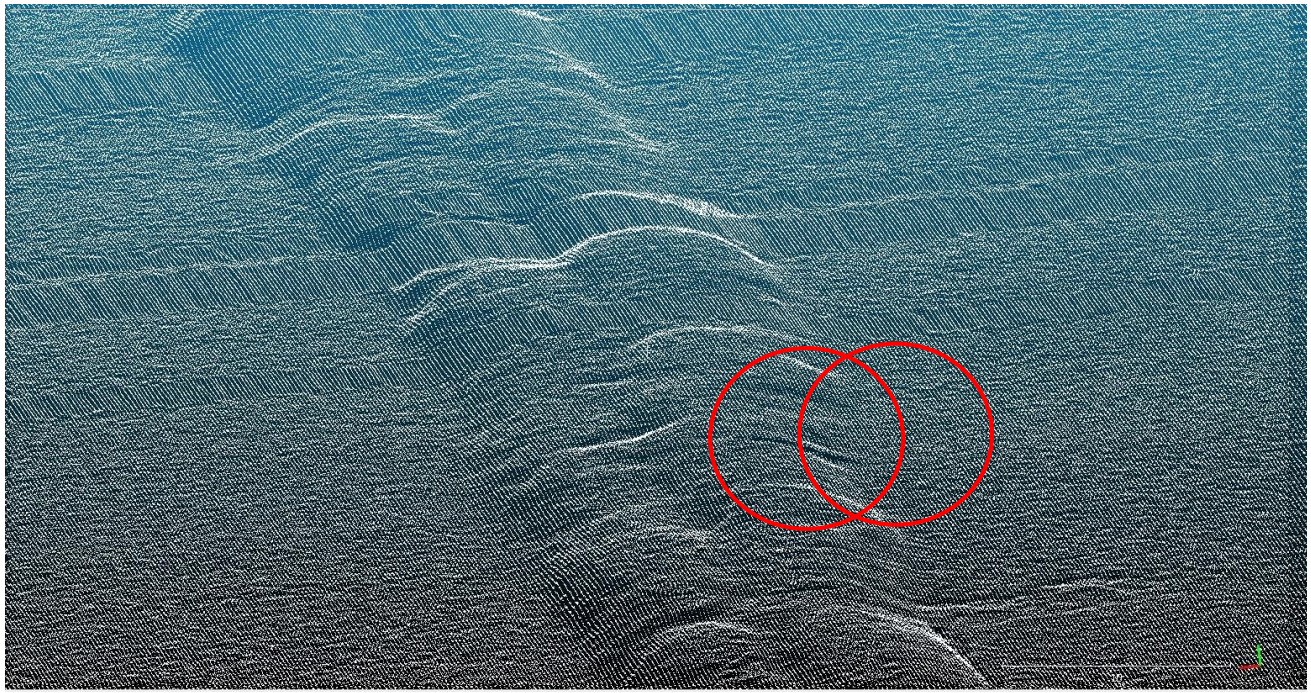
Post Inspection Analysis
Weld Inspection



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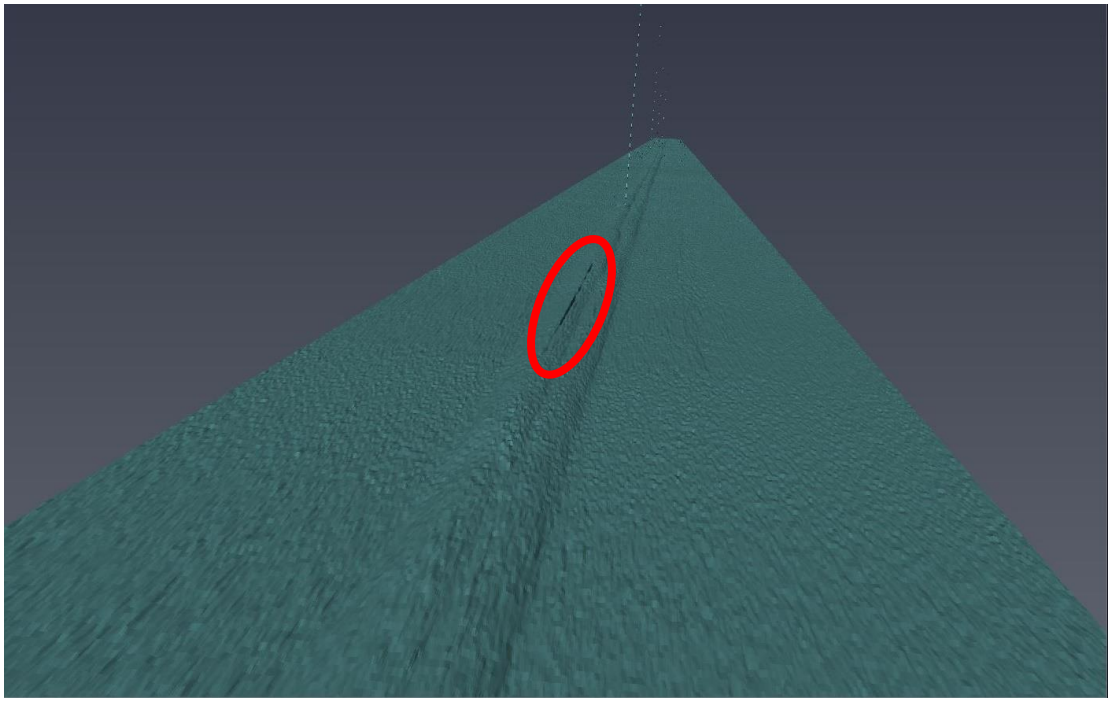
Post Inspection Analysis
Weld Inspection



Reconstruction of Weld Inspection showing the location of Defects

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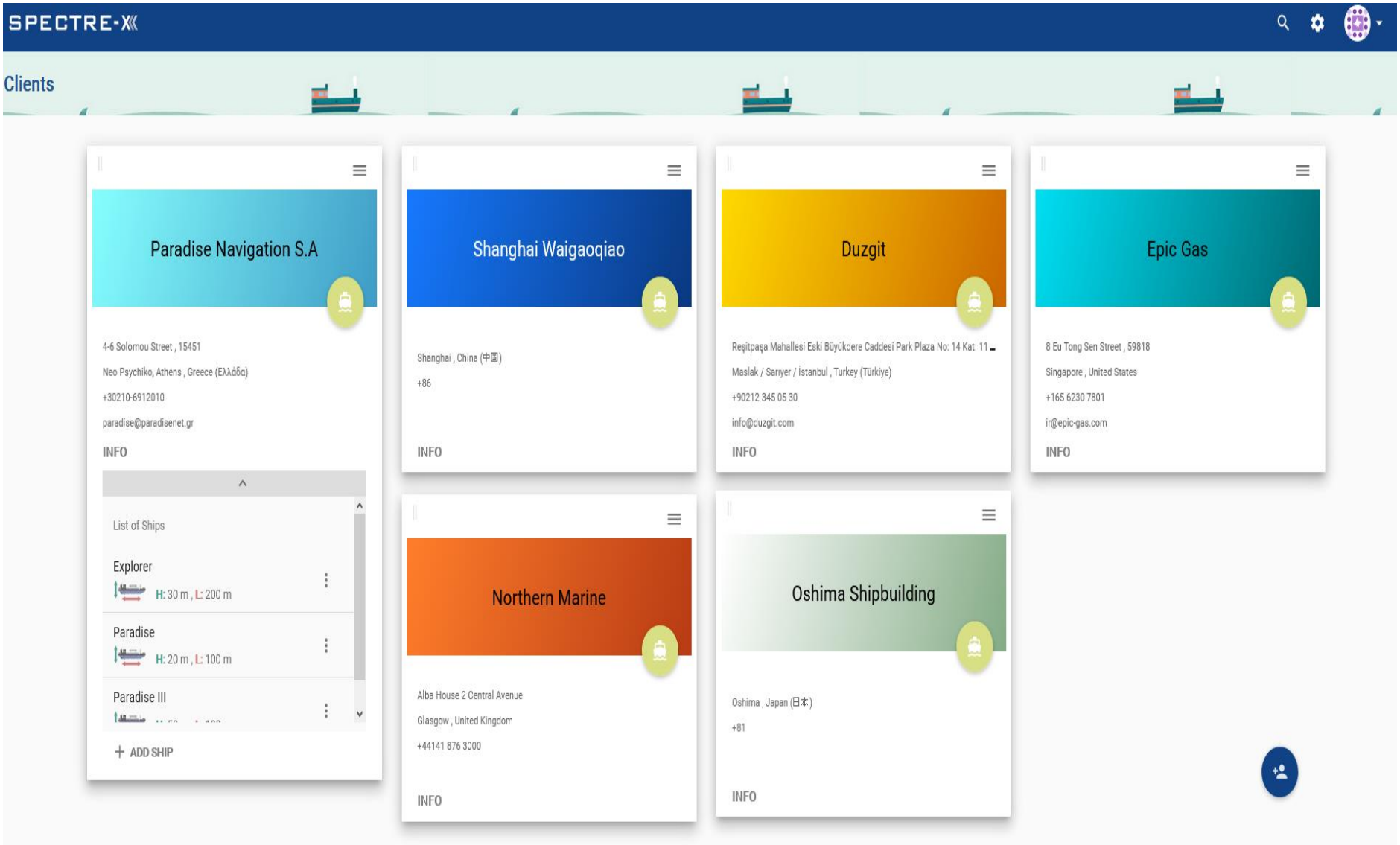
Software – cloud platform



Thank you for your attention

QUESTIONS??