The European ship fleet counts 23,000 vessels, accounting for 40% of the global gross tonnage. The marine industry is a major prosperity engine of the EU contributing a total of €147bn to the GDP and supporting more than 1.7m jobs.

Vessels’ structural integrity verification is a major issue for the shipping industry. Regulations dictate
that Non-Destructive Testing (NDT) inspections should be performed every 5 years for the first decade of a vessel’s life and every 2.5 years thereafter. Ship hull weld inspection is a challenging process as safety-critical welds length exceeds 120km in large vessels and involves human inspectors on-site using scaffolding or cherry-pickers. These procedures require long periods of drydocking incurring loss of revenue and costs amounting to more than €150k per inspection. Moreover, conventional ultrasonic techniques cannot be applied to metal plates of thickness <10mm. Currently, this necessitates the use of dangerous radiographic techniques posing health and safety issues. These challenges give rise to a unique business opportunity which SpectrumNDT and Tecnitest (leading NDT equipment and service providers) along with IKH (a dynamic high-tech company specializing in robotics) and TWI (a global leader in NDT technology) aspire to seize with the help of Lloyds’ Register, the most reputable Classification Society with 230 years of experience.

We aim to redefine ship NDT inspection by commercializing Spectre-X, a ship inspection platform capable of performing NDT inspections for ships from cradle to grave. Spectre-X provides single-pass volumetric and surface weld inspection with automatic laser centreline tracking typically for new building ships. For in-service ships, a corrosion mapping version is offered. Through a combination of bleeding-edge ultrasonic and electromagnetic techniques, Spectre-x can accurately inspect metal plates of <10mm thickness significantly reducing or eliminating the need for radiography. The robot can be set-up and operated by Level I NDT operators. The data produced is uploaded on a secure private online cloud platform for remote analysis and results interpretation. The thickness gauging technique currently practised and the conservative criteria applicable for changing plates, result at considerable losses which are drastically reduced by performing corrosion mapping instead. More importantly, an increase in safety margins compared to single point measurements, without bringing a noteworthy penalty in scanning speed is delivered.

Work performed from the beginning of the project to the end of the period covered by the report and main results achieved so far

During the first period of ShipTest, most of the weight fell on better defining what was technically required from “Spectre-X”, the name chosen for the robotic system. From the time the proposal was submitted, technological advances in NDT electronics allowed for a much more compact system to be developed. It was agreed from the onset of the project that to make the Spectre-X commercially viable the level of miniaturization required to make it robust enough for real-world use would require a complete redesign and use of board-level electronics. Although the penalty for a complete redesign in terms of time was significant, the Consortium took the decision to proceed and the construction of the first unit is expected to finish in the last week of February 2018.

The system is built from the ground up as a reconfigurable platform. The basic platform is underwater operations capable. The platform is currently produced in three distinct forms i.e.: a) a welding inspection with automatic weld centreline tracking, b) a corrosion mapping system and c) an underwater inspection mode.

Work on WP2, the unification of the software that controls the four distinct subsystems of Spectre-X, the redesign of the main Graphical User Interface (GUI) and the development of a cloud infrastructure software to organise, secure and streamline inspection data during a Spectre-X field deployment by the clients, started. The Cloud software platform prepared by IKH/TWI in WP2 was rolled out in October 2017.
During the second reporting period, work began on testing. Demonstrations started being arranged in parallel with testing. A third-party Agency was chosen to examine the system for CE marking, WP4. System manuals and other pieces of system documentation started being populated. A series of events have been attended to assist the dissemination and marketing of Spectre-X, WP5, among which the most important were Posidonia 2018 and ECNDT 2018. The potential of the system was positive but the time to reach the level of readiness expected was more than the 24 months, the original project duration and given that the certification was taking a longer than initially forecast, a project extension was requested to 36 months.

During the third and final reporting period, more exposure was sought, attending and organizing events for the system’s dissemination and preparation for commercialization, WP5. A LinkedIn page has been set and videos posts were created. The Agency that was chosen for system CE examination provided feedback that triggered a number of modifications – some of a considerable significance – that were fully implemented, WP4. Additionally, a roadmap to the recognition of Spectre-X by Classification Societies was paved. All the required preparations, such as system validation with reference plates containing artificial defects and inspection procedures, for an independent surveyor’s system assessment were made, WP4. Field testing continued covering ships in operation and a submarine pressure hull, WP3. A worldwide distribution network of dealers and distributors has been set-up complete with arranged commission deals, WP6. Furthermore, following demonstrations further requests came for more demonstrations. We have received also requests-for-service, that were left to be materialized after the end of the project.

Progress beyond the state of the art and expected potential impact (including the socio-economic impact and the wider societal implications of the project so far)

Spectre-X revolutionizes the hull inspection market offering:
- On-board inspection while the ship is afloat, field demonstrated.
- Triple-mode NDT Inspection, 38% faster than the current state-of-the-art systems for volumetric and surface welding inspection in a single pass.
- Spectre-X performs corrosion mapping for marine, offshore and other industrial applications.
- Spectre-X is currently the only existing system with all NDT electronics on-board allowing very long tethers (more than 30 meters) while keeping the quality of data at the highest level.
- Consistent automated examination via a robotic platform able to reach areas inaccessible to human inspectors without supportive equipment.
- Ship inspection with significantly less risks since the need for scaffolding or radiography are greatly reduced.
- Straightforward set-up and operation.
- A private cloud platform supports secure data storage for remote expert data interpretation and report generation from a central location reducing overall cost and increasing availability.
- Parallel testing and system validation in fields other than the marine (wind turbines, power generation, tank storage) increase the commercial potential and value of Spectre-X.
- A roadmap to Classification Societies' endorsement for the system and the service has been established.
• Spectre-X has been method validated for welding inspection and corrosion mapping.
• The system is currently awaiting CE marking certification.

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