



Spectre-X a fully submersible weld inspection and corrosion mapping NDT robotic system for the marine and power generation industries

Al. Mitsoulis¹, K. Berketis¹, I. Dimoulis¹, N. Thorpe², G. Asfis³, N. Arapkoules⁴, N.R. Devalapalli⁵
¹ SpectrumNDT Greece, ² Tecnitest Spain, ³ TWI UK, ⁴ IKH Greece, ⁵ Lloyds Register UK

Introduction

Spectre-x is a fully submersible robotic NDT inspection system that uses the well-established ACFM and PAUT techniques with universal acceptance in the NDT world regarding their flaw detection capabilities. It also integrates a laser profilometer for weld center tracking and surface visual inspection. The tethered robotic system carrier is a tracked crawler that uses permanent magnets for attachment on ferrous metallic surfaces. It can move in any orientation and on highly curved surfaces. A significant system innovation is the introduction of simultaneous multimode NDT for surface and volumetric weld inspection and corrosion mapping.

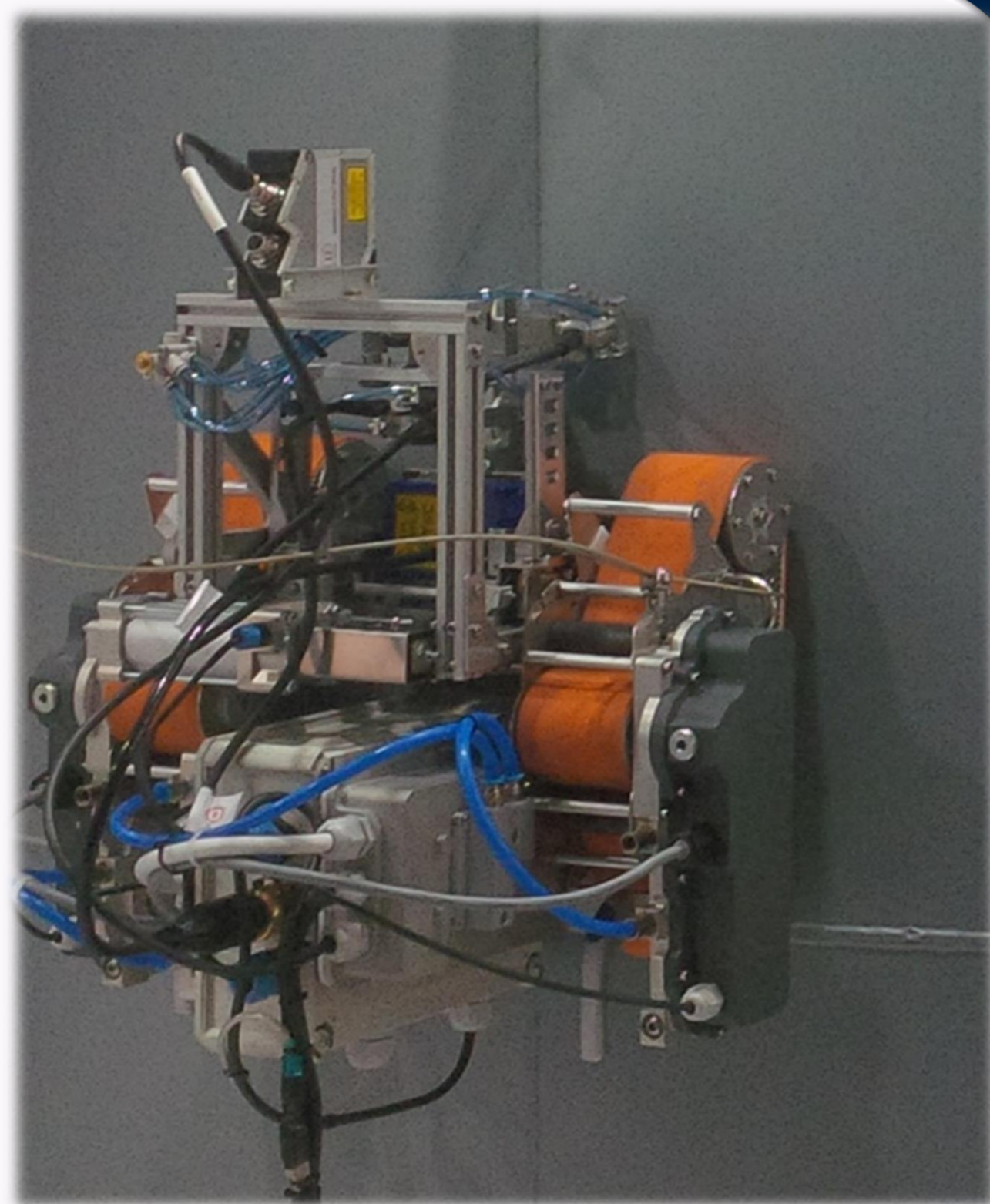


Fig. 1 Spectre-X in welding inspection configuration.

NDT Systems and Methods

The robotic platform is capable of carrying a multitude of NDT systems. Currently it is equipped with a Laser profilometer, a Phased Arrays UT system, and an ACFM unit.

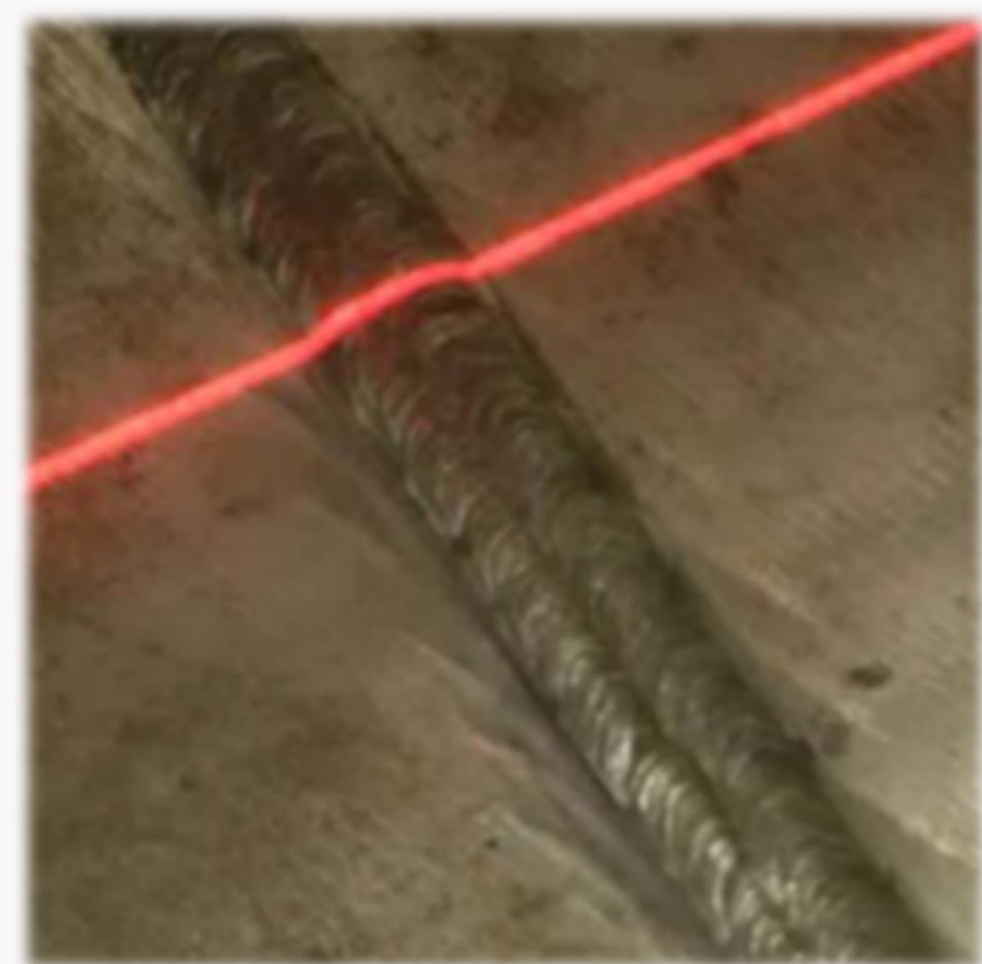


Fig. 2 Laser profilometer weld center tracking and visual inspection.

Laser Profilometer

A red laser profilometer is used for weld center tracking in order for the robot to place the NDT sensors in the correct position. It is also used for visual inspection of surface defects.

Phased Arrays Ultrasonics (PAUT)

Full volumetric inspection in a single pass utilizing two wedge probes, one on each side of the weld. An array wheel probe is used for corrosion mapping.

Alternating Current Field Method (ACFM)

An array probe is used to inspect for surface breaking defects on and around the weld cap.

Configurations

The system can operate in two distinct configurations:

- Volumetric and surface weld inspection (ACFM, PAUT welding probes, Laser for profilometry/visual inspection and weld center tracking).
- Corrosion mapping (PAUT roller probe). The robotic carrier weighing around 20 kg including the magnets, motors, transmission and structural parts can easily be carried, deployed and maneuvered by a single person.

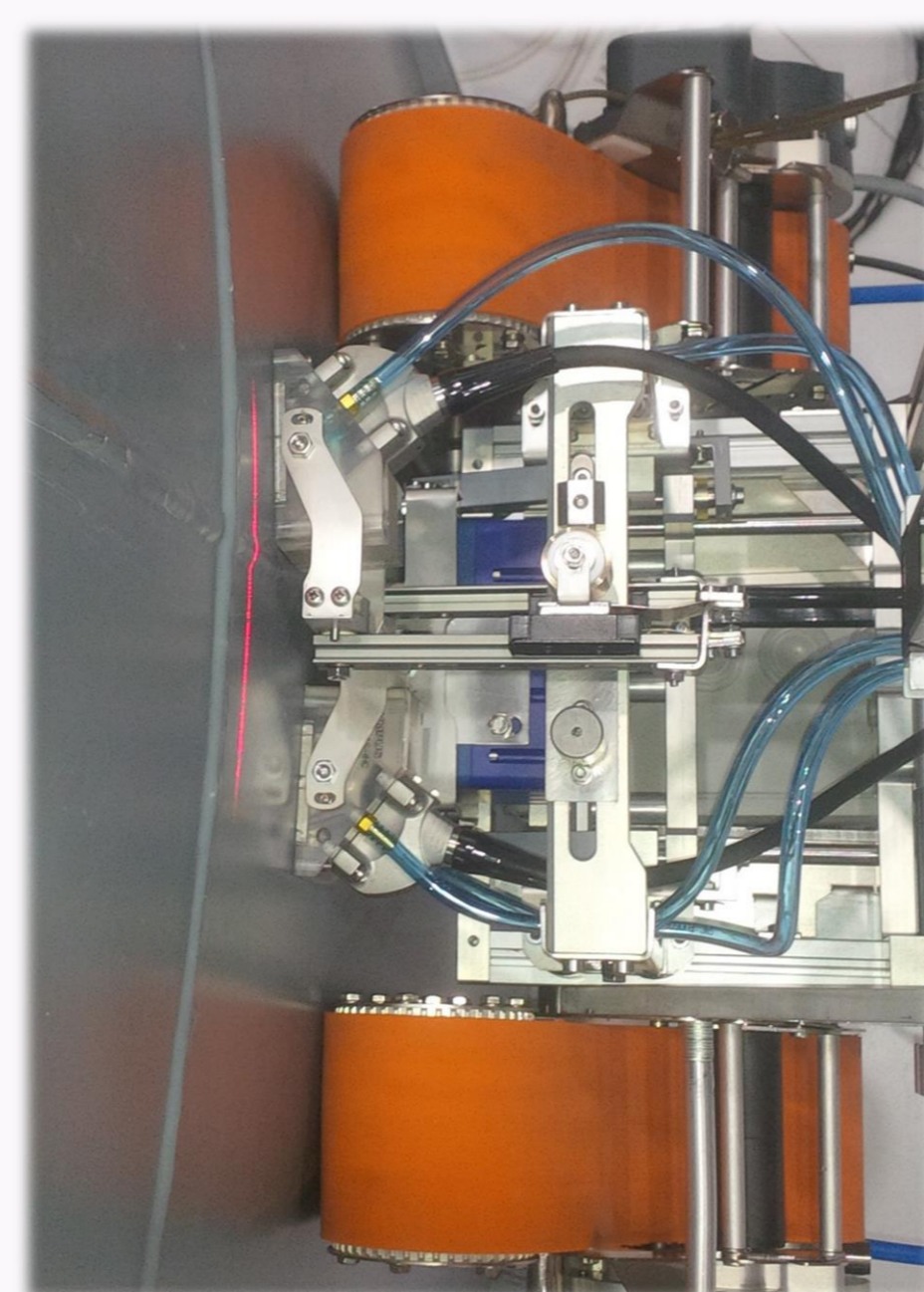


Fig. 3 Laser profilometer and the two PAUT wedges.

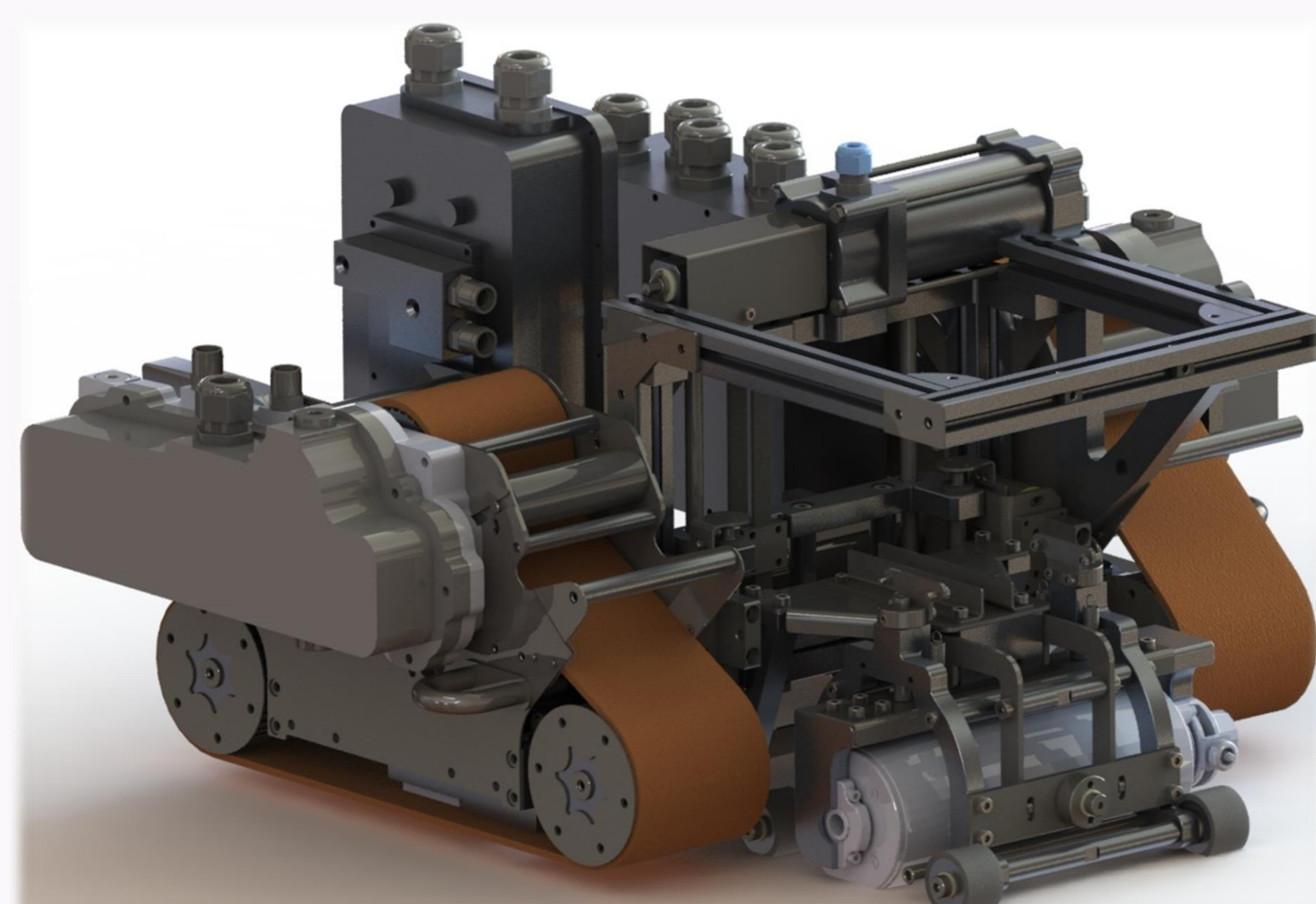


Fig. 4 Spectre-X in corrosion mapping configuration using the PAUT wheel probe.

Software

NDT Software

Spectre-X has a GUI to control and operate the main functions of the platform in manual mode using a wireless handheld controller or in fully autonomous mode. The GUI allows system setup, monitoring the NDT instruments' deployment and accessing the IP cameras onboard the robot. It has advanced safety algorithms implemented that prevent or restrict motion depending on the terrain using inclination and optical sensors data.

Visual inspection module

Using the data from the laser profilometer, Spectre-X has a software module for defect identification based on a set of rules that can be adjusted to various standards like ISO 5817.

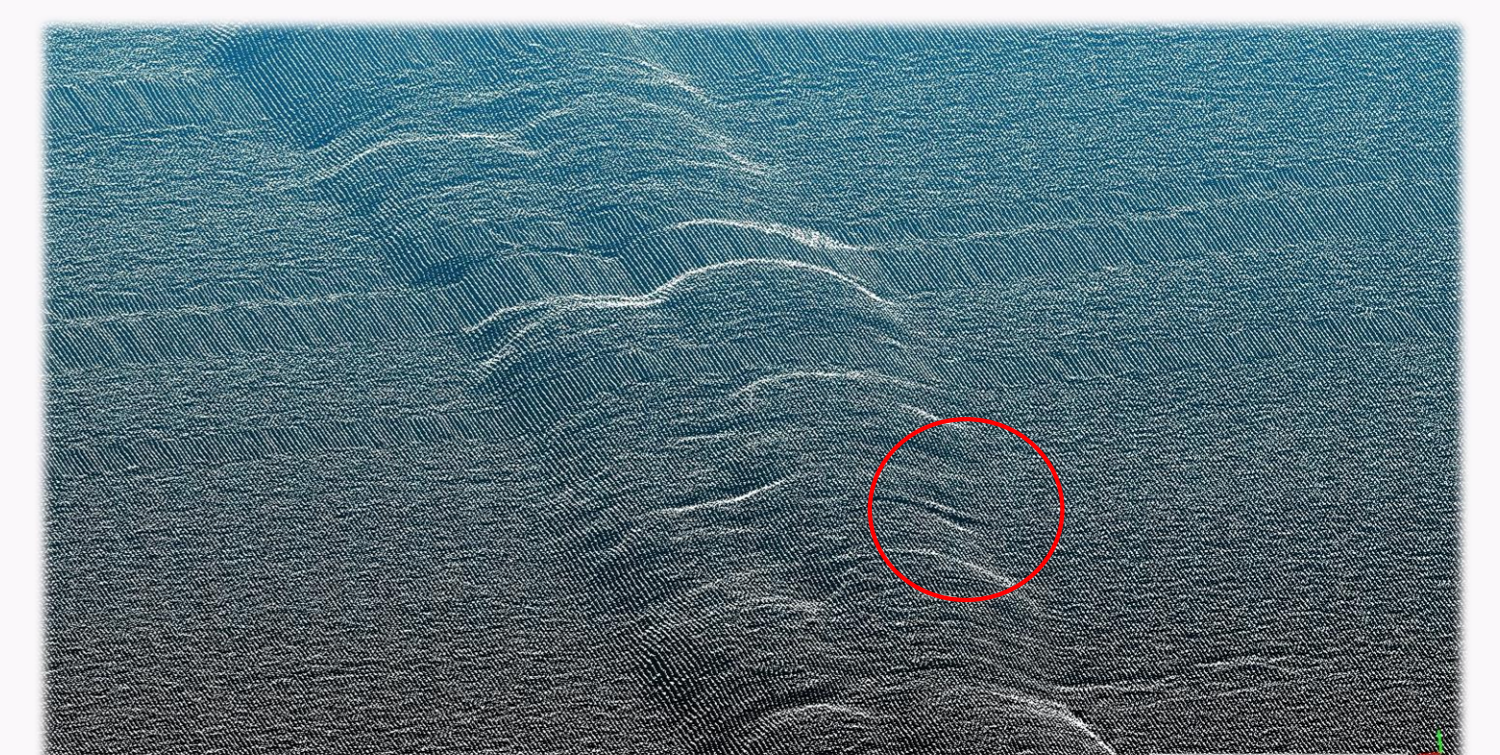


Fig. 5 Welding surface reconstruction with defect identification based on set rules.

Spectre-X cloud platform

Spectre-X creates a multitude of data from the NDT methods used. In order to increase productivity, reliability and data security, a cloud platform has been implemented where data from inspections are saved and accessed from all interested parties in a secure manner.

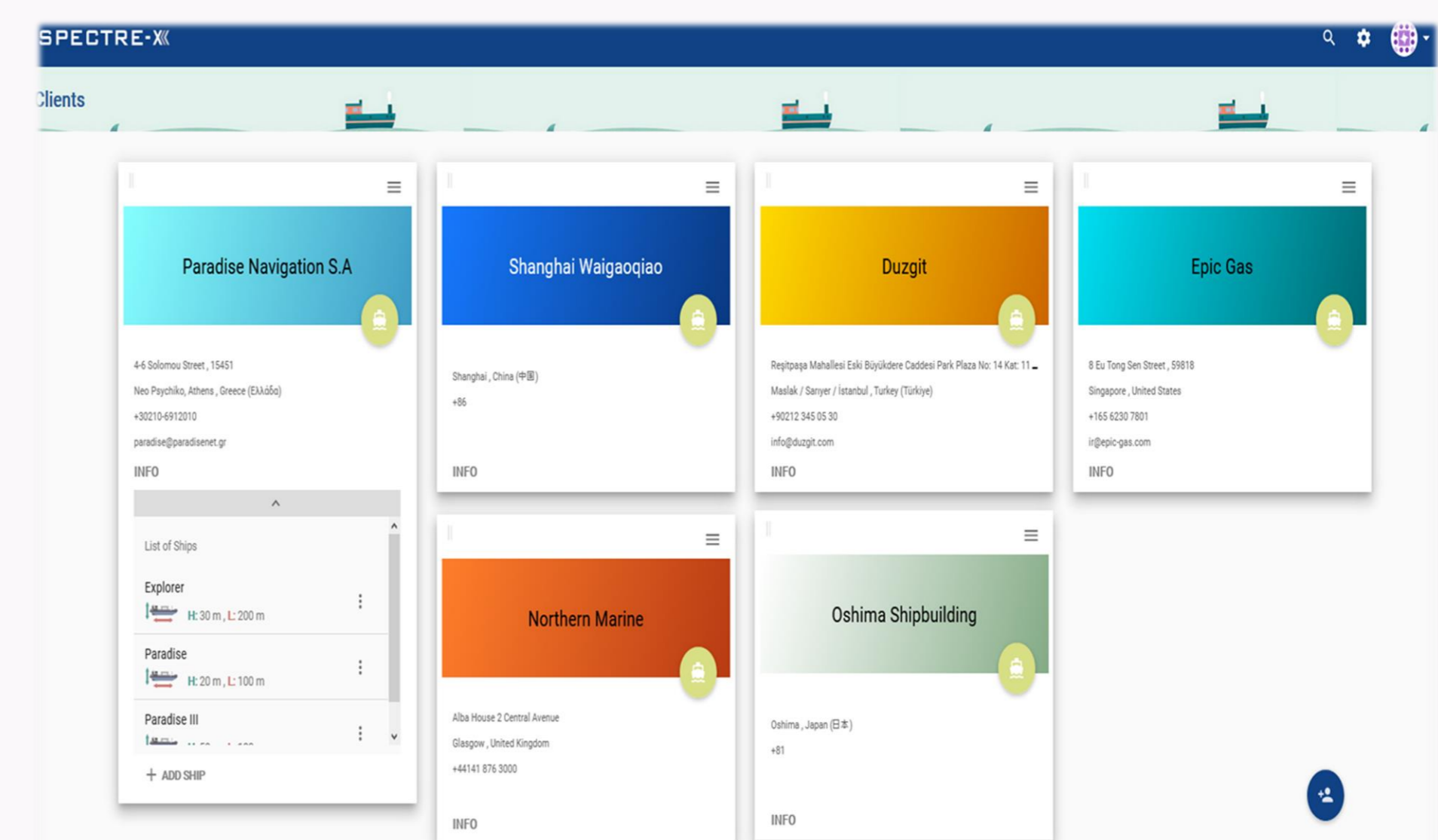


Fig. 6 The Spectre-X cloud platform.

Acknowledgments

The SHIPTEST project has received funding from the European Union's Horizon 2020 research and innovation program under Grant Agreement No. 730645.



European Commission

Horizon 2020
European Union funding
for Research & Innovation

Contact **SPECTRE-X**



SpectrumNDT, 49 Efplias Street, Piraeus 18537 Greece,
 +302104526708, info@spectrum-ndt.gr