OFFwind Highlights No. 13 – JULY 2025

INSPECTIONS OF UNDERWATER CONSTRUCTIONS

Underwater inspections of offshore wind infrastructure are increasingly carried out using ROVs and AUVs, offering a safer, more efficient, and cost-effective alternative to traditional diver-based methods.

Unmanned underwater vehicles (UUVs), also referred to as Unmanned Undersea Vehicles, are vehicles that function underwater without requiring a human operator on board. They are classified into two primary types: Remotely Operated Vehicles (ROVs) and Autonomous Underwater Vehicles (AUVs).

Autonomous Underwater Vehicles (AUVs) are unmanned submarines that operate without human control. They follow programmed routes to collect data or activate payloads, and some use AI to make decisions and adapt to their environment.

A remotely operated vehicle (ROV) is an autonomous robotic apparatus typically utilized underwater for various operations. It is generally managed by an operator aboard a surface vessel, using a joystick interface. Most ROVs are outfitted with cameras and lighting systems, enabling them to relay visual data to their operators. Additional equipment, such as sensors, instruments, cutting arms, and water sampling devices, can be integrated to enhance their functionality.

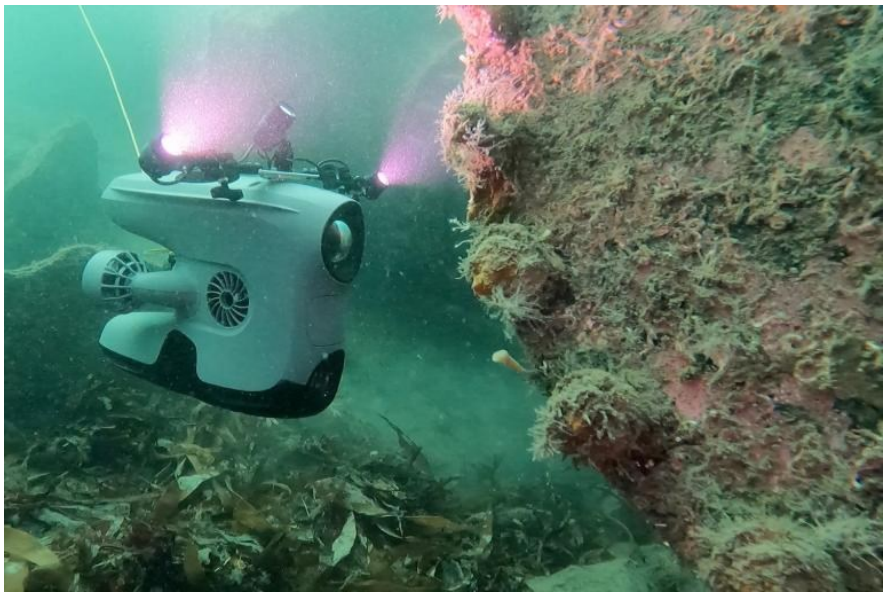

Figure 1:ROV doing inspections (Blueye, u.d.)

Underwater ROVs are used in search and rescue, military, aquaculture, marine biology, oil and gas, offshore energy, and shipping. The rise of offshore renewable energy projects, especially wind farms, is boosting demand for ROVs for installation, maintenance, and monitoring.

The increasing number of offshore wind farms has led to the usage of ROVs for their maintenance and inspection. These devices offer a method for monitoring offshore infrastructure that is flexible, efficient, and safe, resulting in both cost and environmental benefits.

The inspection and maintenance of wind farms in offshore environments present unique challenges. Traditionally, these tasks have been carried out using divers and heavy surface vessels, which are associated with high costs and elevated risks. Remotely operated vehicles (ROVs) mitigate these issues by minimizing the reliance on fuel-intensive vessels and reducing the potential for human injury.

Underwater inspection of turbines, foundations, and cables is part of preventive maintenance strategies in offshore wind. These inspections identify wear, corrosion, and structural issues that could lead to repairs or operational downtime. Sensors and imaging technologies enable ROVs to detect minor issues before they become significant problems. The data collected from inspections supports repairs and provides insights into long-term trends, such as material degradation and environmental impact.

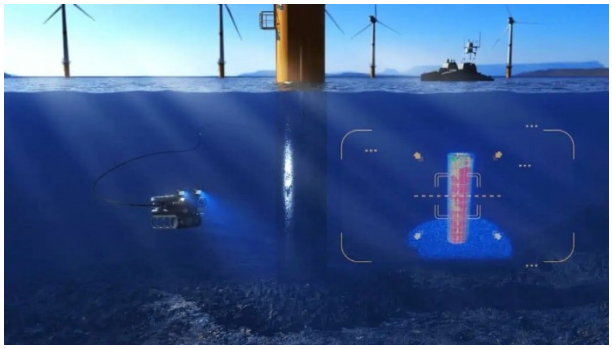

Figure 2: ROV mapping the foundation with sonar. (Ball, 2022)

The advantages of using Remotely Operated Vehicles (ROVs) for offshore inspections include:

Cost Savings - ROVs reduce the necessity of employing commercial divers, acquiring or leasing specialized equipment, and arranging helicopter schedules.

Enhanced Safety - ROVs undertake hazardous tasks, thereby working in conjunction with divers to minimize their exposure to perilous conditions and improve overall safety measures.

Increased Efficiency - ROVs expedite the examination of offshore facilities significantly faster than divers and can be deployed at any given moment without the requirement for scheduling inspectors or system shutdowns.

Improved Data Recording Capabilities - Equipped with cameras and data recording software, ROVs enable operators to generate comprehensive inspection reports that accurately document asset status, assisting in the economical forecasting of routine maintenance and repairs.

Superior Imaging Quality - ROVs are equipped with advanced 4K cameras, sonar technology, and location mapping features designed for low-visibility environments.

Creating 3D-Models

ROV inspection data can be used to create detailed 3D models using photogrammetry, a technique that reconstructs 3D models from a series of 2D images. This process involves capturing images from various angles and using software to stitch them together, creating a point cloud and then a 3D mesh. Combining underwater inspections and 3D models can provide valuable and more accurate information about the condition of the construction.

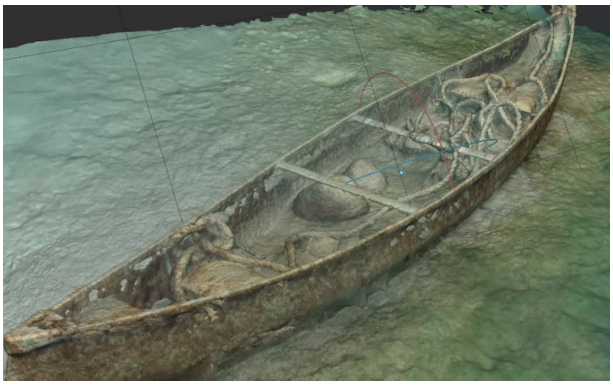

Figure 3: 3D model made by using photogrammetry (Wylie, 2023)

Conclusion

The utilization of Remotely Operated Vehicles (ROVs) for offshore inspections offers unparalleled benefits, revolutionizing the way critical infrastructure is assessed and maintained. Through reduced costs, enhanced safety, faster operations, and superior imaging, ROVs not only streamline inspections but also provide precise data critical for upkeep and forecasting.

The integration of advanced techniques like photogrammetry further elevates the value of ROVs, enabling the creation of detailed 3D models that yield deeper insights into underwater construction conditions. As technology continues to evolve, ROVs remain at the forefront of innovation, setting new standards for efficiency and accuracy in the maritime industry.

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