Marine Autonomous Systems:

Supporting offshore wind

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Marine Autonomous Systems to Support Offshore Wind

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Offshore wind where might marine autonomous systems contribute?

1. Initial site survey (bathymetry, current profile, etc)
2. Pre/Post lay cable survey
3. Scour monitoring
Getting Up Close and Personal

3D swath mapping of cold-water coral communities in Whittard Canyon

7m distance
10cm pixel
70% coral cover
Remotely Operated Vehicles (ROVs)

- ROVs are connected to a surface vessel by a tether, therefore allowing constant communication and control from a human pilot on board ship. Tether allows higher powered instruments without reducing endurance.
- ROVs are traditionally used to replace divers at depths or in environments not conducive to human operation.

- Pros:
  - Ability to interact with environment
  - Real time data
- Cons:
  - Limited Range
  - Requires a support vessel
ISIS ROV

- Length: 2.7m  Width: 1.5m Height: 2.0m
- Max. working depth: 6500m
- Propulsion: 6 x 5HP (3.7kW) Thrusters
- Maximum Power : 18kW at 6500m
- Maximum forward and lateral speed: 0.75m.s⁻¹ (1.5kt).

- Video and still cameras
- High power LED lights
- Two seven function Kraft 2 manipulators, with force feedback
- Multi-Beam Sonar
Typical Missions

1. Manipulator pushing a 50cm sediment corer.
2. Coarse gravel grabbed in a bag.
3. A dropstone is collected.
4. Spider crab caught and placed in ‘biobox’.
5. Removing Umbellula from the seabed.
6. Animals sucked into chamber by ‘Slurp Gun’.
7. Video frame grabs record animals ‘on the fly’.
8. Multibeam survey of Gulf of Cadiz Mud Volcano
Removing the support ship
Autonomous Underwater Vehicles (AUVs)

- AUVs are untethered platforms, once the mission has started there is no significant contribution to the vehicle control by the operator. They are ideal for broad area surveys.

Pros:
- Operation away from vessels
- Very stable platforms
- Able to carry optical and acoustic sensors
- Range of 10 -100s km
- Endurance of hours to days

Cons:
- Underwater localization
- Limited underwater communications
Collision Avoidance System

Multibeam Sonar – EM2000
200kHz, 400 m, 2m

Sub Bottom Profiler – Edgetech
2 – 16 kHz

Pumped, Dual CTD
Also EH, DO, Turbidity ...

Precision Navigation
(FOG INS + DVL)
Drift <1 m per 1km

Lithium Polymer Rechargeable Batteries.
28 hour, 150 km
X 2 in 18 month

3 axis Magnetometer

Multibeam Sonar –
EM2000
200kHz, 400 m, 2m

Sub Bottom Profiler –
Edgetech
2 – 16 kHz

Dual Freq. SSS Edgetech
410 kHz: 250m swath, 0.2 m
120 kHz: 800 m swath, 1m

Acoustic Telemetry and Tracking System

Pumped, Dual CTD
Also EH, DO, Turbidity ...

ADCP, 300 kHz
Current Profiler

AUTOSUB 6000

5.5 m, 0.9 m diameter 1800 kg

2 x High Resolution Colour Camera and Flash System
(forwards and downward facing)
15 m range in clear water
Vent Hunting
with
Autosub6000 –
RRS James Cook Cruise 44 (March 2010)

Science Mission: to find and map hydrothermal vents in the mid Cayman rise.

EH potential survey of 2nd Vent site. Line spacing 60 m. 60 m altitude.
Gliders

Gliders utilise small changes in buoyancy in conjunction with wings to convert changes in potential energy into forwards motion. Adopting a saw tooth profile through the water.

Typical combine low speeds ~0.3m/s (low propulsion power) and very low power instruments to achieve very long endurance.

Pros:
- Very long range ~ 4500km
- Endurance of months

Cons:
- Long range achieved by going slowly with very limited sensors
- Have to follow a profiling path
Unmanned Surface Vehicles (USVs)

Unmanned surface vehicles are becoming an increasingly popular technology. Typically remotely operated via satellite communications.

Pros:
• Continuous satellite communications/remotely operated
• Precision localization with GPS
• Endurance of months possible

Cons:
• Collision avoidance
• Exposed to wind/waves
Summary

- Marine Autonomous and Robotic Systems enable operations in environments where it is impossible/difficult/dangerous to send human operators.

- ROVs allow detailed inspection and moderate subsea interventions but require a ship and human operators.

- AUVs and USVs minimize or reduce the need for support vessels and are ideal for broad area surveys, either acoustic optical or chemical.

- Robotic systems are rapidly evolving. Bespoke platforms can readily be developed for specific mission scenarios. Hybrid vehicles which blur the lines between ROV and AUV are becoming available.
The fleet
- 33 Gliders
- 5 large AUVs
- 3 USVs
- 3 Deep towed vehicle