

SUT Defence SIG



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Agenda

- Introduction to SUT and Defence SIG
- Autonomy in action – some case studies
 - USV
 - ASV
 - AI
- LODs
- Wrap up and question



Who we are ?










- International Learned Society established 1966
- First members largely drawn from scientific, academia, military & archaeological diving community
- Growth of offshore oil & gas dominated SUT through first period of expansion, the sector remains home to the majority of our members, but many new joiners now from Renewables, MetOcean, Sensors & Robotics, communities
- Observer Status at UNESCO-IOC



Photos - Steve Hall, National
Oceanography Centre UK

Why? - Other industries have excellent underwater technology – Exploit Synergies

Non-Defence Industries

-  Environmental Forces
-  Marine Renewables
-  Site Investigation and Geotechnics
-  Ocean Resources
-  Subsea Engineering
-  Underwater Science
-  Diving and Manned Submersibles
-  Salvage and Decommissioning
-  International Vehicles and Robotics Group

Technology

Best Practice and Lesson Learnt

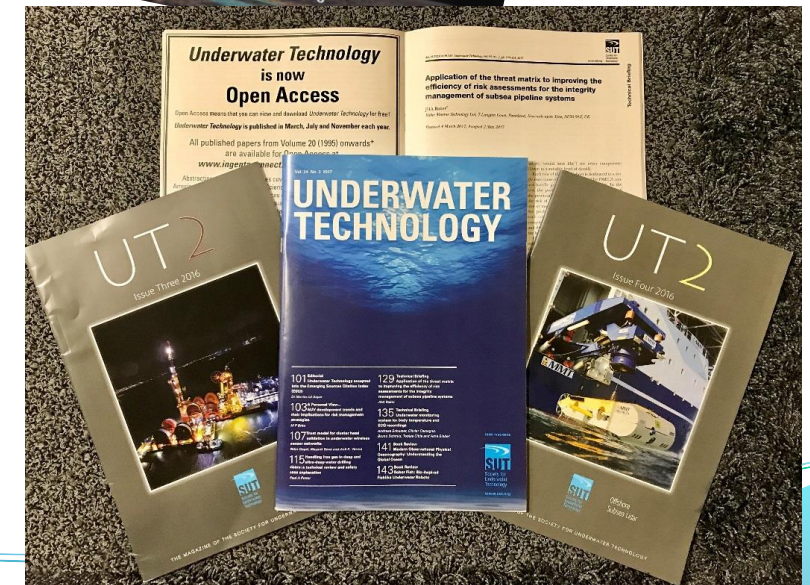
Education

Career Development

Defence

Activities

- Training
 - Face to Face and Virtual options
 - Courses range from introduction through to expert levels
 - Not just engineering focussed, legal, policy, insurance sector covered as well
 - Joint courses with IMarEST e.g. MetOcean Awareness Course
 - Opportunities to personalise courses as an alternative in-house owned training courses
- Peer-reviewed journal & members' magazine
 - Underwater Technology
 - UT2
 - UT3 e-magazine
 - UV2
- Conferences
- Social Activities



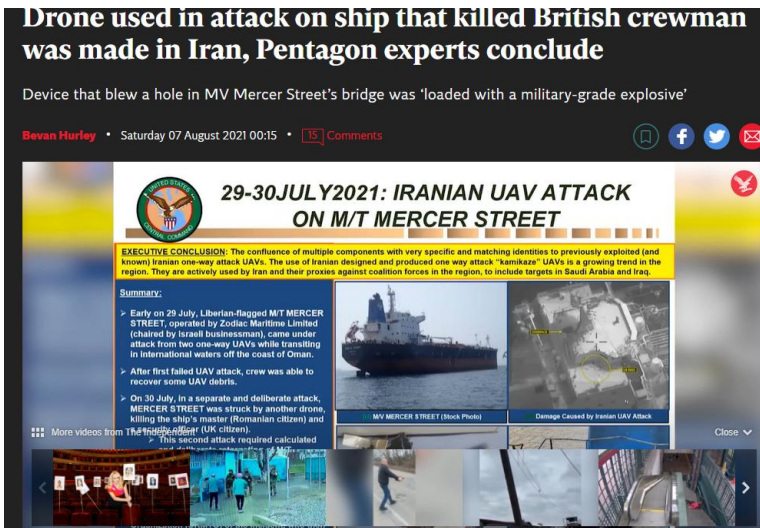
The Tactics/Technology Iterative Loop

New technologies are changing the underwater battlespace

Drone used in attack on ship that killed British crewman was made in Iran, Pentagon experts conclude

Device that blew a hole in MV Mercer Street's bridge was 'loaded with a military-grade explosive'

Bevan Hurley • Saturday 07 August 2021 00:15 • 15 Comments



29-30 JULY 2021: IRANIAN UAV ATTACK ON M/T MERCER STREET

EXECUTIVE CONCLUSION: The confluence of multiple components with very specific and matching identities to previously exploited (and known) Iranian one-way attack UAVs. The use of Iranian designed and produced one way attack "kamikaze" UAVs is a growing trend in the region. They are actively used by Iran and their proxies against coalition forces in the region, to include targets in Saudi Arabia and Iraq.

Summary:

- Early on 29 July, Liberian-flagged M/T MERCER STREET, operated by Zodiac Maritime Limited (claimed by Israeli businessmen), came under attack from two one-way UAVs while transiting in international waters off the coast of Oman.
- After first failed UAV attack, crew was able to recover some UAV debris.
- On 30 July, in a separate and deliberate attack, MERCER STREET was struck by another drone, killing the ship's master (Romanian citizen) and the ship's engineer (UK citizen).

➤ This second attack required calculated

More videos from The Independent (UK citizen)

MV MERCER STREET (Stock Photo) | Damage Caused by Iranian UAV Attack



An underwater cable viewed from the Nautilie deep submergence vehicle at 2,152m depth. The inhabited submersible is operated by Ifremer. Marine Nationale picture.

France Unveils New Seabed Warfare Strategy

Russia's Nuclear Tsunami Apocalypse Torpedo is Named 'Poseidon'

The nuclear-powered torpedo will cross oceans autonomously, attacking coastal cities and possibly enemy fleets.

BY KYLE MIZOKAMI JUL 24, 2018



Evolving threats

- New technologies
- Different types of adversary
- ...but still old traditional ones

New tactics??

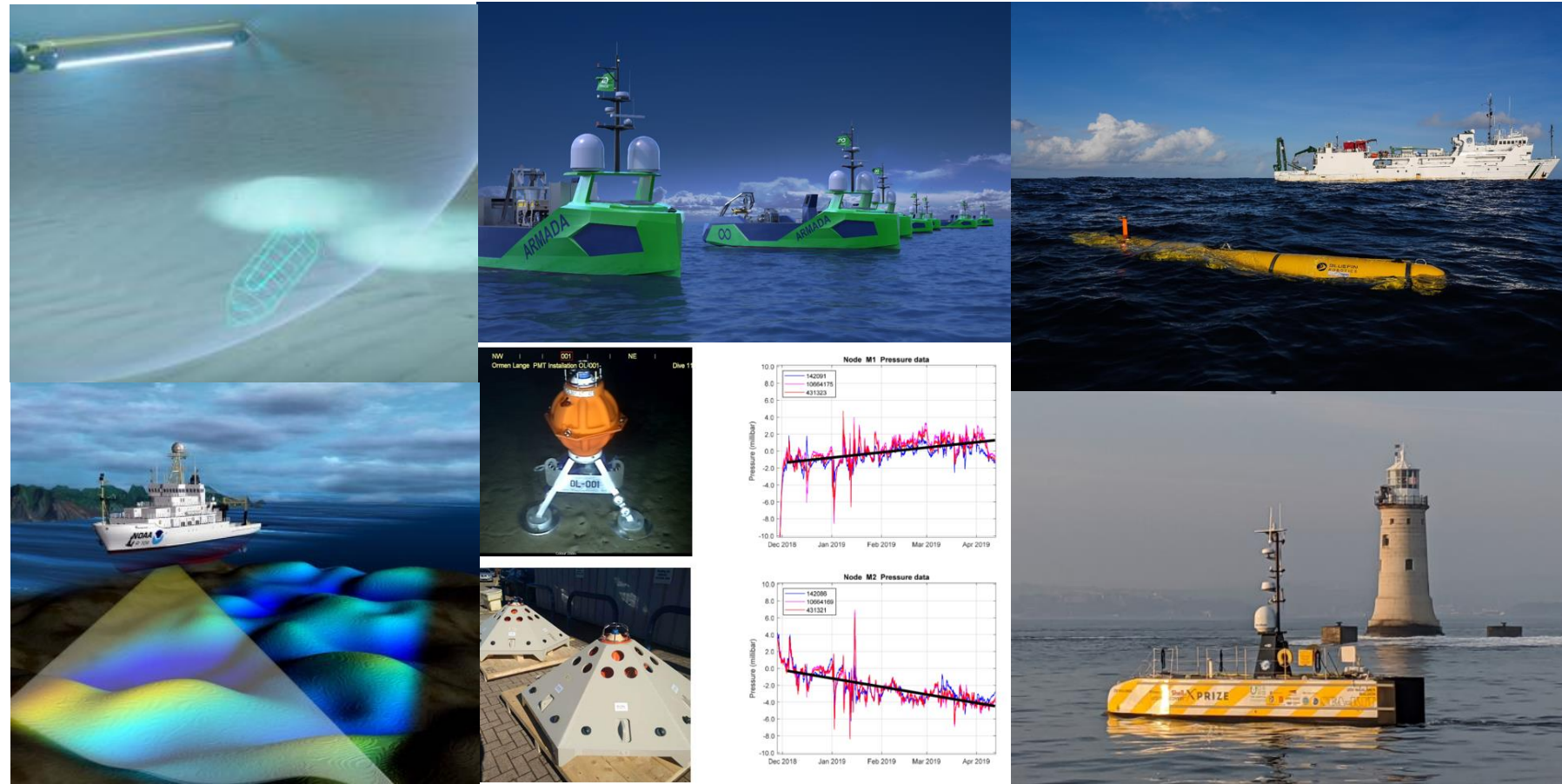
- Force Structure
- Adoption of technology

Technology Developments

Autonomy

Sensing

Communications



Sea-Kit Uncrewed Surface Vessel



Key attributes

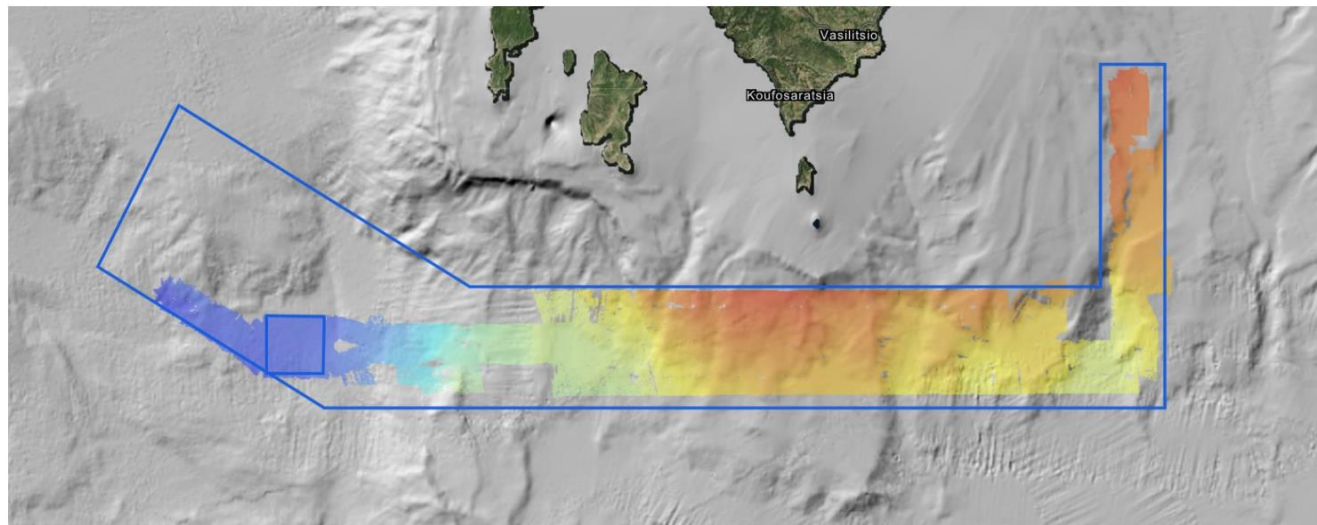
- Persistence – up to 90 days
- Mission Versatility – AUV, ROV, MBES, SSS, Winch deployed sensors, ASW, ISR, MCM
- Containerised for rapid mobilisation also air transportable
- Over the horizon capable – Tonga Operation: 15500km between Remote Operations Centre and USV
- Regulatory Compliance
- Station holding
- Layered system redundancy/ No single point failure

Autonomy



Bathymetry coverage

Survey mode	V [kn / km/h]	AUV altitude [m]	Full swath [km]	Survey time [hrs]	Total length [km]	Coverage [km ²]
Hugin – HiSAS wide area mode	3.5 / 6.5	75	1.00	22.0	142.6	142.6
Hugin – HiSAS standard mode	3.5 / 6.5	40	0.35	2.0	13.0	4.5
SEA-KIT EM 304	3.5 / 6.5	var	2.00	12.6	81.7	163.3
Total (including overlaps and gaps on turns):						278.9 km²



- Two systems AUV-USV concept
- Use new and proven technology
- Based on proven ASV technology using Kongsberg Hugin AUV
 - Hi-Tech leading technology interferometric synthetic aperture sonar on HUGIN
- SEA-KIT x-Class USV
 - New development of an ocean-going, long endurance USV with the capability to launch and recover AUVs
 - Fitter with MBES to conduct survey operations



Shell XPRIZE

U.S. NAVY

VIV MAXIMER MALDON

NOAA

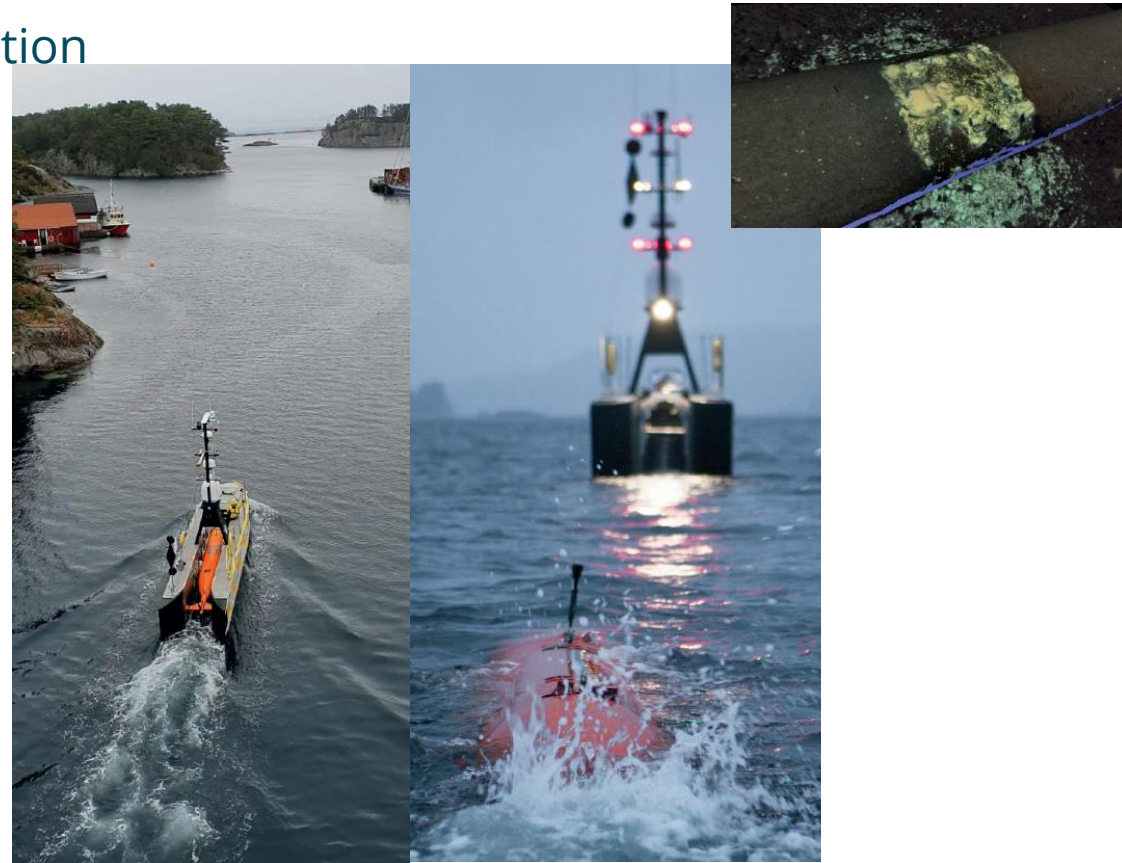
First Uncrewed Offshore Pipeline Inspection

TASK

Complete the first uncrewed, over-the-horizon pipeline inspection for Equinor with a AUV launched and recovered from a USV.

KEY MISSION STATS

- 4 Offshore Pipeline inspections completed
- 175km of pipe surveyed
- 6 days offshore operation
- 100km offshore
- 2 AUV dives completed
- 0 risk to personnel



COST COMPARISON

▲ SEA-KIT USV ▲ CREWED VESSEL

2% BUILD

10% OPERATIONS RATE

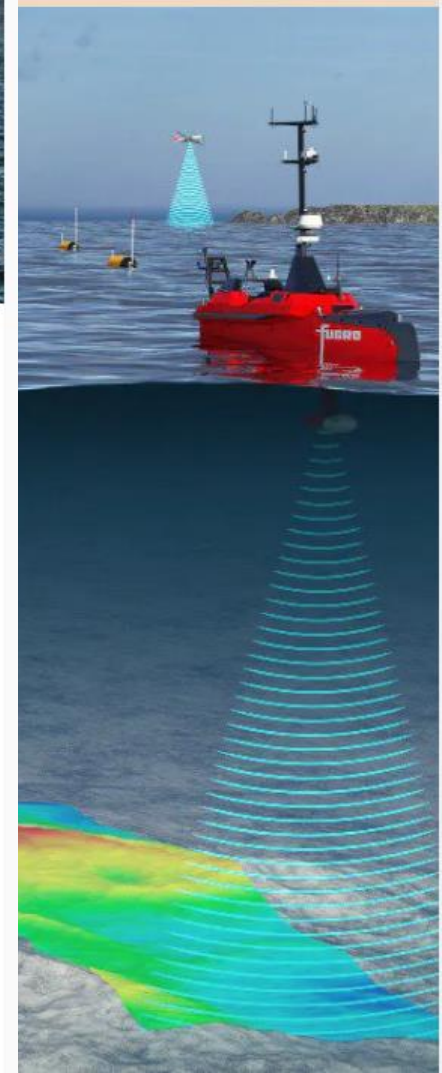
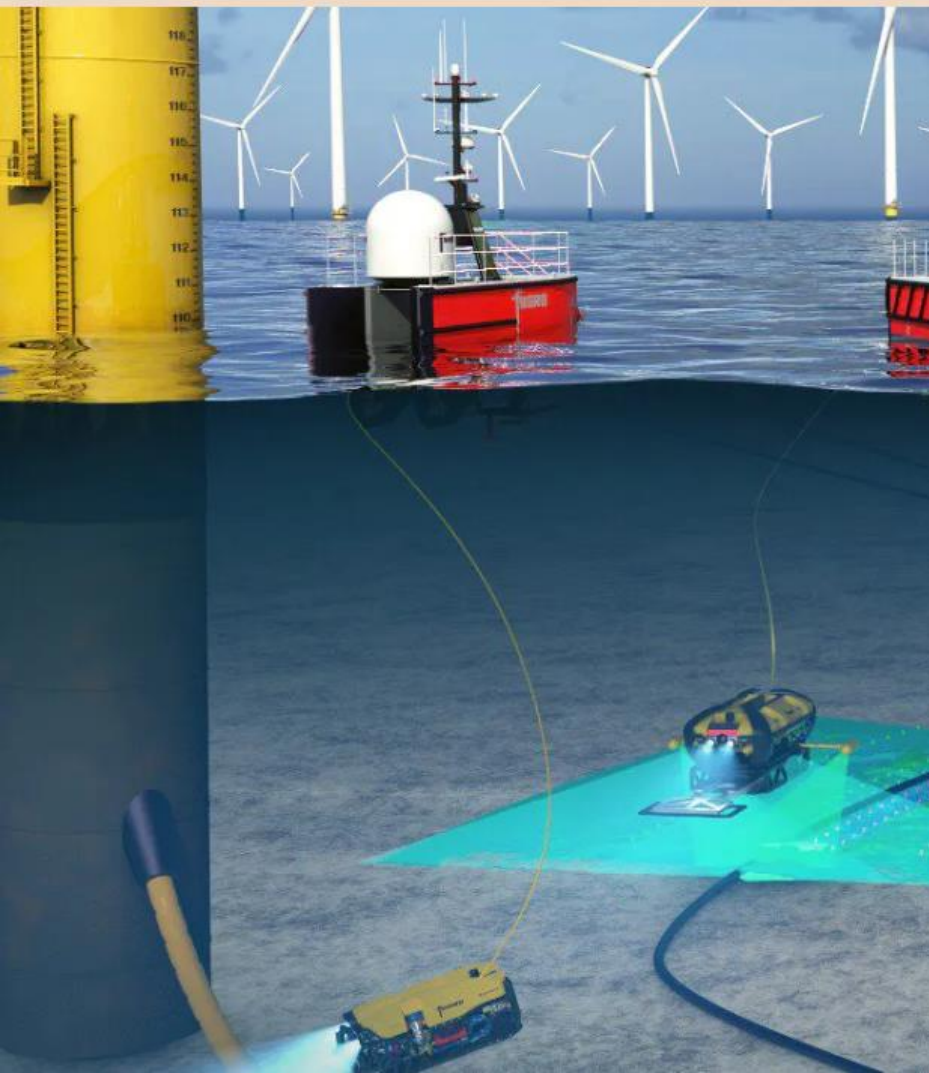
EIVA



KONGSBERG

SWIRE SEABED

Shaping the future of autonomous marine operations



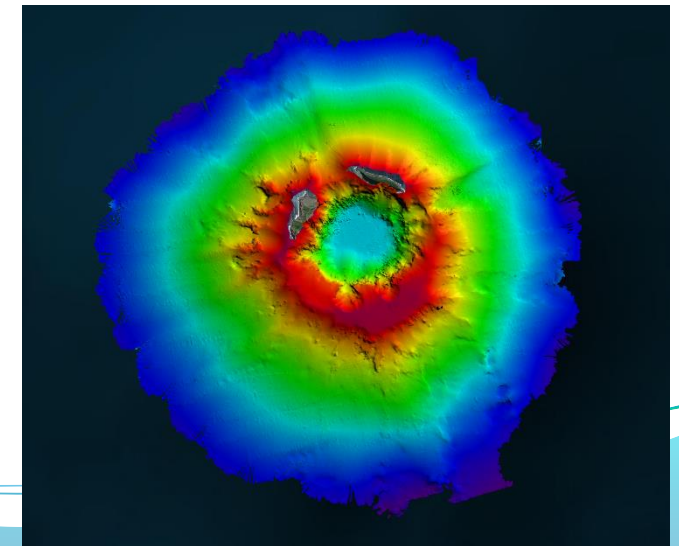
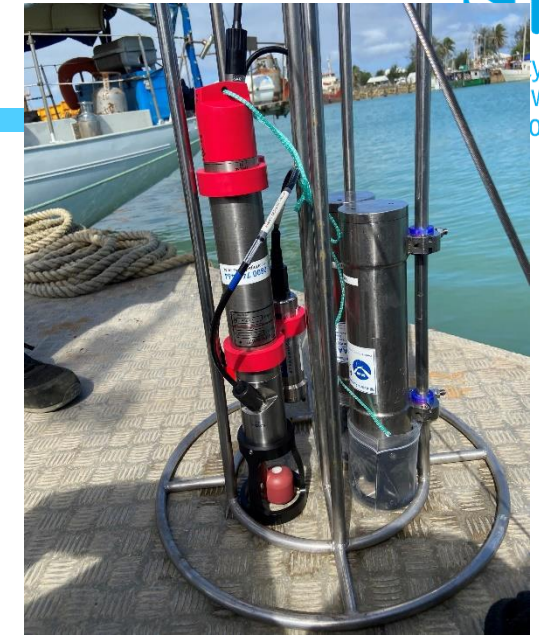
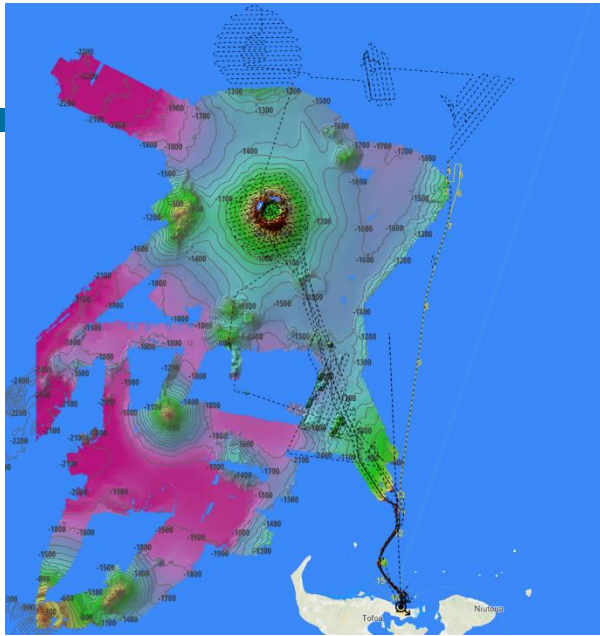
NEWS

Fugro completes fully remote offshore North Sea survey inspection

January 31, 2023

Fugro has completed its first fully remote offshore survey inspection in the North Sea for energy company TAQA. The project utilized the Blue Essence uncrewed surface vessel (USV) and the Blue Volta electric remotely operated vehicle (eROV). The inspection took place in the busiest part of the North Sea and involved the examination of two platforms and over 40 kilometres of pipeline off the coast of the Netherlands.

SEA-KIT International - TESMaP-U Project



IOC in
< 3 Years

FOC in
< 4½ Years

August 2016
Request for concept
from GEBCO-NF Alumni
team



July 2018
Development of
gondola for
mounting deep-
water multibeam



June 2019
Team announced
winners of XPRIZE



September 2019
Continued R&D,
development of
22m USV



May 2020
DASA demo
project with
Sonardyne testing
navigation systems
on USV for MoD



November 2020
First Commercial
USV delivered to
customer



March 2020
Fugro partners
with SEA-KIT to
develop a new
range of USVs



August 2020
First Uncrewed



June 2021
Awarded first ever
Lloyds Register
UMS Certificate



June 2021
Second Commercial
USV delivered to
customer



September 2021
Won funding for
CMDC project for
Zero-Emission
Development



September 2021
Third Commercial
USV delivered to
customer



November 2021
SEA-KIT & Fugro
win Offshore
Support Journal
2021 Subsea
Innovation Award



December 2021
First 18m USV
Ordered



July 2022
Tonga Volcano
Caldera Survey for
NIWA and Nippon
Foundation



Innovation



Emissions reduction



Cost Saving



Business Development

Remote and Resident Ecosystem of the Future, **today.**



Onshore Remote Operations Centres

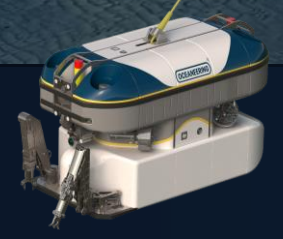
Liberty eROV



Freedom AUV



ISURUS wROV



NextGen wROV



Resident Freedom



Liberty Freedom

MODE: AUTONOMOUS
MISSION: TRANSIT TO INITIAL AREA



OCEANEERING®

Vehicle Behaviors

Autonomous Behavioral Features

Docking

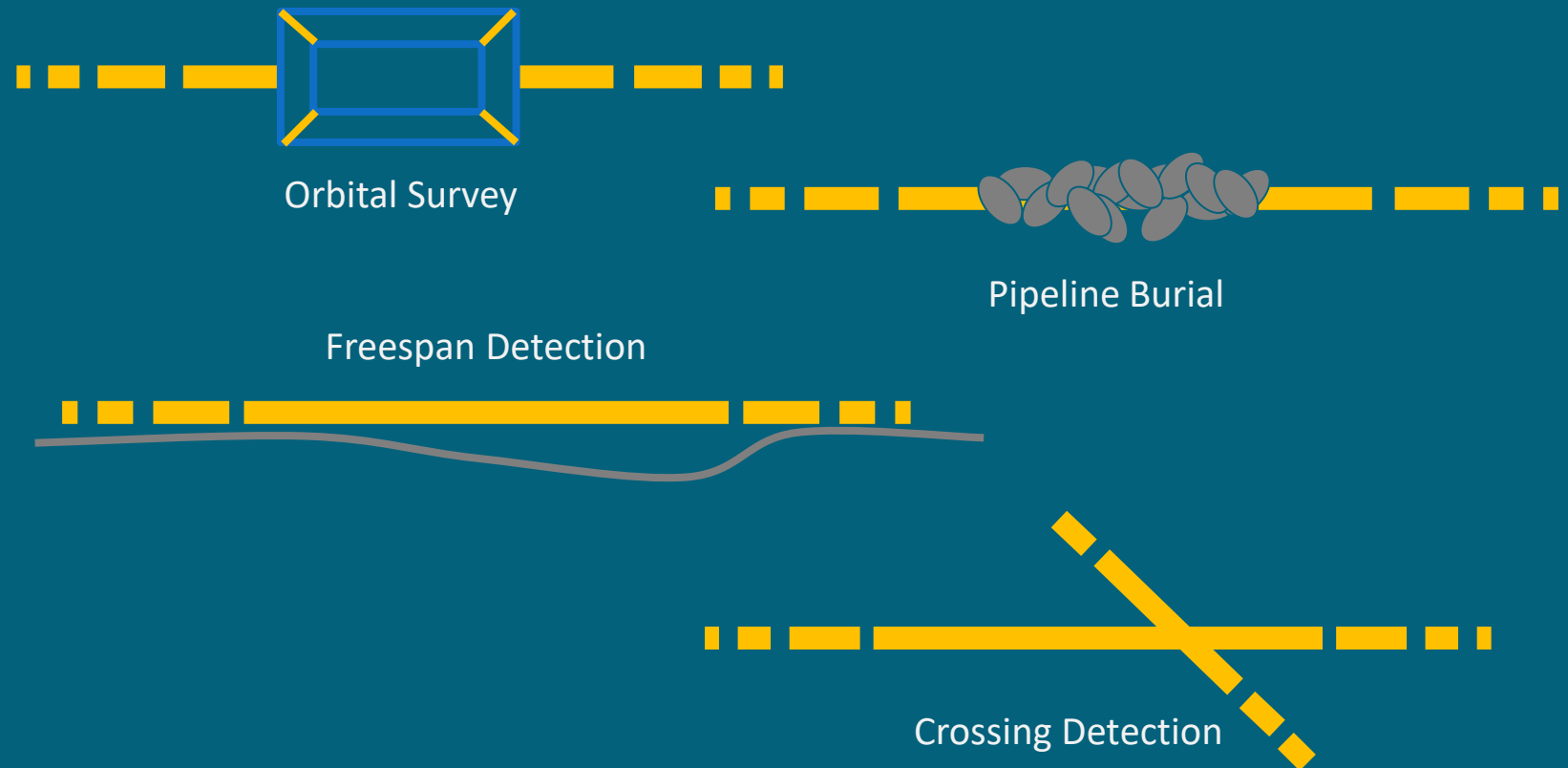
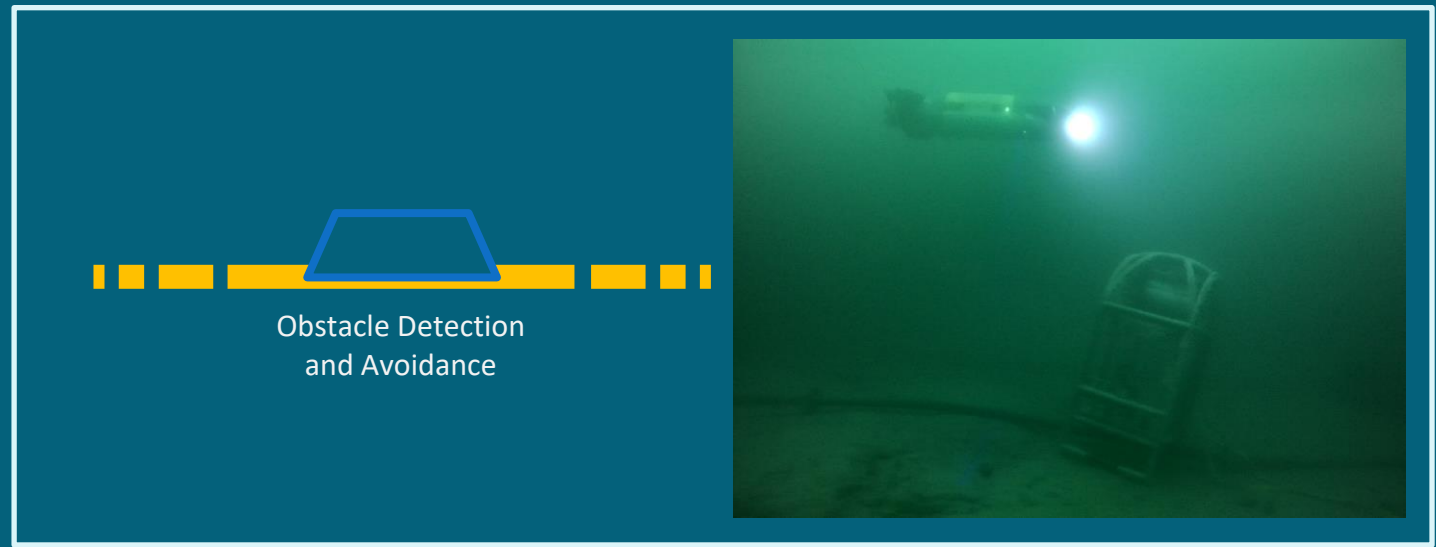
- Horizontal Docking
- Vertical Docking

Inspection

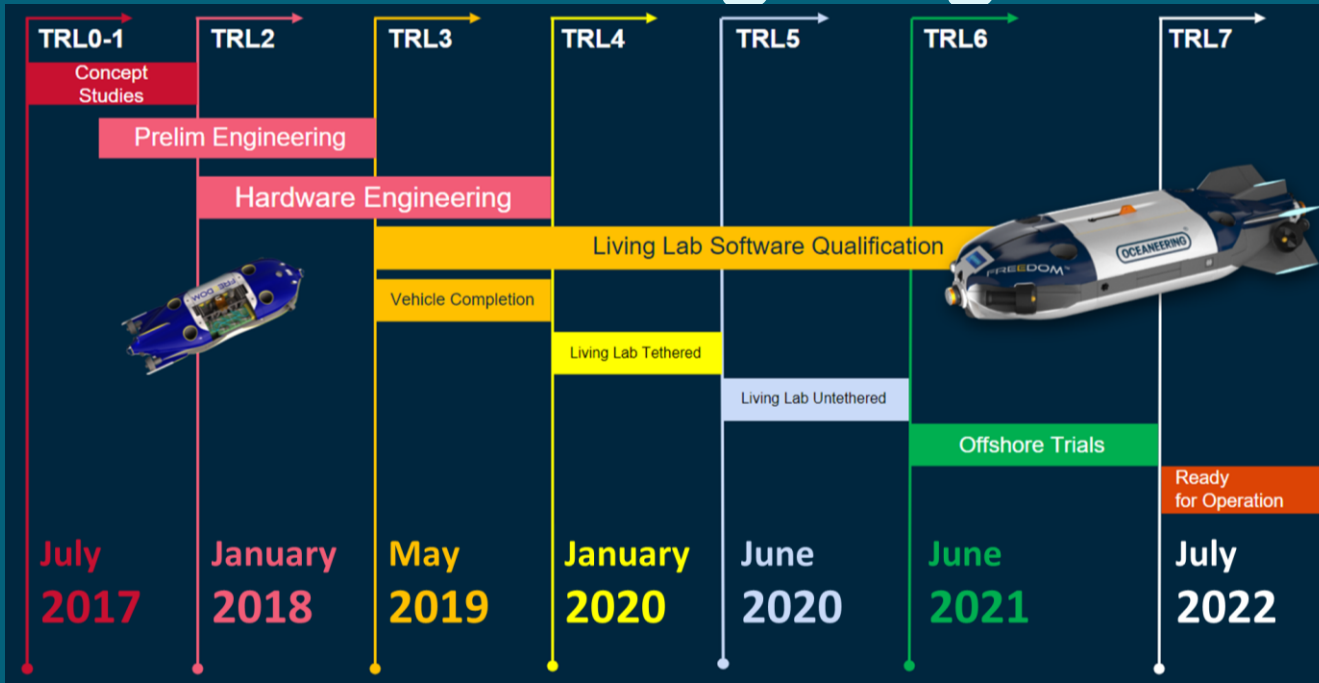
- Pipeline Detection
- Pipeline Acquisition
- Pipeline Following
- Pipeline Burial
- Pipeline Crossing Detection
- Pipeline Crossing Inspection
- Freespan Detection
- Freespan Inspection

Obstacle Avoidance

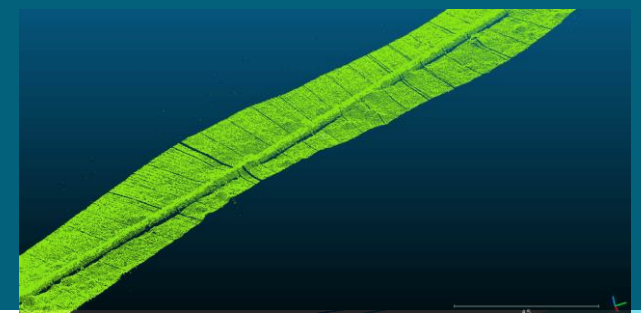
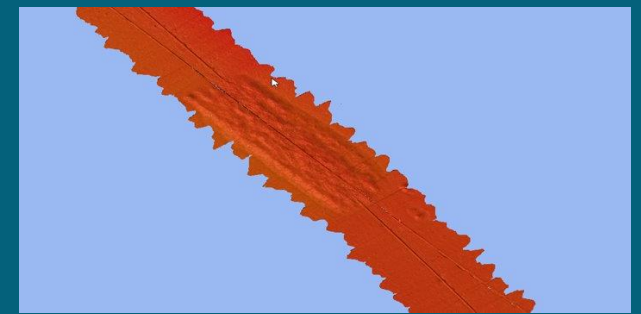
- Known Object Avoidance
- Unknown Object Avoidance



Freedom Testing Programme



Mission	Test Days	Runs	Outcome (HL)
Total Testing Program	107 Days	>400	Pass
TRL6 Campaigns			
EuroPipe / Gryphon Sea Trial (Sept. '21)	7 Days	35	Partial
Tau OA Testing (Jan'22)	2 Days	50	Gold Standard
L&R Behaviour (April '22)	1 Day	11	Gold Standard
Vestprosess (May '22)	7 Days	87	MVP



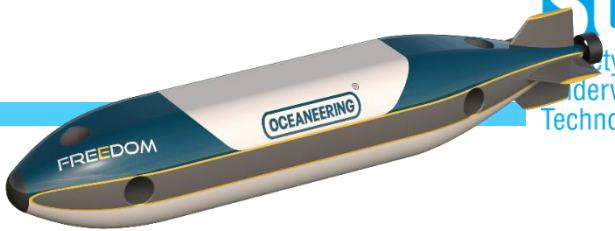
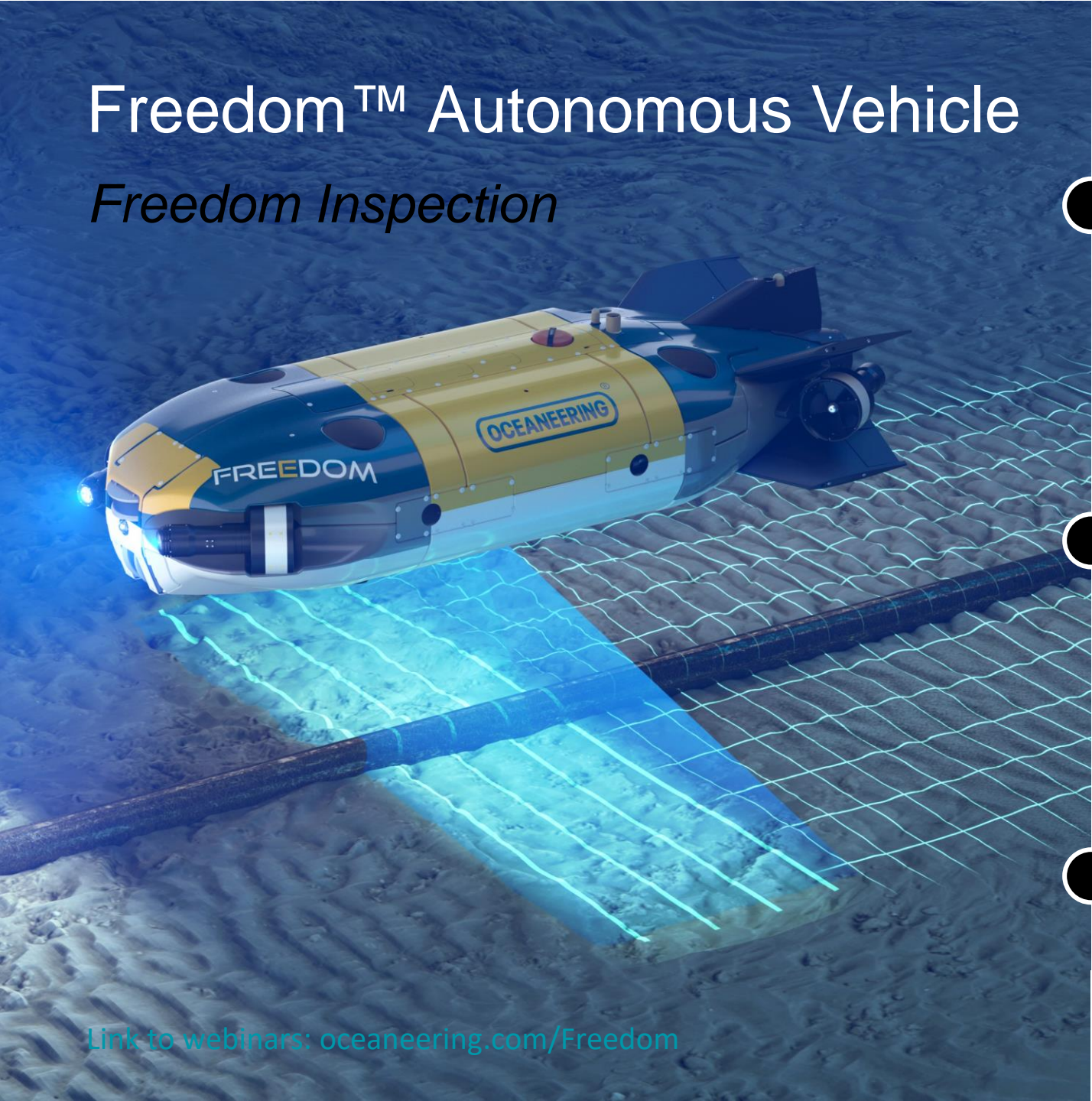




OCEANENGINEERING

Freedom™ Autonomous Vehicle

Freedom Inspection



Link to webinars: oceanneering.com/Freedom



LIBERTY CAGE



FREEDOM AUV



LIBERTY CONFIGURATIONS



WORK ROV



LIGHT INTERVENTION ROV



Vehicle Agnostic

The Liberty can accommodate any form factor, size and type ROV or AUV to suit operational needs

Freedom



What is it?

- 6,000+m Capable Hybrid Autonomous Underwater Vehicle (AUV)

What are the Defence Applications?

- Seabed Mapping
- Rapid Environmental Assessment
- Port Access assurance
- Intelligence, Surveillance and Reconnaissance
- Critical National Infrastructure Intelligence
- Mine Countermeasure

What Unique Capabilities Does this AUV have?

60km+ Range per charge
3knt Optimal Speed

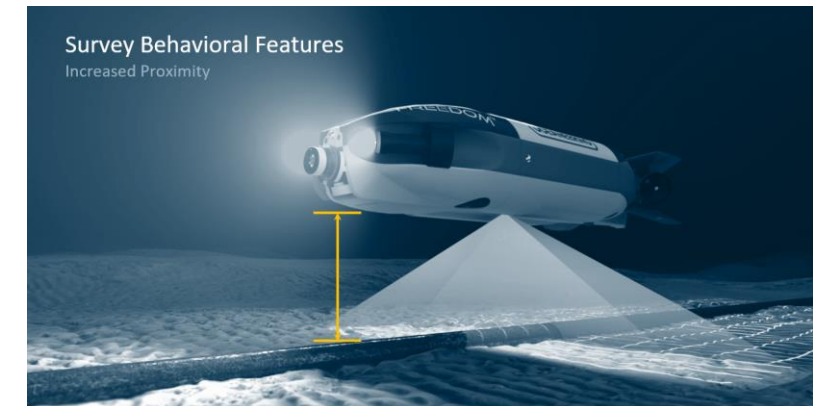
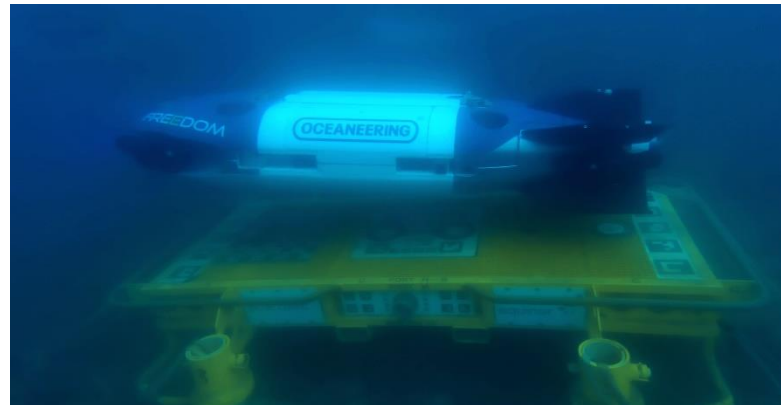
Autonomy: -

- Navigation within GPS denied environment
- Sensor and Flight Control Fusion
- Anomaly Detection and Behavior Trigger
- Stop, Hover and Orbit capability
- Obstacle Detection and Avoidance
- Low Altitude autonomous underwater flight
- Autonomous docking, recharging and data exchange with docking stations



Designed for the Future of Subsea Robotics

- Uncrewed Remote Operation (Supervised or Fully Autonomous)
- Components Designed for Minimum Maintenance (6-month duration deployment)
- Secure data processing and management systems
- Flight Control Artificial Intelligence (AI)
- Flexible Payload capabilities (CDT, Hydrophone, MBES, SSS, SaS, Hydrocarbon sensor & HD cameras)
- Designed and developed within NATO countries (USA, UK & Norway)



Liberty

Resident Deployment System

What is it?

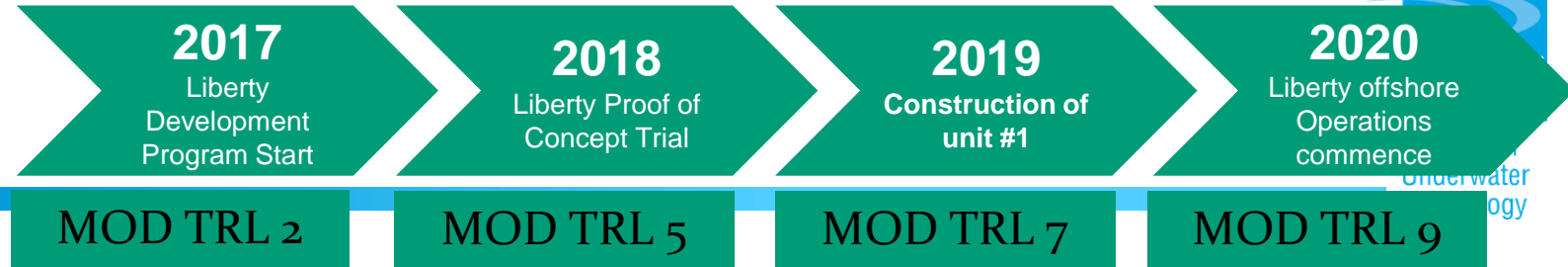
- Short to medium term resident docking Station
- Current depth capability 1,000m
(With Option to extend)

What are the Defence Applications?

- Deployment, recovery and hosting of single or multiple military data gathering (MDG) subsea robots or intervention robots.
- Medium term (60 day) residency
(With Option to extend)

What Unique Capabilities Does this asset have?

- Recharging of battery powered subsea robots
- Data hub to shore (4G LTE, LEO Satellite, FO Cable link)
- Autonomous buoy deployment
- Mission Communications hub for deployed robotics
- 1,000m WROV excursion
- Storage of tooling devices for subsea robot



Designed for the Future of Subsea Robotics

- Uncrewed Remote Operation (Supervised or Fully Autonomous)
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- Subsea Charging and Data Exchange
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Liberty Deploying in North Sea



Liberty Deploying WROV

Artificial Intelligence (AI)

- 2 main technologies used in collecting bathymetric data using sonar



Multi Beam Echo Sounder (MBES)

256-512 beams
Pencil-like
Narrow width

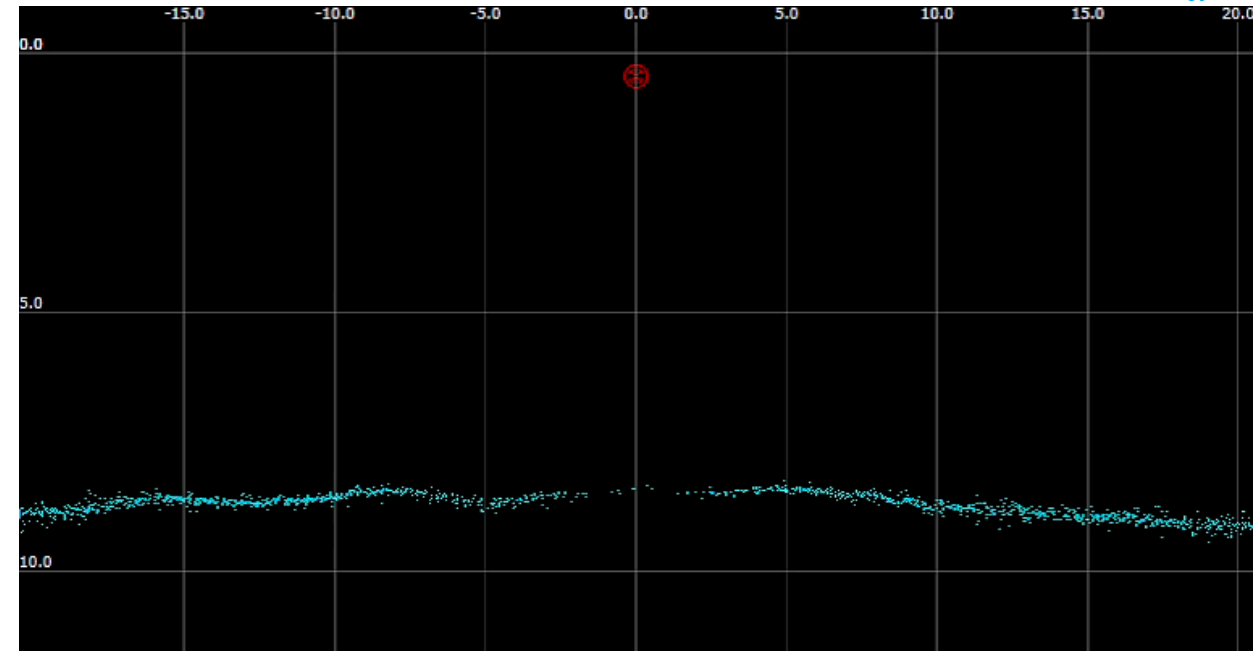
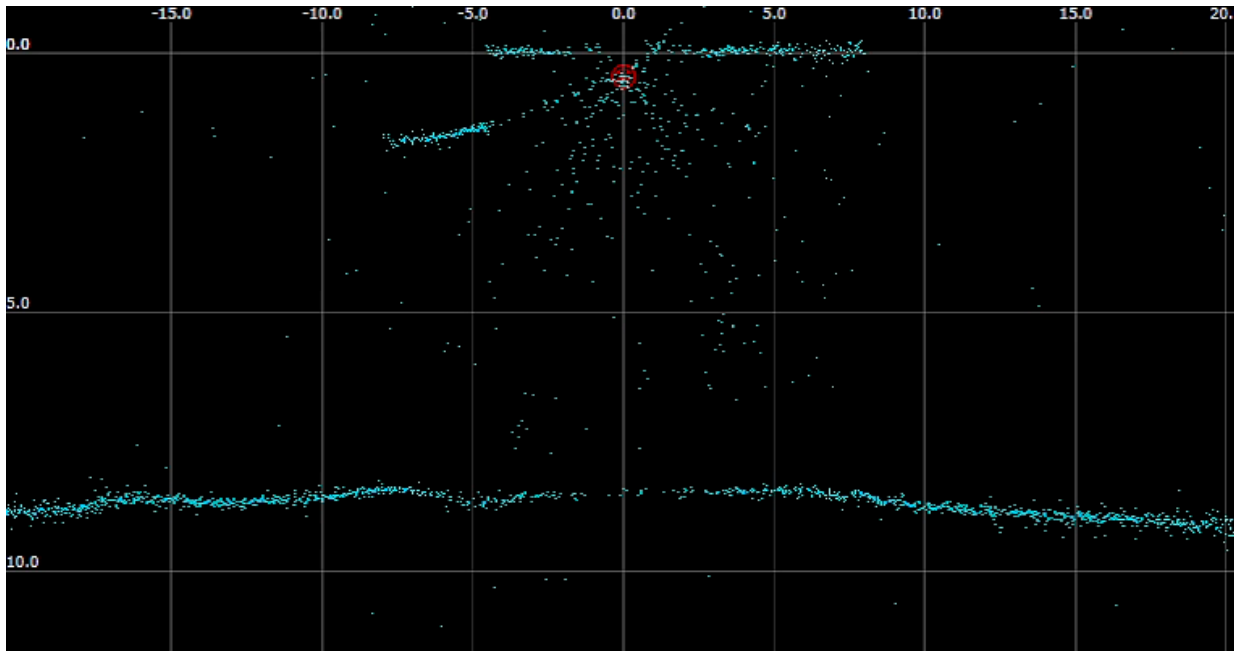


Phase Measuring Bathymetric Sidescan (PMBS)

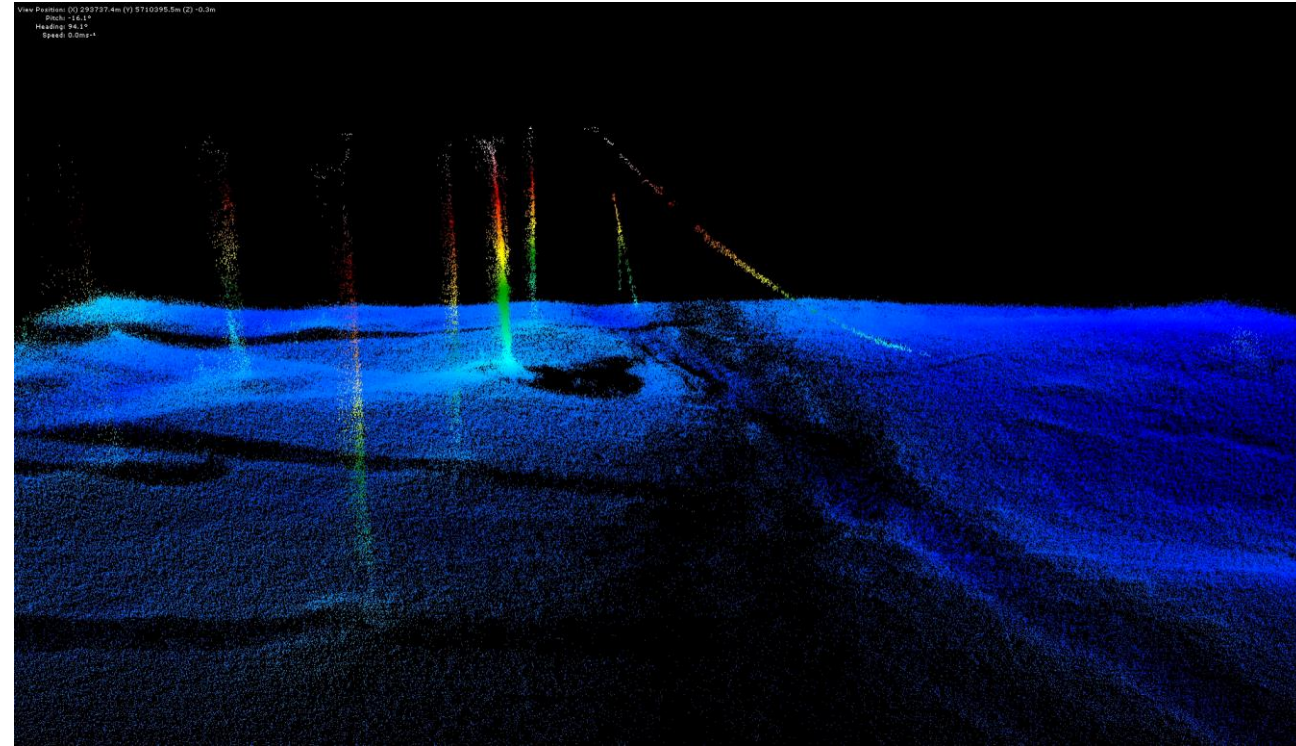
x 2 beams
Fan-like
Wide opening angle

- In shallow water environments PMBS can out perform MBES for data coverage.
- However - Data volumes are considerably larger which complicates processing (10,000+ data points vs 512)
- GeoSwath is a PMBS suitable for small vessels / USV / AUV
- AI has been successfully applied to data processing to give results in real-time

Artificial Intelligence (AI) for GeoSwath – Example (Excel London)



Artificial Intelligence (AI) for GeoSwath – Example (Excel London)



A survey line from a 3m vessel using a 500 kHz GeoSwath

Lines of Development

Training
Doctrine

Equipment
Organisation

People
Information

Infrastructure
Logistics

Remote Operation Centres

- Equipment/Infrastructure
 - Levels of autonomy
 - Reliance
- People/Organisation/Doctrine
 - Manning levels
 - Skills
 - Reliance of technology
- Information
 - Management
 - Security



Lines of Development

Training
Doctrine

Equipment
Organisation

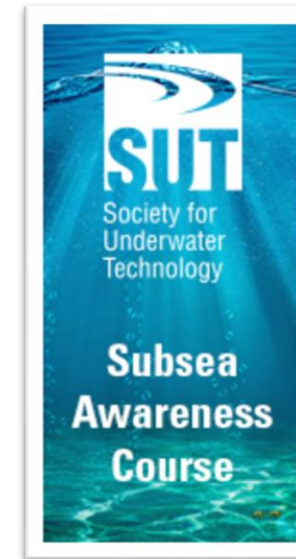
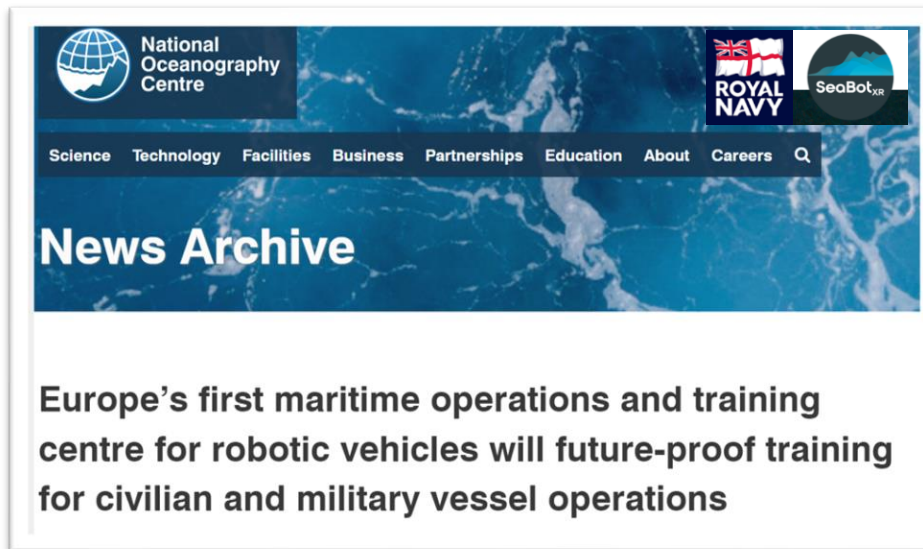
People
Information

Infrastructure
Logistics



Cross Domain Training

- Best practice from commercial operators
- By equipment supplier



Unique Group and AMCS to develop USV Coxswain course

BUSINESS DEVELOPMENTS & PROJECTS

August 30, 2021, by Nadja Skopljak

Unique Group has signed a Memorandum of Understanding (MoU) with AMCS Search (AMCS), the training and consultancy division of the Australian Maritime College, to jointly develop a maritime industry accredited Unmanned Surface Vessel (USV) Coxswain's course.

This industry-academia collaboration will see Unique Group provide the latest autonomous survey technology from its pool of autonomous equipment, with AMCS developing a comprehensive training course incorporating collision regulations and navigation considerations for unmanned systems in commercial operations.

AMCS will deliver the course using Unique Group's fleet of USVs as training platforms and base stations as training simulators.

Additionally, the course will be offered to Unique Group's clients as a part of the USV product package.

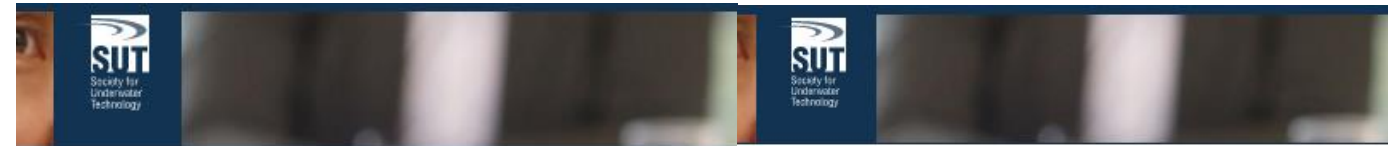
"We are excited to collaborate on building educational and training programs for the emerging autonomous offshore industry," said Sahil Gandhi, Unique Group COO.

"We believe that this emerging technology will become a significant segment within the offshore value chain in the future and as technical experts, providing asset management and knowledge-sharing solutions for our customers globally is the next step for us."

SUT Defence SIG

Next Activities:

- **Workshop/Conference**
- Specialist areas/technologies
- Lesson learnt – Operations
- **Training**
- Introduction to underwater technologies
- Aimed at new entrants (networking benefits)
- Specialist areas/technologies



Aberdeen – Gadgets and Widgets

Save the date!

27 April, 2022

[RETURN TO LISTINGS](#) 



Many of you will be well aware of the very successful **Gadgets and Widgets (G & W) Evening** that has been presented each year by the Aberdeen Branch of the Society for Underwater Technology (SUT) and we are pleased to announce that, as we seek to reintroduce our Evening Meetings we plan to kickstart those efforts with a Gadgets and Widgets Session on **Wednesday, the 27th April** at the Holiday Inn, Westhill. This note will serve as an **initial invitation**

to those companies and organizations who would like to be considered for a 10-minute presentation slot at this year's event.

Please read the following outline of our 2022 event and if you have a suitable technology that you would like to showcase in April 2022, then **please submit your request (abstract)** for consideration to our event organisers who are:

9th International SUT OSIG Conference “Innovative Geotechnologies for Energy Transition”

12 September, 2023 - 14 September, 2023

[RETURN TO LISTINGS](#) 

Conference Venue – Imperial College, London

Conference Dinner Venue – Natural History Museum, London

The SUT's Offshore Site Investigation and Geotechnics (OSIG) committee is pleased to announce that its 9th international conference, 'Innovative Geotechnologies for Energy Transition', will take place from 12-14 September 2023 at Imperial College in South Kensington, London.

Click for – [Conference Themes](#) | [Scientific Committee](#)

Call for abstracts now open! see www.osig2023.com

For any queries, and for details of sponsorship opportunities, please contact SUT Events osig2023@sut.org

Further information to follow.

[+ Export to Calendar](#) [+ Google Calendar](#)