atlantis The Atlantic Testing Platform for Maritime Robotics

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Test Centre Conditions

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1. Introduction

The Test Centre is composed by two testbeds, Coastal Testbed and Offshore Testbed, and a Supervisory Control Centre (Figure 1). While the Coastal Testbed is focused on the de-risking of robotic technologies with lower Technology Readiness Level (TRL), the Offshore Testbed consists of dedicated positions within a commercial wind farm, the WindFloat Atlantic (WFA)[1], that will be reserved for demonstrating robotic technologies in a real environment (higher TRL).

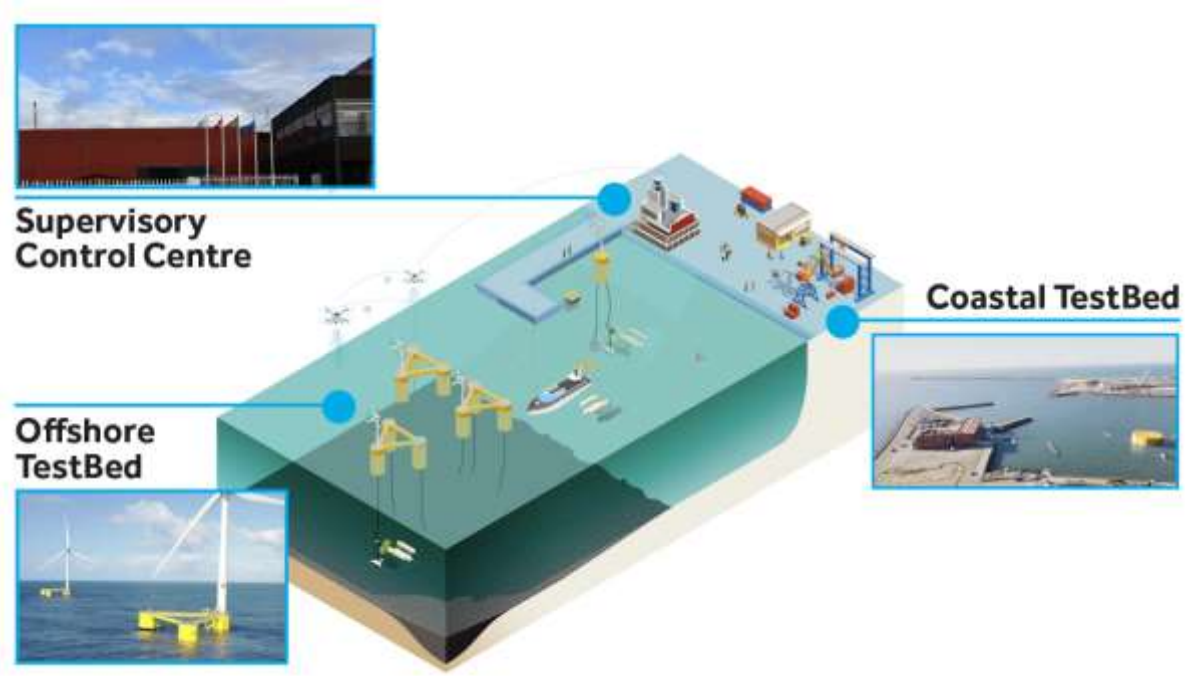

Figure 1 - Conceptual image of the ATLANTIS Test Centre

[1]https://www.edp.com/en/innovation/windfloat

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2. Coastal Testbed

2.1. Floating Structure

The Coastal testbed of the ATLANTIS Test centre is equipped with a floating structure, that simulates an offshore floating structure of an offshore floating wind turbine. The floating structure installed is a decommissioned Catenary Anchor Leg Mooring (CALM) buoy, that provided support to the loading and discharging of liquid product cargo to/from tankers, near onshore or production fields [1].

Figure 2 - Floating Structure installed on the Coastal Testbed of the ATLANTIS Test Centre

Figure 2 shows the floating structure, named DURIUS, as installed in the Coastal Testbed of the ATLANTIS Test Centre, in Viana do Castelo. The buoy has a diameter of 16meters, and a height of 6meters. The floating station is anchored in exit of Lima river using three mooring chains. The current installation of the buoy in the Test Centre has the bottom two meters of the structure submerged, with the top four meters above the water. A total of eight anodes are distributed around the buoy, in an equidistant manner, for corrosion protection. To allow the monitoring or the support of the tests being performed in the Testbed, work is possible from the top of the buoy, with access to the top of the floating structure enabled through two ladders, placed almost diametrically opposed in the buoy. Power and network connection is available on the buoy, being provided from shore by an underwater cable. All these elements (access stairs, mooring chains, anodes, and power cable), as well as the floating structure itself, can be used as subject for the testing and validation of robotic technologies for offshore inspection. All the relevant information is presented in Table 1.

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Table 1 - Summary of details on the Coastal Testbed

DURIUS Dimensions	
Diameter	16 m
Height	6 m
Submerged Height	2 m
Elements Available in DURIUS	
Anodes	8 (Equidistant)
Access Stairs	2
Mooring	3 Chains
Power Cable	1
Typical Environment Conditions	
Water Depth	5 to 8 meters
Wind Speeds	Up to 8 m/s

2.2. Water and Wind conditions

Information such as water depth and typical weather conditions, as well as updated information on seabed and status of the floating structure (for tests related to cleaning or surface inspections), are extremely relevant to ensure a good design of the testing protocol. As the Costal Testbed of the ATLANTIS Test Centre is installed at the exit of Rio Lima in Viana do Castelo, it is subject to the environmental conditions of the area. At this location, maximum water depths vary between five and eight meters, based on the tides, with typical wind speeds going up to 8 m/s. It is important to note that, based on results of previous testing experience, the visibility of the water decreases with the day, while the salinity of the water is not constant with depth, which can impact underwater sensing tests.

2.3. Data on the test area

Data from bathymetric studies of the area surrounding the floating structure, as well as a complete mapping and point cloud reconstruction of the buoy (transition and aerial areas), will be made available to companies and institutions aiming to use the Coastal Testbed, to allow for the proper design of the tests to be performed. Figure 3 and Figure 4 show preliminary data on the bathymetry and position of the elements present in the testing area of the Coastal Testbed.

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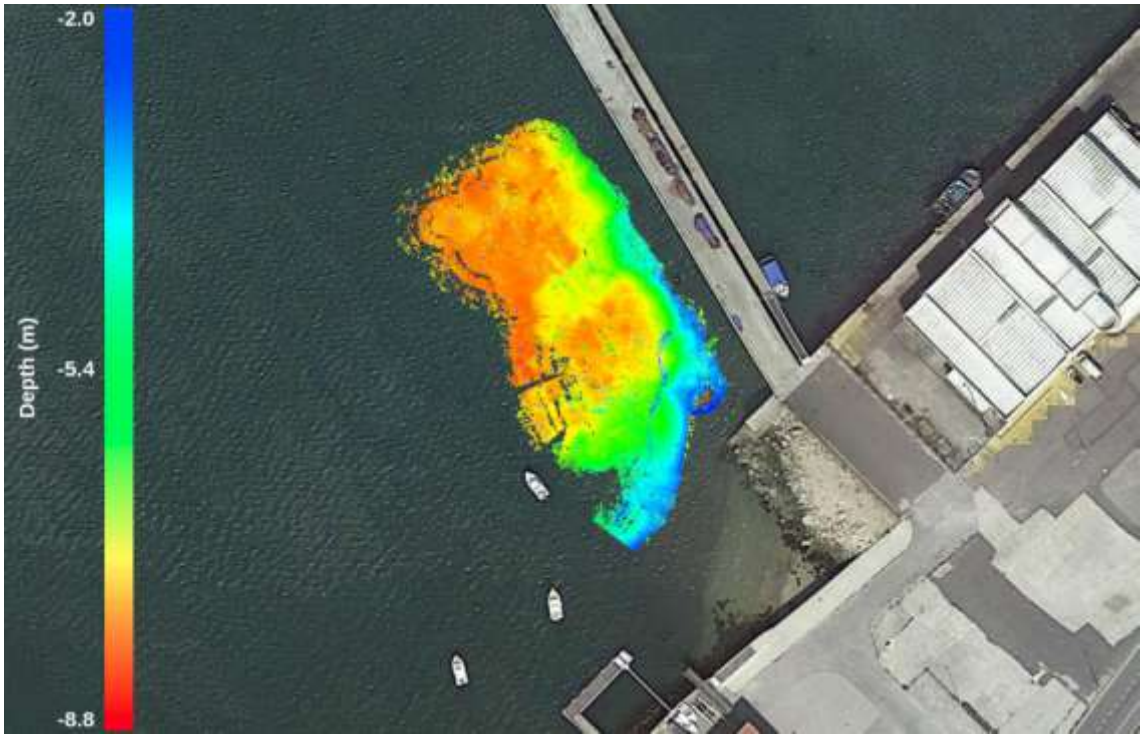

Figure 3 - Bathymetry of the Coastal Testbed testing area

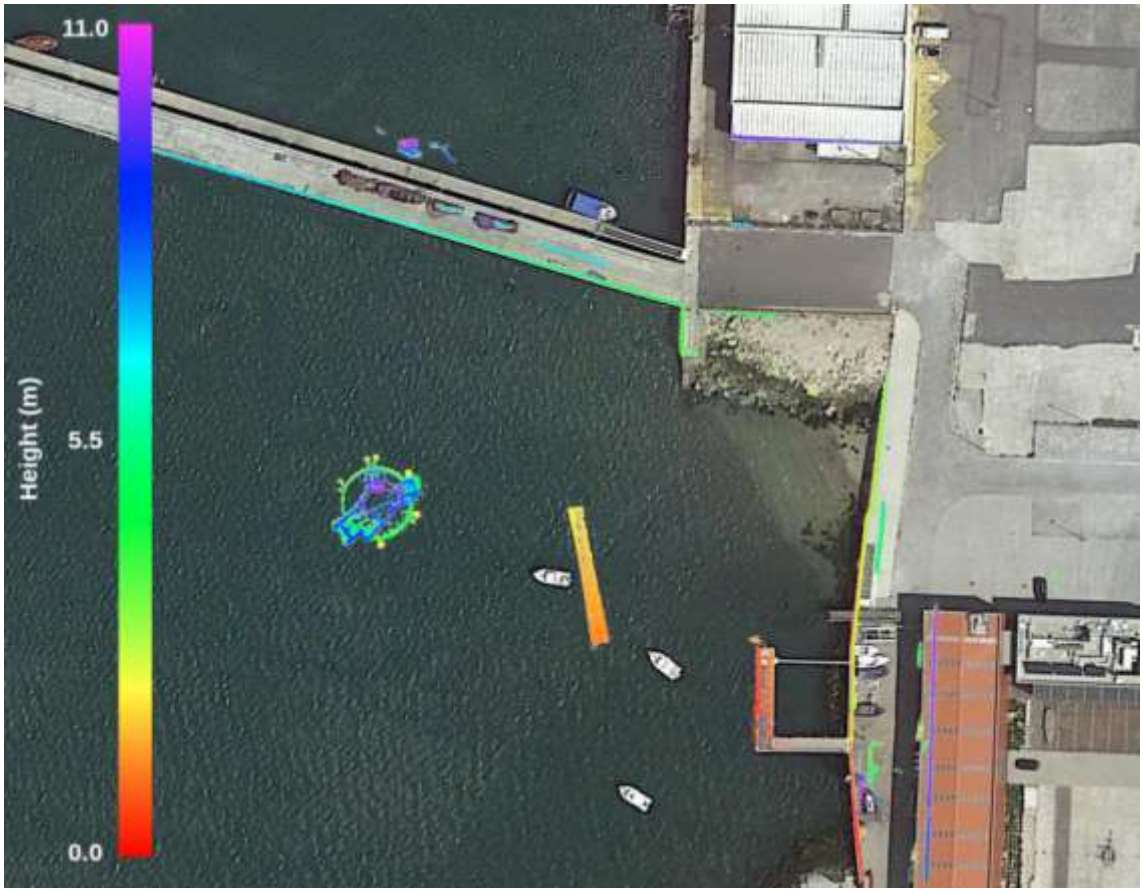

Figure 4 - Buoy position and height data in the Coastal Testbed testing area

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3. Offshore Testbed

The Offshore Testbed is composed by the real offshore wind farm WindFloat Atlantic, containing three floating offshore wind turbines. These turbines are located between 10 and 20 kilometres of shore from Viana do Castelo. Water depths in the WindFloat wind park area range from 40 to 100 meters.

As it is a real environment, the infrastructures available for the demonstration of robotic technologies include all components that require inspection in a fully functional offshore wind turbine. These include:

- Wind turbine blades and tower
- Transition Piece
- Mooring lines
- Anchors
- Array cables
- Export cables.

For demonstrations related to the blades and tower or requiring close proximity to or work on the floating structure, the wind turbine is required to be stopped. In addition, specific training and valid medical certification are required for all team members performing the demonstrations to access the area of the WindFloat Atlantic. The level of training required depends on the demonstrations being performed, but the Sea Survival training and OEUK (old OGUK) medical certification are a minimum requirement. Access to the Offshore Testbed is performed through a vessel departing from Viana do Castelo.

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4. Supporting Infrastructures

Beyond the floating structure and respective working area, the Coastal Testbed of the ATLANTIS Test Centre has access to a set of supporting amenities and infrastructures that facilitate the realisation of the tests and validations.

4.1. Infrastructures

As the Test Centre is installed in close proximity of the premises of the Clube de Vela of Viana do Castelo, support of the activities in the Coastal Testbed is performed through existing infrastructures of the Clube the Vela. One of the most relevant supporting infrastructures to the testing in the Coastal Testbed is the crane (Figure 5) that allows easy deployment and recovery of the robotic vehicles into and from the water. Additionally, there is also access to a dock and support vessels (with skipper if necessary) to monitor from the water, if needed.

Other relevant amenities include:

- Access to changing rooms and toilets
- Overnight storage of equipment (Clube's hangar and maritime containers (Figure 6))
- Proximity to hardware and maritime equipment stores.

Figure 5 - Crane and Pier of Clube de Vela de Viana do Castelo

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Figure 6 - Maritime containers used for overnight storage of equipment

4.2. Supervisory Control Centre

In addition to the physical infrastructures available, a Supervisory Control Centre (SCC), with a direct line of sight to the floating structure (Figure 7), has been implemented in the premises of the Clube de Vela. The SCC will allow for the planning, monitoring and control of the operations from shore.

Figure 7 - ATLANTIS Test Centre Coastal Testbed and related infrastructures

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The SCC has a connection network with both the Coastal Testbed floating structure and offshore Testbed (through a mobile network box), to allow for remote planning, monitoring and control of operations. All robotic vehicles performing validations or demonstrations are required to connect to the ATLANTIS Test Centre SCC, through the installation of an interoperability layer that facilitates their integration into the SCC.

In the SCC, multiple stations are available running the client used for the planning and monitoring of operations. Additionally, a small work area is available for more software intensive work.

4.3. Mar Profundo Vessel

To perform the transfer between Viana do Castelo and the Offshore Testbed, the ATLANTIS Test Centre makes use of the vessel Mar Profundo, that is part of the TEC4Sea project (see Figure 8). Mar Profundo is a catamaran type vessel, with a maximum capacity of 12 passengers, including the 3-member crew.

Figure 8 - Mar Profundo Vessel

equipped with the equipment required to perform offshore operations with robotic technologies. These include:

- Crane
- A-frame
- Lifts for water access
- Support boat (semi rigid)
- Communication link to the Supervisory Control Centre (monitoring of operations)

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5. References

[1] E. Holdings. Spm calm buoy system – the ultimate guide. [Online]. Available: https://epcmholdings.com/spm-calm-buoy-system/

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