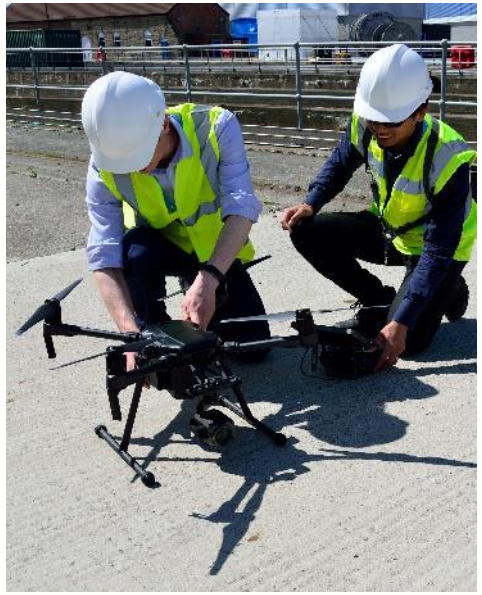


Autonomy and Robotics in Marine Renewable Energy

26/09/2019 | Neil Farrington

CATAPULT Offshore Renewable Energy

Agenda

- The Offshore Renewable Energy Catapult (OREC) – Intro
- Marine Renewable Energy and applications for Autonomy and Robotics
- Robotics and Autonomous Systems - OREC Testing and Validation
- Technology demonstration and innovation projects

Our Mission and Vision

Our mission

To accelerate the creation and growth of UK companies in the ORE sector

Our vision

By 2030, ORE Catapult will be the world's leading offshore renewables technology centre

- **Centres of Excellence**
- **Academic Research Hubs**
  in partnership with leading universities
- **Expanding our assets in Blyth and Levenmouth**
  the world's foremost open-access facilities

Marine Renewables Energy applications

Offshore wind is growing……

United Kingdom

- 2020 Operational Turbines

Rest of Europe

- 2470 Operational Turbines

Globally

- 5046 Operational Turbines

Practical challenges: Offshore Wind Inspections

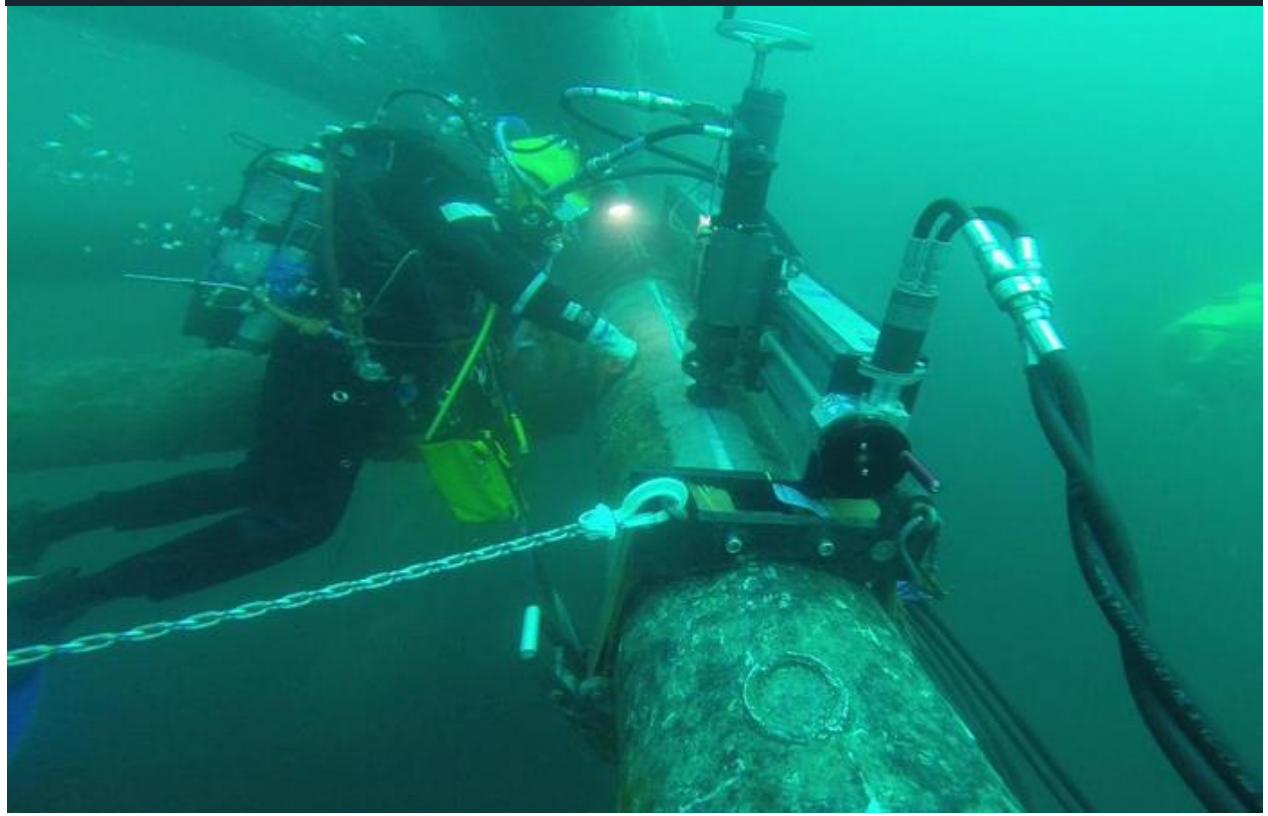
- There are several aspects of the foundation that are of interest in terms of inspection:
  - Internal corrosion of monopile foundations
  - Scour, including
    - Local scour around foundations and cables
    - Global scour in the wind farm
  - Subsea weld integrity
  - Fatigue Crack Growth

- All of these currently are, or have the potential to be carried out by underwater vehicles.

Things are changing!

- Robotics and autonomous systems have a huge potential to disrupt practices
- Engagement with operators (and turbine manufacturers) shows strong interest in reducing usage of expensive divers which carry large health and safety risk
- Underwater robotic solutions can reduce costs
    - Enable more proactive monitoring & inspection – better understanding of what is happening on site

"Doing anything subsea is very expensive, so any activities have to be very well justified"
– Anonymous Wind Farm Operator



Key Trends

- Larger turbines
  - Greater cost of downtime, each asset is becoming increasingly important
  - Walney Extension has a greater installed power and half the number of turbines compared to the previous world's largest offshore wind farm – London Array
- Life extension
  - As assets are ageing, lifetime extension considerations are becoming increasingly important
  - Understanding foundation health is very important
- Increasing access windows

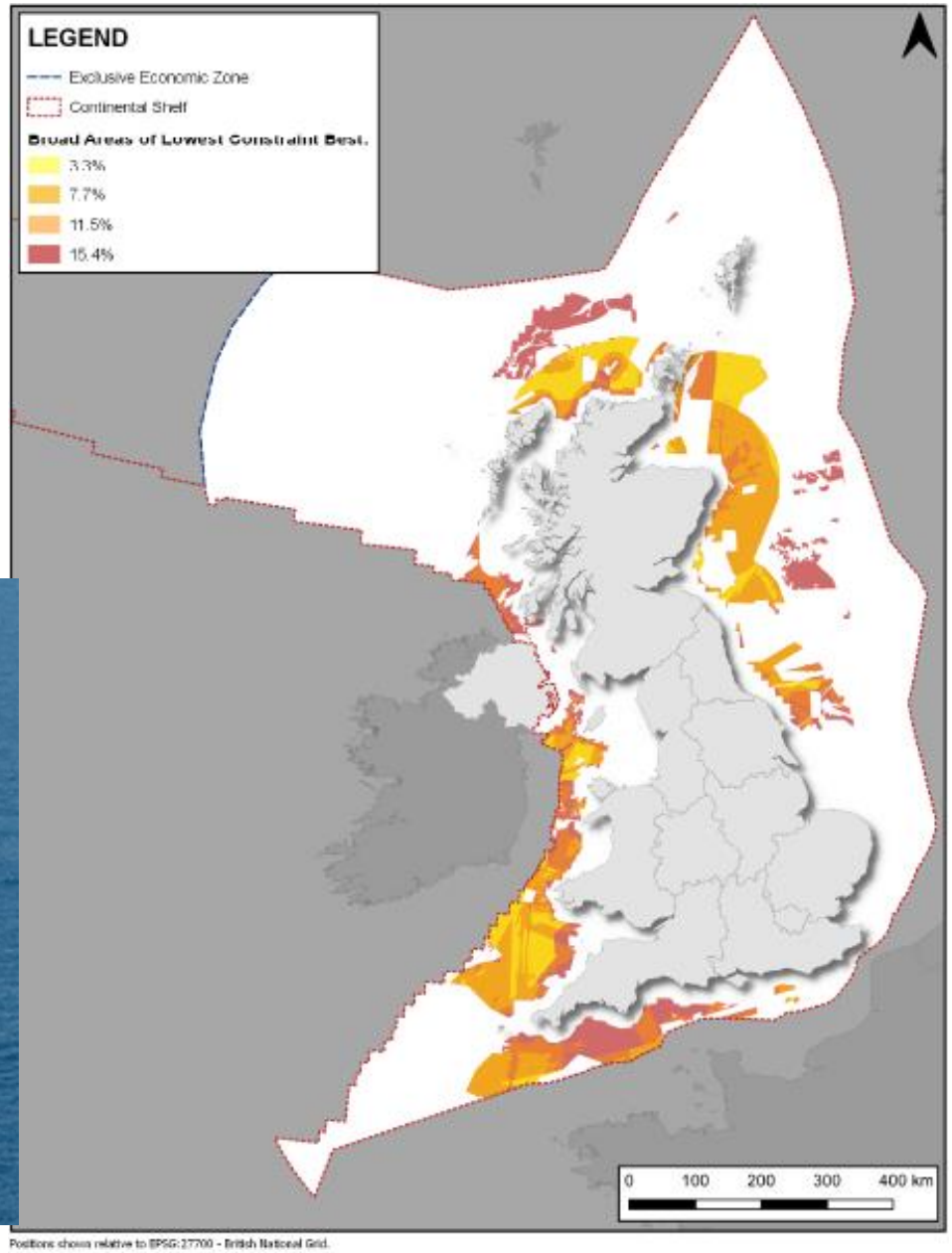
Access

Type of Access	Vehicle/System	Sub Category	Significant Wave Height, H_s [m]
Boat Landing	Crew Transfer Vessels (CTVs)	Mono-hull	1 – 1.2
		Catamaran	1.2 – 1.5
		Trimaran	1.5 – 1.7
		Small Waterplane Area Twin Hull (SWATH)	1.7 – 2
		Surface Effect Ship (SES)	1.8 – 2.2
	Systems that enhance access to the boat landing		2 – 2.5
Access to the Transition Piece (TP) Platform	Service Operation Vessel (SOV)/ Walk-to-Work Vessel	SOV Vessel	n/a
		SOV daughter craft	~1.2
	Motion compensated Systems	for transfer of personnel	1.5 – >4.5[4]
		for transfer of components 1 ≤ weight (metric tonnes) ≤ 20	3 – 4.5[4]

: 2 Offshore Windfarm Vessel Significant Wave Height (H_s) Limitations [5]

Celtic Sea Alliance

- Realising the Floating Offshore Wind opportunity.
- Spatial planning, innovation and the local supply chain.

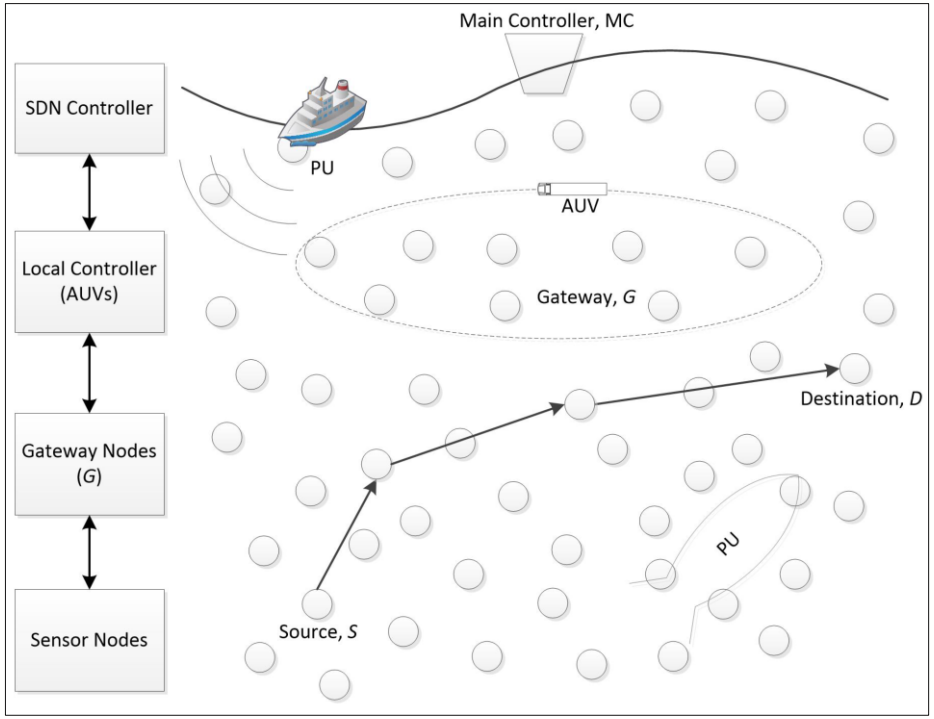


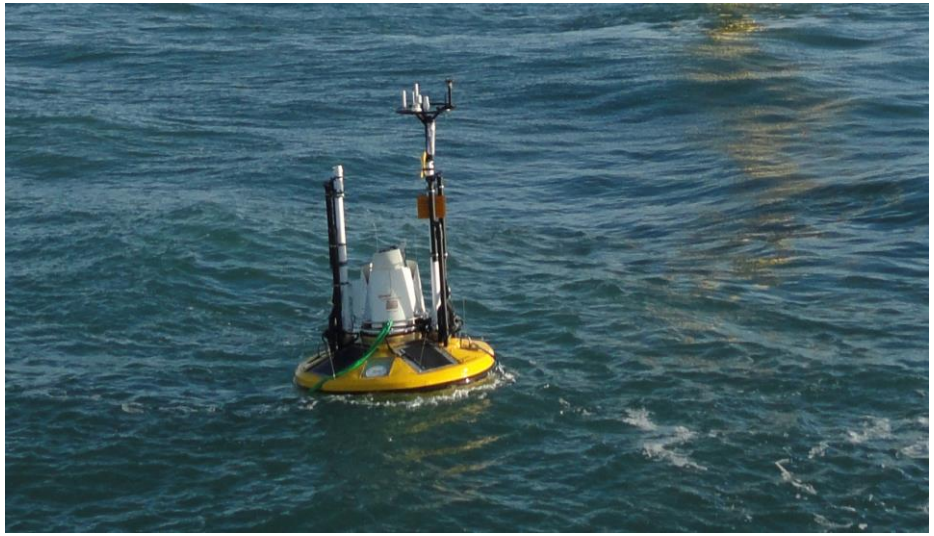
Autonomous opportunities & challenges

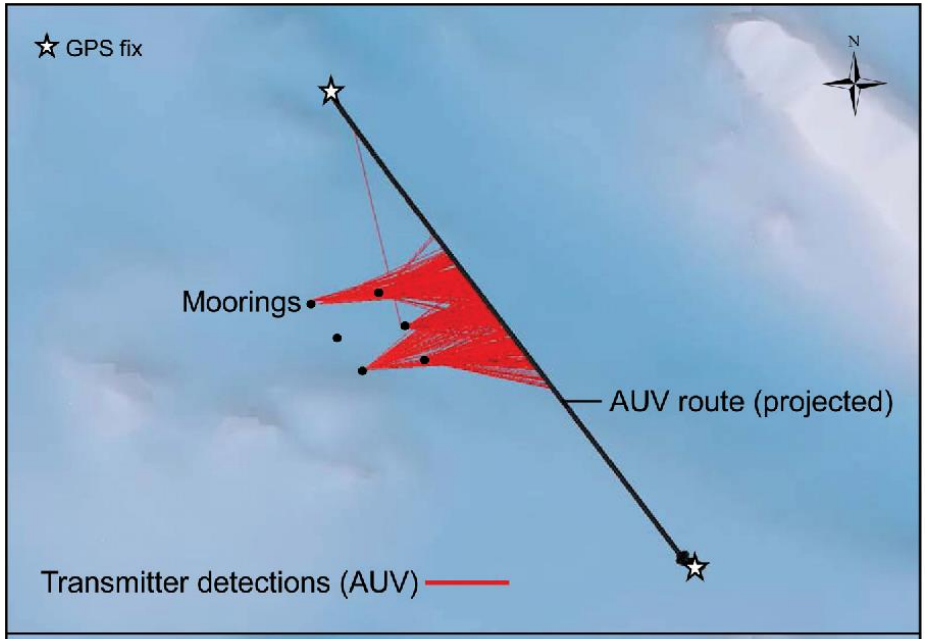
- Further reduces the need for manned operations

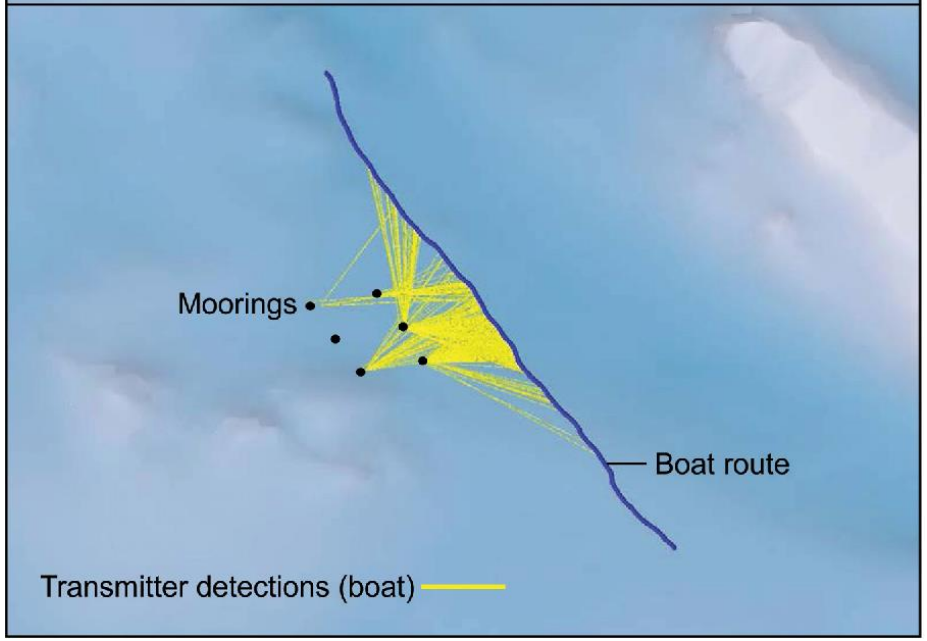
Challenges

- How is this tested and verified?
- How is data returned to the users?
- How to plan the optimal route (not unique to autonomous systems)
- Power requirements









Robotics and Autonomous Systems Testing and Validation

Testing and validating tomorrow's robotic and autonomous maintenance solutions.

- **Marine Robotics & Autonomous Systems Testing**
- **Contact systems testing**

The Catapult's National Offshore Anemometry Hub (NOAH), off the coast of Blyth, Northumberland.

Technology demonstration and innovation projects

Innovative Payloads

- The payload is a key differentiator of ROVs and AUVs

Soil Machine Dynamics - Anemoi Project

- Developing a method for detecting and following buried cables in an offshore wind farm
- Supporting with research to understand different failure mechanisms of array cables
- Trialling of methodology in simulated seabed dock with buried cable

From Data to Knowledge

- Huge amount of work to watch and annotate ROV video streams
- Often just to advise actions on a few key findings

ROVCO - AUV3D Project

- Creating 3d visualisation models of assets
- Generating actionable information rather than hours and hours of video
- Iterative testing in docks to develop the 3d models

Resident Systems

- Increases efficiency, allows charging of AUV in situ, eliminates need for support vessel
- Facilitating technologies required
    - Power source
    - Data transmission

Modus Seabed Intervention & Osbit Avision Project

- Vehicle recharging
- Upload of acquired data
- Downloading of new mission plans
- Trials in dry docks followed by offshore met mast

MIMRee

Multi-Platform Maintenance, Inspection and Repair in Extreme Environments, a project that was awarded funding by Innovate UK to develop and test a fully automated inspection and repair system for offshore wind farms.

https://www.youtube.com/watch?time_continue=50&v=kQvN71bfTA4

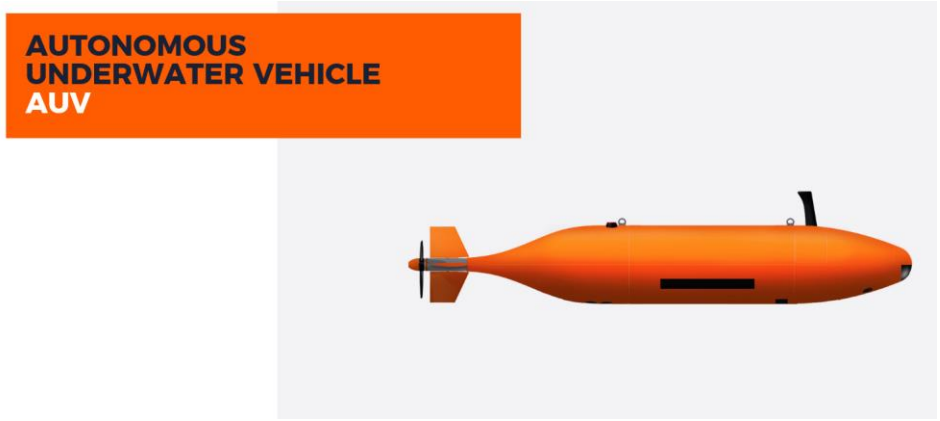
The MIMRee deployment system in operation

Blade bug & the Halycon Autonomous Vessel

Thales' Halcyon autonomous surface vessel will play a key role in MIMRee.

Ocean Inifinity -

- Operating the World's most advanced fleet of autonomous vehicles.
- Ocean Infinity has applied proven systems at an unprecedented scale on board a single multi-purpose offshore vessel. The technology is precisely integrated into a comprehensive system for offshore survey, inspection, repair and recovery.



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