UNDERVATER R.O.B.O.T.C.S.

NEMOSENS



ISSUE





NemoSens® VERSATILE MICRO AUV



rtsys.eu



HQS Wellington, Victoria Embankment, London WC2R 2PN

Issue No 10

Editor: John Howes

Editorial John@ut-2.com +44 7859905550

> Production: Sue Denham

Advertising: Zinat Hassan UT3subsea@gmail.com

Tel: +44 (0) 845 6522 483 Mobile: +44 (0) 781 1200 483

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RTS' NemoSens AUV

COVER STORY

NemoSens THE DEMOCRATISATION OF MICRO AUVS

Bringing into reality what only a few could only dream about was not an easy challenge, but 5 years after the project started, RTsys has become a world leader in the micro AUV market with its already well known and reputable vehicle NemoSens!

NemoSens is a single person portable micro AUV, measuring less than 1m long and weighing less than 10kg. It can navigate up to 8kts and work down to 300m depth for up to 10 hrs. NemoSens can carry several payloads such as multiparameter probes (CTD among others), side scan sonar, video camera, magnetometer, altimeter, ADCP and more.

NemoSens represents the new generation of affordable but capable systems, giving the possibility to any operator from scientist community, offshore survey companies and worldwide navies to acquire underwater data for the most competitive budget ever offered in the AUV industry over the years.

One of the key strengths of RTsys AUVs is its RACAM acoustic repositioning protocol, allowing from the surface a real-time tracking of the vehicle while navigating underwater. This protocol also provides constant and accurate positioning whatever the mission duration, with an accuracy of 5m.

Back in 2018, RTsys had only one focus in mind, one target- the democratisation of micro AUV usage. Increasing accessibility and availability of micro underwater vehicles to a broader range of users, far beyond just large research institutions or specialized industries.

This democratisation has been facilitated over the years by several factors: advances in technology, miniaturization, and manufacturing processes led to decrease NemoSens' cost, and as a result, making the platform more affordable and attainable for a wider range of users including smaller research organisations, educational institutions, environmental NGOs, and even individuals with specific underwater exploration needs.





Real time tracking of Nemosens through RACAM[®]protocol



COVER STORY

The reduced cost lowers the barrier to entry and promotes wider adoption.

as habitat mapping, archaeological site documentation, pipeline and infrastructure inspection, wreck localization, resource exploration Countermeasures.

NemoSens can get even closer to the seabed and provide the more accurate data as the depth is increasing; this is specifically

Last but not least, the RTsys micro vehicle can navigate in very shallow water (only a few meters!) as well as very difficult areas where a surface







SUBSEA ADD-ON FACILITATOR

Blue Logic has developed a Subsea Communication Hub, SCH, to allow retrofit of additional sensors and instruments for smartification of subsea systems.

The SCH originates from Blue Logic's range of inductive connectors, and can facilitate up to 5 off instruments / sensors. Main interface for power and data transfer is represented by a secondary 250W inductive connector to be connected to the subsea infrastructure. Each of the 5 off 50W connectors can supply up to 50W of electrical power and/or 80Mbps data on Ethernet or 230Kbps on RS232/485.

In short, the SCH will contribute to a high degree of flexibility for subsea instrumentation thus allowing any subsea control system keeping up with the latest technology. Adding sensors, cameras etc. can bring a standard subsea control system to another level with respect to real-time monitoring of production, condition monitoring and environmental caretaking.

The Subsea Communication Hub is designed for installation and retrieval by ROV and capable of long-term service. To suit any subsea control system, the 250W inductive connector can be replaced by wet-mate connectors for power and communication.

SMOOVE **OPERATOR**

The SMOOVE resident camera system combines Forssea's knowhow for real-time underwater vision with Ifremer's expertise in resident systems and scientific observatories deployment.

Smoove comes with a turnkey API, web user interface and multiple customisation options (depth, lights, cables & power supply). Typical applications include seabed observatory, coastal survey, visual monitoring and military surveillance.

The first two systems will be deployed imminently on deepsea observatories for long term biodiversity visual monitoring.



Smoove





Communication Hub

8



The power you need to get tough jobs done

Mission Specialist underwater robotic systems are engineered to work hard. With powerful thrusters to handle currents up to four knots. A modular platform built to handle heavy payloads and a wide array of accessories. And durable construction that can take a beating and keep on working. That's how we're redefining "inspection class" to give you the performance you really need.

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FOURTH LIDAR

GEOxyz succesfully deployed a fourth LiDAR buoy for the Netherlands Enterprise Agency last month.

The deployment of our fourth Accurasea buoy is a crucial step in providing essential Metocean data for the Dutch offshore wind farm zones Lagelander and Doordewind.



The four buoys will collect wind- and water measurements, enabling precise calculations of wind park yield and their respective influence on each other.

The data collected by the buoys will play a pivotal role in supporting the ambitious 2030 climate reduction goals set by the Dutch government. By collecting this invaluable information, we are actively contributing to the realization of the Netherlands' vision to produce 21 GW of offshore wind energy by 2030/2031.

ARGEO WHISPER

Argeo Robotics has been granted a patent from the Norwegian Industrial Patent office for a subsea electromagnetic remote-sensing system for tracking of buried cables and pipelines below the seafloor.

This patent protects "Argeo Whisper" which is used for finding and tracking pipelines and cables below or on the seafloor at depths not possible with conventional technology. Argeo Whisper is integrated on Argeo' Autonomous Underwater Vehicle (AUV) but can also be installed on other subsea vehicles.

Argeo has developed a portfolio of electromagnetic source and receiver systems for AUVs, Underwater Intervention Drones and ROVs.

With the successful development of subsea



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electromagnetic technology and by establishing a significant patent portfolio around it, Argeo is now pursuing product sales and services utilizing Argeo Whisper in new markets segments with significant growth potentials.

"There is significant interest from the offshore windfarm and oil and gas industry in this technology for power cable and pipeline tracking, and this patent puts us in a strong position with a competitive edge" says Trond F. Crantz, CEO in Argeo.



FLiDAR

French marine renewable energies company Akrocean has deployed a Floating Light Detecting and Ranging Device- or FLiDAR. This is to be towed into position 37km off the coast of Patea.

This will provide data crucial for accessing the feasibility for a 1 gigawatt, \$5 billion offshore windfarm in the South Taranaki Bight. The buoy will provide a 'next level, more granular' understanding of wind conditions in the bight.

It is designed to record wind speeds at various heights all the way up to 300m about sea level. This should provide the user with a very good understanding of what kind of wind speeds can be expected if an offshore windfarm is to be installed in that area."

It was proposed 60 wind turbines standing 230m would be erected in the bight, which would be comparable to some of the largest hydroelectric power plants in the country and capable of meeting more than 11 percent of New Zealand's current demand for electricity.

Inclination Monitoring Has Never Been So Easy



Offshore Honolulu, C-Power has completed an in-water harbour test of its SeaRAY autonomous offshore power system (AOPS) that will soon be deployed for a six-month pilot project at the U.S. Navy's Wave Energy Test Site (WETS) off the Hawaii coast.

With support from Sea Engineering, C-Power tested the components of the AOPS and the Halo subsea battery storage system and gravity anchor from Verlume, to ensure proper system deployment and operation. The successful test marks the final milestone before C-Power's pilot project begins.

This will be the world's first field test of an ocean energy device purposebuilt to provide power and real-time data communications to both mobile and static assets. The SeaRAY AOPS is a charging station, data server, and cell tower enabling remote, autonomous operation of offshore assets. The field test includes plans for the system to serve several assets including:

• A Saab Sabertooth autonomous underwater vehicle (AUV) operating in untethered mode, without a top side vessel. From shore, operator Hibbard Inshore will remotely program and monitor the AUV.

Equipped with the R2Sonic Sonic 2024 multibeam echosounder, the untethered Sabertooth will patrol the surrounding area to collect sonar imagery of the sea floor and underwater infrastructure. After each survey mission, that imagery will be communicated back to shore and the Sabertooth recharged via the SeaRAY AOPS. • A BioSonics long-range subsea environmental monitoring system deployed for the entire six months, sending data real time to the cloud. The system will also serve as an intrusion detection system.

Saab and BioSonics are partners in C-Power's Partner Engagement and Co-Development (PEC) Program, which allows companies to participate in C-Power demonstrations in a number of ways.

C-Power is currently expanding membership in the PEC Program ahead of its upcoming demonstration of a next generation SeaRAY AOPS at the new PacWave South site off the Oregon coast. The DOE-sponsored demonstration has a primary goal of simultaneously demonstrating applications critical to offshore operations.



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BARRACUDA

After successfully competing in the Shell Ocean Discovery X Prize, Florida-based underwater vehicle manufacturers Tampa Deep Sea Xplorers began to recognise there was a definite market need for low cost affordable AUVs. The result is the Barracuda, a small, one-person portable vehicle which can work at depths down to 600m. It weighs only 16 Kg (35 lbs), making it easily launchable by hand from a small vessel or shoreline.

The AUV was specifically designed to allow the rapid collection of subsea data to support researchers, explorers, and individuals, as well as the objectives of the GEBCO Seabed 2030 Initiative. The company is now starting to take orders and will deliver those by the end of the year. Next year it will commence full scale production.

"We see this as a sensor platform for small businesses and small institutions who need to collect subsea data but they may not be able to afford a large-scale ship based launch vehicle," said CEO Edward Larson.

"Our first customer is Ocean Builders, a company involved in developing small houses and condominium type dwellings under and in the water. They are using the vehicle for bottom surveys, inspections and also for data collection in the water column.

We've taken three orders this year and the base unit itself will be about \$15,000.

BARRACUDA

"From a vehicle design point of view, we have moved the motors to the dive planes rather than placing them on the rear of the vehicle. This results in improved manoeuvrability Most autonomous underwater vehicles require a fair amount of space in order to turn around, however the Barracuda can perform a full 360deg turn within the body length of the vehicle.

"At the centre is the battery and this not only provides the power but also the ballast. In the tethered

Barracuda AUN

version, the battery moves backwards and forward which helps with diving and rising upwards. In the battery dies it is buoyant enough that it floats to the top and you not going to lose it.

"As there is no tail thruster we are working on the engineering to make it as hydrodynamic as possible.

"The battery is good for 46 hrs. We started out with a commercial off the shelf battery and separate ballast but we decided to use a purposed designed unit. We have also bee working with the University of South Florida to develop communications technologies

The vehicle is based on a 1.2 meter long, 10 cm diameter, body tube streamlined using syntactic foam over the outside, Barracuda's main CPU/GPU is an Nvidia Nano Al platform running Ubuntu Linux and Robot Operating System (ROS). It has a large forward facing viewport that provides a wide field of view for onboard cameras and optical sensors

> It is large enough to carry a side scan sonar but we believe the

breakthrough will come next year where the LIDAR system that's currently in development should be available. We think this will revolutionize the small AUV market.





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KRAKFN

Kraken have announced \$1.1 million of purchase orders for its AquaPix synthetic aperture sonar (SAS). These systems will be integrated to Autonomous Underwater Vehicles (AUVs) for use in minehunting and security applications. Delivery is expected in 2023.

Kraken's AquaPix is an off the shelf, configurable SAS that replaces high end sidescan systems at an affordable price, while delivering higher resolution, range, and area coverage rates (ACR).

The increased range, resolution, and therefore higher useable ACR of SAS over traditional Side Scan Sonar systems significantly expand the capabilities of naval, scientific, and commercial applications. Kraken's AquaPix is capable of 2 cm x 2 cm Ultra High-Definition SAS imaging at long ranges.

AquaPix is uniquely positioned within the industry to bring this capability to the increasingly popular small, manportable vehicle class.

AquaPix is modular and has been integrated and deployed on over 20 different underwater vehicle platforms from shallow water to full ocean depth.

This ability to cross several platforms enables military customers to streamline their Post Mission Analysis by having the same sonar resolution and ATR performance across their entire fleet of vehicles and mission requirements.

• Kraken Robotics has received a purchase order for subsea batteries valued at \$16 million. Deliveries will occur in 2023 and 2024. With this order Kraken has now received more than \$30 million of purchase

Density corrected depth data directly from one instrument.

The Bathy2 is an enhancement of the **MIDAS Bathypack** offering Valeport's proven survey industry standard sensors to generate precision Sound Velocity and Density profiles for highly accurate depth and height data.

orders in the last 6 months for its SeaPower subsea batteries. Since the beginning of 2022, Kraken has announced more than \$120 million of contracts providing us solid visibility for our strong growth trajectory we are on.

Kraken's SeaPower 6000m-rated pressure tolerant batteries are based on Kraken's unique pressure tolerant gel encapsulation technology for lithium polymer batteries. This provides an attractively priced, environmentally friendly, and superior energy density alternative to the traditional oil compensated batteries commonly used for deep subsea battery applications. Kraken's hot swappable batteries are modular and include an integrated battery management system within each battery module which provides a very high level of redundancy and safety.

EXAIL'S INS/DVL SYSTEM



High-performance subsea inertial navigation systems (INS) developer Exail , has launched a new all-inone system that combines the best of inertial navigation and Doppler Velocity Log (DVL) technologies, the Rovins 9 DVL.

With this new tightly integrated system, Exail can provide subsea vehicle manufacturers with highly accurate and reliable subsea navigation. Highly compact for easy vehicle integration, the Rovins 9 DVL all-in-one design combines, in a single housing, Exail advanced Fibre-Optic based INS with a Nortek DVL.

This new all-in-one system is perfectly suited for subsea companies looking to maximize efficiency, and allows for higher levels of reliability, with a position accuracy of up to 0.02%TD and a heading accuracy of up to 0.01°RMS.

"By merging the INS and DVL complementary measurements, the resulting navigation data becomes much more precise and accurate than either system used alone. The ability to connect external sensors such as pressure sensors through the satellite connectors available on the system, provides even greater accuracy." Says Maxime Le Roy, INS Product Manager at Exail.

"The Rovins 9 DVL greatly simplifies the work of subsea operators in the field. The system can be easily integrated into a variety of subsea vehicles, including ROVs, AUVs and tow fishes, thanks to its unique compact horizontal design and plugand-play feature."

The Rovins 9 DVL is an ideal choice for AUV manufacturers and e-ROV operators seeking to save watts without compromising on data processing power. It operates on low power consumption and is highly resistant to high pressure and harsh environments. It can be deployed down to 6,000 meters.

Exail new all-in-one system is ready for immediate deployment and will help subsea operators saving This tight integration of raw sensor data from both INS and DVL provides operators with highly accurate position, velocity, and attitude information.

significant time and money enabling fast in-motion self-alignment and not requiring on-the-field calibration.

• Fugro has become the first customer to purchase this new technology in a deal unveiled at the Ocean Business.

The new Rovins 9 DVL will be integrated into the Fugro fleet across its range of ROVs. The company says that it will improve the execution of projects through accurate precision of positioning and stability accuracy. **MIREX**

WORK WHEEL

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SRV-8X OPTIMUS

Oceanbotics has recently launched its latest ROV, the SRV-8X Optimus. This is a larger and more powerful version of its small but mighty brother, the industry-leading, easy to use, SRV-8.

"The SRV-8X Optimus pushes the limits required for challenging offshore deployments, offering significant payload capabilities and an increased number of sensors for more demanding and deeper underwater missions," said Jeff Vos, Special Projects Manager, Brand Mgmt and Marketing. "The ROV is battery-operated,



ROVS

Meet zeerov, the future unveiled

NEW!



Introducing ZEEROV (Zero Emission Electric Remotely Operated Vehicle) - the latest work-class ROV from Kystdesign. Designed to push the boundaries of subsea exploration, ZEEROV delivers a new level of performance, versatility, and sustainability. With its advanced electric propulsion system KD300E, ZEEROV is a zero-emission vehicle that offers a more environmentally friendly alternative to traditional ROV's.

permitting improved range and ease of movement (down to 500m depth). It also offers sophisticated data synchronization with SubNav-X software for seamless integration of optional accessories and a "plug-n-play" installation.

The developers say that these increased capabilities make the SRV-8X Optimus ideal for market applications such as search and rescue, civil inspection, military defense, offshore drilling, and more. It expands the reach of those looking to navigate the underwater world through its streamlined design and intuitive interface. The operator has total control of their underwater environment.

The SRV8X Optimus has a length of 64cm (25 inches), a width of 51cm (20 inches), a height of 43 cm 17 inches and a weight of 25 kg or 55 lbs It is powered by eight large brushless DC thrustersnand has a depth rating of 500m or 1640 ft.

At the front are four dimmable lights each with an output of 1500 lumens. These work with a 1080p (or 4k

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Introducing KD300E, our new electric thruster



• kystdesign.no

optional) camera with a camera tilt range of 140 deg. For navigation it uses commercial grade AHRS IMU precise heading altitude, pitch and yaw. Full stop. It also carries depth, temperature, turns, counter, heading, humidity and pressure sensors. The battery is a dual hot swappable battery modules with a life of 4 to 6 hrs depending on usage.

At the front there are manipulator arms, two jaw, three jaw grabbers, cutter or sediment sampler, although articulating arms are available.

The SRV-8X Optimus is connected to the surface by a 4.5mm diameter copper tether, with a length of 250m. This supplies the necessary power.

If the ROV uses its onboard power, it only needs a 4.3mm fibre optic line which is available in 3km in lengths.

Navigation is aided by a Doppler Velocity Log. Navigation also uses a C-track USB-L. It has Oculus 3D imaging sonar. (static)



FRAMEWORK ROV

When underwater vehicle manufacturers talk about constructing ROVs from building blocks, what they normally mean is selecting a variety of discrete components such as thrusters, lights or sensors, and integrating these into a pre-assembled body. Rostockbased company Framework Robotics, however, has taken the idea more literally by designing standardised 3D-printed open box frames that can house components.

"A conventional ROV can be described as a container holding several pieces of hardware," said Nico Günzel, joint managing director of Framework Robotics. "Our design essentially gives major hardware items their own container. These boxes can be then bolted together in a variety of configurations to form an underwater vehiclenot only classic ROV box-shapes, but equally, small/flat or long/thin hulls.

"One of the main advantages of modular systems is the cost. In economic terms, principal cost driver is not the vehicle itself but is the delivery platform as a whole. A small support vessel operates at US\$10 000 a day but this can easily exceed \$50 000 for a large vessel. Effectively, whenever the system is not in the water, this is what the ROV costs."



Adjacent frames are joined by a series of bolts that provide a strong and sturdy connection yet are relatively simple and quick to disassemble as required



A 3D printed open box frame

3D PRINTING

3D printing is a very quick, adaptable

the fabrication of complex structures

and convenient process. It allows

- some of which cannot be built

with other production processes. Because it can build complex shapes,

these can be designed to be light

or reinforced in specific places. The

whole concept is resource-friendly

as only necessary components are

The term 3D printing, has become a

Framework Robotics has selected

is one of the highest performing

techniques- HP Multi Jet Fusion.

highly resistant and extremely

precise functional structures that can be built as prototypes and small batches with very short lead times at simultaneously low costs. The high resolution 1200dpi printer produces layer thicknesses of only 80µm to

achieve minimum wall thickness of

This produces mechanically strong,

blanket term for a variety of different technologies. The technique that

printed.



All vehicles fail at some time, and while reliability of the many components are high, it may only take an issue with one to abort the entire mission.

The ethos behind Framework Robotics, therefore, is to improve uptime by making repairs quicker and easier, and that is accomplished by improving access.

In addition to modules for telemetry and power electronics, Framework Robotics produce two thrusters- the BEE30 which has capacity of 30kgf and a larger BEE40. If one were to fail, it can be quickly removed from its housing while adding or a replacement is just as simple but in reverse. Because this quick release was in integral part of the design considerations, the actual time to carry this out this entire replacement is negligible when compared with some vehicles.

MODULARITY

"The product is based on the option to buy one system to satisfy a specific application but easily reconfigure it into another system should the

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Buddy ROV

Thruster module

UNDERWATER • ROBOTICS

demands in future operations change," said Günzel. "To do this, other things have to be taken into account," said Günzel. 'Say the user has a small agile observation ROV, but the subsequent task may call for

an additional payload such a manipulator. The increase in mass changes the vehicle's balance.

"Keeping the centre of flotation above the centre of gravity keeps the system inherently stable, and this changes when adding a heavy manipulator. That is why the designers have made it easy to add modular flotation to rebalance it.

"Using a detachable universal handle, the engineer can simply add a buoyancy disc into the open face by means of a bayonet fitting. Simply pushing and turning this disc, activates the safety locks to ensure that the floatation doesn't work free.

"The advantage is that all this can be done on site- it does not need to be send back to the ROV base.





Remotely Operated towed vehicle built along the same design ethos Left: Adding additional flotation.

VEHICLES

"Adding or removing blocks can change the dimensions and properties of the ROV called BUDDY, but the same the concept works for entirely different vehicles.

The company has also designed a remotely operated towed vehicle called COMPANION consisting of four blocks, one of which contains hydrofoils, and a nose-cone.

BUDDY ROV Depth Rating (msw] 1,000 (option 6,000] Dimensions (mm] Length: 1,025 Width: 710 Height: 600 85 / 110kg *Dwt (air) Payload (kg) 4.5 Thrust (kgf) forward: 70 lateral: 35 vertical: 25 Speed (knots) > 2.5 Depth Temperature Motion sensing USBL Deck 400 VAC Power Input ROV: 800 VDC 10 A High Output ROV: 50 VDC- max. 25 A Low Output ROV: 2.5-50 VDC Umbilical: 1 GB Ethernet over COAX Optional 10 GB Ethernet ROV: 1 GB Ethernet

There is also a remotely operated crawler called the TRACKER and the SCOUT, which is described as a hydrodynamically-optimised and scalable sensor platform for longterm and wide-range operations in the deep sea, with the capability to operate autonomously or via fiberoptic-tether.

It can be used for pipeline and submarine cable observation, seabed observation and subsoil investigations

"Autonomy is the next step in the development pathway. We know from customers that that is where we need to be," said Günzel. "We also have plans to integrate new sensors and equipment into our existing vehicles."

DeRegt Cable s challer



Which design considerations are the most important for your project? And how does ROV Cable manufacturing work?

Discover all about ROV Cable manufacturing, requirements, the latest trends and make your subsea project a success!

To help you select the perfect ROV cable, please download our Ultimate Guide <u>here</u> or scan the herein QR code.

Cable solutions that **challenge** the status quo

ing, requirements, project a success! , please download in OR code.



FLOODED MEMBER

Impact Subsea's flooded member detection system has been integrated onto Outland Technology's newest and most powerful model ROV-3000,. The combined ROV-3000 and ISFMD system will be put to work by Offshore Drone Inspection Services for a wide variety of inspections in the Gulf of Mexico.

The new ROV-3000 pushes the limits of inspection class ROVs. Features include a 2,000 feet (600 meters) depth rating, auto depth, auto heading, auto pitch, and tool-free maintenance. The ISFMD system is the first of its kind to utilize digital acoustic detection instead of typical harmful gamma rays to inspect offshore platform members or subsea pipelines for flooding as a result of cracking, damage, corrosion, and/or other defects.

The ISFMD is suitable for small ROV deployments as it uses a compact broadband ultrasonic probe paired with an advanced digital signal processing engine to provide the most reliable readings on the market today.



Saab Seaeye EMPOWERING

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A Vehicle Used to Search all Environments...

safe and quickly with a JW Fishers commercial grade ROV



NORD STREAM

Recent findings indicate that the damaged Nord Stream gas pipelines located on the seabed southeast of Bornholm in Denmark were sabotaged using a relatively small explosive charge. These details were unveiled through new recordings during an inspection conducted using the Blueve X3 ROV!

Contrary to previous announcements by authorities, the footage reveals a small but significant dent at the



top of the opening of a large metal pipe. Experts believe this discovery holds crucial information, making it one of the most striking sabotage cases in recent Danish history.

The new footage provides a fresh perspective on the damaged Nord Stream

Blueye X3 2 gas pipeline and highlights the urgent need for further investigation into the incident.





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Damaged Nord Stream pipe

• Blueve ROV has integrated a Water Linked UGPS system has been integrated into the system, offering hydroacoustic positioning capabilities. It is an SBL system that uses triangulation to find the relative position of the object its tracking. The system consists of an antenna (4 transducers), a topside box (for signal processing), and a locator (transponder) placed on the ROV.

The UGPS is especially beneficial for tasks in the following shallow water, inside tanks or pools and Close to ship hulls as well as Inside fish farming cages.



EXPEDITIONARY RESPONSE

VideoRay has announced a \$16.1 million order for Mission Specialist Defender underwater remotely operated vehicles (ROVs) and related components for the US Navy's Maritime Expeditionary Standoff Response (MESR) programme.

This brings the U.S. Navy's total procurement of Mission Specialist Defender vehicles and accessories to \$49 million since they entered into a Production-Other Transaction Agreement (P-OTA) with VideoRay.

With this order, the US Navy continues their efforts to procure and equip Explosive Ordnance Disposal (EOD) units with the Mission Specialist Defender as the base platform for the MK20 Defender ROV program.

This programme uses advanced technology provided by these remotely operated underwater vehicles to locate and neutralize underwater mines, such as those being laid near Ukraine, and in other maritime war zones.

"VideoRay is proud to continue to serve our U.S. Navy customers and to have been chosen as the production partner for the MESR program," said Chris Gibson, VideoRay's Chief Executive Officer.

"The Mission Specialist Defender, from which the U.S. Navy's MK20 Defender ROV derives, offers modularity and an open systems architecture allowing easy integration of 3rd-party sensors and payloads.

Our product provides our customers



VideoRay Defender

with industry-leading performance in size, weight, and power (SWAP) for its class with a proven record of reliability.

And all of this is delivered in a man-portable package capable of performing a variety of demanding missions in the most challenging underwater environments."

With the MESR Program, the Navy plans to upgrade the baseline vehicle with incremental updates to sensors, autonomy, tools and manipulators in

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order to provide enhanced capability to the EOD operator, further increasing standoff and decreasing risk. Among the recent uses of the U.S. Navy's fielded Mission Specialist Defender units was the recovery of the recently downed high-altitude balloon off the coast of South Carolina.

For critical missions like this, or locating and rendering safe underwater mines, the Defender's portability, power, versatility, and reliability are unmatched.

SUSTAINABLE SOLUTIONS

We're engineering solutions for the future of energy. Our autonomous and remote technologies help solve critical challenges in some of the toughest environments around the world.





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Connecting What's Needed with What's Next[™]

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SEAEYE LEOPARD FOR BALTIC FIELDS

LOTOS Petrobaltic, part of multienergy concern ORLEN, has ordered Saab's Seaeye Leopard work class robotic vehicle to service underwater infrastructure within Poland's B3 and B8 oil fields in the Baltic Sea.

After evaluating other work vehicles on the market, LOTOS Petrobaltic chose the Seaeye Leopard for its versatility and ability to accommodate far more equipment options for a wider range of tasks.

Current tasks include the comprehensive inspection of underwater structures, construction cleaning, cutting, dredging for inspection, basic support for head installations and support for diving teams.

The Leopard's adaptability is particularly important for LOTOS Petrobaltic. The vehicle's design means it can be expanded and configured in the future to perform comprehensive measurements and underwater works and inspections for a wide range of customers. It will be equipped with a survey package to include multi-beam sonar, LIDAR and pipetracker.

Their current Leopard configuration includes a Sonardyne DVL/INS survey system, Sprint-Nav INS, Digital Edge recording and event system, five cameras including Kongsberg HD system, also a One Laser for video and measurement, Tritech Super Seaking sonar, a seven-function manipulator, Schilling Orion gripper, electric torque tool, rotary disc cutter, WeSubsea dredge system, FlexiClean cleaning tool, water jet system and caviblaster, Cygus

UNDERWATER • ROBOTICS





Saab Seaeye Leopard

ultrasonic thickness gauge, multiplex survey pod and tooling sled.

The Leopard package also includes a tophat tether management system (TMS), an 'A' Frame launch and recovery system (LARS) and a custom control cabin.

At the same time, LOTOS Petrobaltic is preparing their supply vessel, Bazalt II, as a dedicated operational platform for the Leopard, including adapting it to receive the LARS system and the custom configured



control cabin, along with additional peripheral systems.

Seaeye Leopard

The 3000m-rated Seaeye Leopard is the top-selling electric work vehicle of its class and the most powerful of its size in the world, enabling it to tackle large and complex work tasks previously performed by much larger hydraulic systems.

At half the size of an equivalent hydraulic work vehicle, operators find the Leopard more agile and responsive and able to handle stronger currents and wave motion. It can also tolerate higher environmental temperature ranges and has a considerable acoustic advantage for survey work over hydraulic equivalents.

CHINOOK IN UXO DETECTION TRIALS

SEAMOR Marine's Chinook ROV is working in the field of undetonated explosive ordnance (UXO) detection after a successful compact magnetometer integration with subsea engineers at Ocean Floor Geophysics.

Magnetometers detect disturbances in the earth's magnetic field and are critical instruments for locating undetonated explosives along the ocean floor, referred to by the military as UXOs. Magnetometers are typically bulky, towed by a manned marine vessel or pick-up truck-sized autonomous underwater

vehicles (AUV), and scan the seafloor through a process that is arduous, time-consuming, and expensive.

The compact maneuverability offered by remotely operated vehicles (ROV), such as SEAMOR Marine's Chinook ROV, has always held a great deal of promise to subsea engineers designing magnetometer scanning systems. However, technicians have been challenged by the electromagnetic interference created by the electrical systems of these smaller units; that is, until recently.

Earlier this year, SEAMOR Marine was

contracted at the request of a private client through Ocean Floor Geophysics for a third party integration of their magnetometer with the Chinook ROV.

"SEAMOR's Chinook is compact, maneuverable, and reliable," says Nathan Ehrenholz, subsea robotics engineer at Ocean Floor Geophysics. "It is the best ROV on the market at that price point for the sensitivity of work we are doing and that is why we chose it to trial our magnetometer."

Robin Li, President at SEAMOR Marine, explains that his team of engineers designed a custom extended attachment which holds the device far enough away from the ROV to mitigate potential electrical magnetic field interference.

"ROVs are complicated devices with many electronic and mechanical components. However, the carefully refined design of the Chinook meant very little baseline interference which helped our magnetometer integration to go smoothly."

Most ROV pilots make use of the built-in, movable camera during inspections and scans, but that was not an option for this trial. "The solution was to fix the camera in place, using the Chinook's quiet thrusters to reposition the magnetometer while mapping rather than the pan/tilt feature of the builtin camera," explains Li.

"The submerged explosives might induce a flux of 5-20 nanoteslas, while the tilt mechanism might induce a flux of up to 500 nanoteslas which is far too much interference to get accurate readings. I'm glad to say that, when put to the test, the magnetometer trial integration for the Chinook was a success."

The potential of such an agile, portable, and easily deployable magnetometer system extends well beyond military applications like UXO detection; these instruments could provide critical support for green energy infrastructure, including offshore wind farms, and crucial location data for submerged fiber optic cable lines.

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MDV

The SRV-8 MDV (Mine Disposal Vehicle) is the latest addition to Oceanbotics' Special Purpose Vehicle Division. This field-tested underwater ROV will detect and eliminate explosive mine threats quickly and efficiently, utilizing ECS Special Projects' Viper MDS technology for neutralizing improvised explosive devices (IEDs).

Use the SRV-8 MDV's imaging sonar will be used to detect mine threats. Upon reaching the mine, the Viper MDS will secure the charge disruptor to the mine.

The operator will then navigate the vehicle away from the mine threat while deploying a shock tube that remains connected to the ROV. By activating the charge through the shock tube, the operator will effectively neutralize the mine threat, ensuring the safety of both personnel and the ROV.

See SRV-8 article

UXO SURVEY

Greensea Systems, Inc. (Greensea), a leading provider of advanced robotics solutions, is pleased to announce the successful demonstration of a mission to locate buried munitions in the surf zone.

This UXO survey demonstrated the power and flexibility of OPENSEA to rapidly integrate and deploy a new sensor suite for the task while showcasing the capabilities of the Bayonet 250 AUGV, which was selected as a finalist in The Defense Innovation Unit's (DIU) Autonomous Amphibious Response Vehicle (A2RV) program's rapid prototyping phase. Out of 67 proposals, the Bayonet 250 crawler prototype, developed in partnership with Greensea, was chosen for its exceptional performance and potential to detect, identify, and neutralise naval mines and other explosive hazards in the challenging surf and beach landing zones.

Operating over 8 days and covering 18 square kilometers in depths of up to 10 feet, amidst wave heights of 4-6 feet in the challenging surf zone, the Bayonet 250 provided a stable

and reliable platform for conducting the survey that included a towed sled equipped with White River Technology's (WRT) marine APEX technology, seamlessly integrated into Greensea's software platform, OPENSEA.

The rapid integration of the sensor sled facilitated the detection and classification of objects, with a buried depth of up to 3 meters based on material composition.

"We are very excited about the recent success of crawler-based 3DEM

sensing for advanced geophysical classification of munitions in the most challenging environments like surf zones", says Greg Schultz, Chief Technology Officer for WRT.

"The combination of autonomous amphibious crawlers, like the Bayonet units, and the WRT APEX dynamic electromagnetic classification arrays, appear ready to go where divers and towed systems have not been able to in the past".

David Pearson, Program Manager at Greensea, expressed his satisfaction with the successful mission demonstration, stating: "The success of this program and our ability to operate effectively in the challenging surf zone environment is a testament to the strength of our team and our commitment to innovation.

By quickly integrating a new sensor for buried UXO and munitions, mobilising an operations team, and collecting data in demanding conditions, we have demonstrated our capability to locate and address explosive hazards in one of the most dynamic and challenging



operational environments. This achievement showcases Bayonet, Greensea, and our partner's expertise to make the impossible possible. Positioning us as the trusted partner in providing solutions for maritime and underwater operations from the beach to the deep."

Throughout the mission, the Bayonet 250 successfully identified buried targets based on burial depth and signal signature, highlighting its ability to detect and identify explosive hazards in both the surf and on beach landing zones.

VOYAGER HUGIN

Robosys Automation has launched its new Voyager AI. It is designed to transform a new or existing vessel into a fully autonomous Uncrewed Surface Vessel (USV). Furthermore, it is capable of independent navigation, collision avoidance and dynamic route optimisation.

The company says that it uses cutting-edge AI and Machine Learning (ML) algorithms to provide scalable levels of autonomy, up to and including full Degree 4 Autonomy, being capable of driving a vessel fully autonomously without human operator assistance or intervention.

Robosys' four solutions are: Voyager Al Bridge, Voyager Al Vessel, Voyager Al Survey, and Voyager Al Co-Pilot, providing intelligent autonomy solutions for ships, USVs, workboats, and most other craft, from 3m to 320m.

VOYAGER AI SURVEY

Voyager AI Survey is suitable for oceanographic, coastal, and offshore research, monitoring, and surveying it features entry-level autonomous navigation with collision avoidance, obstacle avoidance, and grounding avoidance, which is scalable to full Advanced autonomous navigation.

It delivers Routes and Waypoints planning and following, with Heading and Track Control. Voyager AI Survey will also seamlessly integrate with most existing sensors.



Ørsted, one of world's leading developers of offshore wind farms, has designed and developed the first uncrewed surface vessel (USV) in the industry for offshore met-ocean measurement campaigns.

The measurement data will help lower uncertainties in the expected annual energy production for new offshore wind farms. Ørsted, who has patented the USV concept, sees enormous potential in the technology and has initiated a serial production based on their successful prototype USV.

The prototype USV is named Hugin USV. It is designed for continuous operation in the harshest offshore conditions for a year at a time. The USV has a built-in navigation system, which enables it to transit from shore at various degrees of autonomy, and it can be controlled both in line-ofsight or from a beyond-line-of-sight remote control centre.

The USV is designed as a generic sensor platform and can collect large amounts of data on, among other things, the wind conditions, the state of the seabed, and biological and ecological measurements, all dependent on the sensor instrumentation chosen for a given operation. The broad range of measurements collected by the USV is essential for Ørsted's early-phase development activities prior to the construction of new wind farms.

The USV concept was invented by Ørsted employees and has been patented. The design, development, construction, and testing of the prototype USV was conducted as part of Ørsted's innovation programme in collaboration with selected industry partners. The prototype USV is constructed by the Danish shipbuilder Tuco Marine Group, and the USV control system is delivered by the innovative Norwegian company Maritime Robotics AS.

Frederik Søndergaard Hansen, Programme Manager and co-inventor of the USV concept, says: "What's so special about our USV concept is that it can bring our measurement equipment to and from our offshore sites without the need for large, specialised support vessels, and, while on site, it can operate autonomously for extended periods of time, measuring large amounts of data that can be sent onshore and processed in real time. The USV concept enables Ørsted to obtain a consistently high data availability, which is essential for achieving the highest possible certainty regarding the annual energy production for new offshore wind farms.

Ørsted's USV concept has several advantages over conventional



Another benefit of the USV concept is the significantly lowered costs of conducting offshore measurement campaigns, while providing increased flexibility for Ørsted through internal ownership and operation of the USVs. The prototype vessel, Hugin USV, has been tested in Danish and Norwegian waters and has been operational during hurricane conditions, where it experienced waves up to nine metres in the North Sea. Hugin USV has also achieved type validation as a floating LiDAR system by the internationally accredited Norwegian classification society 'Det Norske Veritas' (DNV), enabling it to be used for commercial operations related to wind farm development.

SVS



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UNDERWATER • ROBOTICS



SSS TRIMARAN

In recent years, SubSeaSail (SSS) has made some significant contributions to the world of uncrewed semisubmersible, monohull wind-driven vessels. The latest design, (UT2 Issue 2 2023), currently undergoing the finals stages of development, is known as HORUS.



SubSeaSail's Horus vessel

The company, however, has another vessel design on the sidelines. Still at concept stage, it could hold a unique position in the wind-powered vessel workspace.

Called HERMES, it is a cargo-carrying trimaran designed to help *de-risk* the supply chain by using a swarm of affordable, vehicles. It will benefit from the same low acoustic, heat, radar and visual signature as HORUS while still retaining a submerging capability.

"The current world's record for sailing around the world is held by a trimaran," said SubSeaSail partner Mark Ott. "No monohull comes even close to the sort of speeds these sleek multi-hulls can generate. The reason that we have been experimenting with three hulls is that the quicker we can get to site and commence operations, the better.

"The greater speed comes from the shallow draught. It is this property that also allows the vessel to go into shallow waters only a few feet deep or - depending on the size even right up onto the beach.

"Another advantage of the multihull design is that there is physically more space to accommodate a larger sensor payload for more comprehensive surveys and/or, carry a larger traditional or even non-traditional cargo."

Like the HORUS monohull. fundamental to the trimaran's design is its patented automatic steering cam arrangement that passively positions the sail at the correct angle irrespective of wind direction. This would otherwise have to be executed using an anemometer and servo motors.

"Another intrinsic advantage of a multi-hull over a monohull is that it has such a larger surface area. Because of this, there is a greater surface area for solar panels," said Ott



"We are looking at a 4 ft by 4 ft prototype at the moment but if we were to increase this to 16 ft by 16 ft, we estimate that the amount of solar power would be large enough to keep the batteries permanently charged.

"In the HORUS, there are solar power on the main sail, but this would be unnecessary in the HERMES "

So if multi-hulls are advantageous, why aren't they a more common sight in the blue water workspace? The answer is that they have a debilitating Achilles heel.

Multi-hulls have a much wider beam that gives them greater stability, but if they *do* flip over due to high wind gusts, it becomes very difficult to right them.

Once inverted, with the mast and sails now pointing downwards, the vessel becomes more stable upside down than it was the correct way up, sailing.

This unacceptable risk might reasonably rule out any use of an autonomous multi-hull in a remote, ocean-going application.

The solution to this conundrum comes from its patent-pending technology allowing the vessel to submerge on demand. By flooding the ballast tanks, the entire vessel is able to sink to pre-determined or algorithm-derived depths.

Being underwater and out of the high-energy wave zone, it can more safely ride out passing storms. While submerged, it can also be used to conduct underwater monitoring operations or even become a secure underwater offshore storage facility, but it is this submerging capability that is also the solution to righting a vehicle that becomes capsized.

The HERMES has a load levelling capability that enhances stability if the cargo is unloaded unevenly from the outside amas (outer hulls). This is all part of the system that facilitates the controlled submerging/ emerging capability," said Ott. "It selectively adds buoyancy to part of the hull."

The can change the entire vessel's centre of buoyancy, effectively causing it to right itself while still underwater. Once it has been returned to the correct attitude, the water can be pumped out and the entire vessel can rise upwards through the waves and continue its journey.

APPLICATIONS

There are a number of applications for the trimaran. These could include humanitarian aid, remote island and scientific cargo delivery. It could be used to create the ocean equivalent of a parcel delivery service.

The trimaran can also be useful for the military, particularly due to its ability to move at significant speeds but without the acoustic signature of a motorised vessel," said Ott. "It could be used for pre-positioning of goods and resupply to expeditionary forces on the beach even in contested environments.

"Being relatively small with an ability to submerge, it will be difficult to detect and can hide from anyone looking for it.

Last year, Iran's Islamic Revolutionary Guard Corps Navy (IRGCN) attempted to capture a large, unmanned surface vessel sailing in international waters. This was prevented due to US naval presence in the area, but this did create diplomatic issues and became a wake-up call for all concerned.

" If this had been a HERMES, the vehicle would have submerged long before anybody got near it."

HERMES could have other military applications including non-traditional cargoes that could include tubelaunched aerial drones, UUVs and any number of other items. Tube launched aerial vehicles could be used both to "see" long distances and create line-of-sight communications capabilities that are more difficult to intercept or block than via satellite."

HERMES cargo carrying trimaran

HYDROGEN POWER

Acua Ocean is in the process of developing a novel 25t autonomous vessel powered by hydrogen. It is designed to travel 40-60 days offshore at speeds of up to 4kts (with future capabilities for a 15-18kts sprint speed) while offering a flexible payload for use across multiple maritime sectors.

"The hullform we selected as the most efficient to carry out the work we have targeted is a Small Waterplane Area Twin Hull (SWATH) design," said Michael Tinmouth, Chief Operating officer of Acua-Ocean. "This is an intrinsically stable platform while its small waterplane lets it move through the water extremely effectively. We believe this will confer a broad range of operational capabilities, especially in higher sea states.

"Most vessels servicing the oil and gas and renewable sectors are monohulls although twin and tri-hulls do exist. These are typically limited to work in sea states of around 2m. The SWATH, however, can operate in a sea state nearer 3m (and in future beyond) and we consider that that extra margin could effectively unlock many additional days of operational time over the year.

"We have been working closely with specialists Ad Hoc Marine Design to work on the design. SWATH designs are not unknown but they are more complex and more costly to build than more conventional vessels and this may be reason that they are not more commonplace. As companies compete to work in an entirely new marketplace, many designers and naval architects have been encouraged to move away from traditional hullforms and be unafraid to experiment. The industry has already seen a new generation of vessels departing from traditional designs.

"There has always been a large ethical incongruity in carrying out work on renewable offshore projects in vessels powered by dirty diesel. In recent years, a variety of solar powered vessels have appeared in the marketplace but these just don't provide the endurance and especially, able to support power-hungry payloads that may need to carry out real time data processing.

"That is why we turned to liquid hydrogen. The SWATH has two pontoons permanently submerged beneath the water. Each incorporates a cryogenic liquid tank purpose-designed by Hylium Industries, a manufacturer in South Korea. These provide a total



6000 litres of hydrogen that weigh about 420 kg – a minimal amount for a 25 tonne vessel. In comparison, a conventional mono hull might burn nearer hundreds of tons of diesel and in doing so, it would have to change its displacement considerably – something far less applicable to liquid hydrogen.

This system employs heat exchangers to cope with the natural boil-off ratio that comes with liquid hydrogen. The hydrogen is routed through a PEM fuel cell and this in turn charges the battery. The entire system, therefore, can be considered a hybrid hydrogen-electric propulsion system.

"We went down this route because apart from not emitting greenhouse gasses, it gives us the reliability that just isn't available with diesel engines," said Tinmouth. "Crewed vessels require constant maintenance, filter changes, etc. All we need is an annual visual inspection.

"Another intrinsic value of our design that comes from fact that the vessel is nearly silent. This is really useful for acoustic surveys but also useful for work in the security sector and not wanting the vessel to be detected. It also has a closed loop cooling system which helps to give the vessel a very low thermal signature . There is no venting NOx or SOx gases so any chemical signature is also negligible.

<u>PROJECT</u>

Phase one of the pilot demonstration will involve transporting a standard 4t payload between the port of Aberdeen, Orkney and Shetland.

"The vessel is entirely modular in its design, so in phase two, we may convert the middle section into a moon pool and see how it works for the launch and recovery of ROVs in phase 2. This will eventually enable us to carry out asset inspection asset integrity inspection, supporting AUVs and ROVs of all sizes. We see it as the ultimate launch platform. Pairing it with aerial drones will allow it to see over the horizon while anything travelling at 40-50mph can carry out an interception role. We see, however most of our services directed at the underwater market but we intend to offer a 'platform as a service' business and it is quite agnostic to the type of technology onboard.

The vessel is essentially a power source in the middle of the sea. So could it be used for refuelling vessels recharging underwater vehicles?

"We have had many conversations along these lines and we do not see ourselves competing with subsea charging stations. We are capable, however of working together with these by launching and recovering ROVs.

"The onboard power allows use to perform a gateway link between underwater equipment and satellite/onshore facilities. "We have sufficient power for AI edgebased processing and comms to support near real time data transfer.

Further down the line, it may be conceivable to refuel the SWATH at sea."



FLYING GLIDER

Teledyne Marine and the U.S. Navy has successfully executed the first-ever undersea glider launch from a helicopter and the first-ever successful deployment from an aircraft.

The Teledyne-owned Slocum glider, configured with Littoral Battlespace Sensing – Glider (LBS-G) mine countermeasures (MCM) sensors, was launched from the ramp of U.S. Navy helicopter flying "low and slow" over shallow waters. Teledyne Marine provided Slocum glider piloting and technical support in theatre.

"We are excited to be a part of another series of firsts! In this instance, the first launch from a helicopter and the first-ever successful glider deployment from an aircraft.

Teledyne Marine takes pride in our continued innovation and support of the U.S. Navy as it expands the operational envelope of underwater gliders," said Dr. Thomas Altshuler, Senior Vice President, Global Maritime Defense Strategy and Business Development Teledyne Technologies.

The Mine Countermeasure (MCM) Commander now has the capability for rapid and widespread glider deployment by Task Force elements under direct, tactical control, eliminating the dependency on strategically tasked oceanographic ships.

The gliders provide critical environmental information to optimize acoustic and optical MCM sensor performance. This constitutes



a revolution in MCM decision support.

The Teledyne Slocum glider is a longendurance, autonomous undersea vehicle (AUV) used for multiple persistent operational missions, including oceanographic data collection. Teledyne has delivered over 1,000 Slocum gliders to a global customer base. The Slocum glider is the backbone of the US Navy LBS-G program, with over 210 delivered since 2009. The Naval Oceanographic Office (NAVOCEANO) pilots the LBS gliders and includes collected data supporting Navy operations. Until this successful helicopter deployment, LBS gliders were almost exclusively launched and recovered by the T-AGS 60 class multimission ocean survey ships.

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CHANNEL YUCO

THE WORLD'S FIRST MICRO ROV TO MAKE THE CROSSING

The YUCO micro-AUV, manufactured by SEABER, has successfully crossed the English Channel. This technical feat is a world premiere, paving the way for new ways of exploring and monitoring marine environments.

AUV Route

In April, the YUCO AUV covered the 39km English Channel between Folkestone, United Kingdom and Wissant, France in less than 8hrs.

Over the course of its journey, the YUCO followed a pre-programmed mission on the SEAPLAN software. During its crossing, the drone resurfaced three times for legal reasons. This mission showed the reliability and high battery capacity of the YUCO, which finished its journey with 35% of its power left.

This accomplishment is a world first for an autonomous underwater vehicle measuring just less than one metre and weighing a mere 10 kg.

The SEABER team rose to the challenge with determination, by developing and testing new functionalities that will soon be available to all YUCO operators, be they researchers, coastguards, sea rescuers, police officers or sailors. This achievement testifies to SEABER's expertise in underwater technologies.

This project has successfully involved the whole company, at different levels, in order to ensure its success. Quentin Peyregne, co-founder of SEABER and CTO, said just before the deployment: "We're confident about this crossing because our staff did a lot of work upstream preparing for it, with the help of an area currentsimulator and by planning the YUCO's mission so that it can adapt to all the situations it will encounter." The challenge is made all the more complex by the maritime route between France and England, regarded as one of the busiest in the world, with more than 400 commercial ships a day and highly variable weather conditions.

Furthermore, nearly 4 million passengers, 27 million tonnes of goods and 400 ships pass through every day. The success of this crossing is an irrefutable testament to YUCO's reliability.

SEABER paid tribute to British partner RS Aqua for its invaluable support and for the video documenting this exceptional adventure. The successful collaboration between the two companies has made this historic crossing a reality.

"This is a collective success. Through its collaborations and strategic partnerships, SEABER continues to develop innovative underwater technologies to meet environmental and industrial challenges.

The Osprey autonomous underwater vehicle (AUV) is built upon the proven field configurable Gavia modular design with a 2000m depth rating and a larger 12³/₄" diameter that can accommodate additional energy and sensor options to meet demanding applications.

The Osprey can carry a variety of sensors allowing it to meet operational requirements from defense, commercial and scientific uses including:

- Pre/Post Construction Support
- Pipeline Inspection
- Mine Countermeasures (MCM)
- Rapid Environmental Assessment (REA)

STAR

OSPREY

- Search and Recovery (SAR)
- Oceanography
- Marine Archeology

Osprey AUV

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POWER PIUS

ecoSUB Robotics has recently embarked on a project to increase the duration of its micro AUV. The development coincided with a request from the Royal Navy for a small but more powerful vehicle. ecoSUB included this in the bid and won the contract in an open tender.

The result is the ecoSUB-m5 Power+. It is ostensibly a special module that can be inserted into the standard m5 vehicle. The higher battery capacity gives greater endurance, more speed and a higher payload capability.

"The previous design iterations and development path gave us a much improved navigation capability, and this meant that we could then bring forward our plans to incorporate imaging with sonar and cameras," said Planet Ocean Managing Director Terry Sloane.

"We see its principal application is working in mine counter measures (MCM). The ecoSUB m series, can accommodate 900, 1200, or ultrahigh resolution 1800 kHz Sonars or indeed dual frequency. We have since looked further than MCM, into port security,

critical infrastructure monitoring as well as habitat monitoring.

"We purchase these sonars from Marine Sonic Technology of North America- our project partners that coincidentally Planet Ocean represents them as a supplier, so we know that they are easy to integrate.

'We have also fitted a small Nortek Doppler Velocity Log (DVL), and so now we've got a vehicle which will carry side scan sonars and cameras with accurate geo-location. The Nortek. DVL also allows current profiles to be acquired. It's got a science payload, CT, pH, Do, and more. Another option is downward looking echosounder for

High frame-rate camera

talk to our electronics easily. Rated to 2500m, this high frame-rate camera that fits in with our front-seat backseat architecture so we can feed

bottom avoidance, altitude following and basic bathymetry

"To the surprise of some, we have also incorporated a camera on the front. We have had to design our own camera because there wasn't anything available in the market that was sufficiently small, consumed low power, had a 4k resolution and would

that images to an Nvidia computer embedded in our system.

"I think that this small camera may suit other small AUV or ROV manufacturers who want to squeeze as much out of their vehicles as possible.

> "At Purdue University, researchers planning to use video to navigate the vehicle into an underwater docking station for inductive charging. Others are embedding their

Al algorithms to carry out image identification, so the leap from a fairly rudimentary low-cost, easy to use AUV to a very capable, inexpensive one-person portable vehicle becomes guite attainable. It suddenly becomes very competitive with larger more expensive AUV's with similar capabilities.

"All the models of ecoSUB AUV are essentially the same from the tail to the forward bulkhead, " continued Sloane. "The user just has to add a nose cone. We 3D print all of the nose cones so if anyone wants, say, a pH sensor, we can easily print a nose cone for that application, and it's not a very expensive thing to do."

Some of the hull internals lie in a dry pressurised hull while other areas are open to the water. Where would additional sensor payloads be added?

"The insides of the vehicle are fully utilised with not much extra space on the dry side," said Sloane. "If we can get sensors which are pressure

3D Printed nose cones

tolerant and able to reside on the wet side, this makes it easier. We've worked with some really good suppliers like Valeport, for example, who have designed pressure tolerant sensor payloads that can live on the wet side. The upside of this is that they tend to be neutrally buoyant, so this doesn't upset the balance of the micro AUV. The Power+ module adds internal payload capacity

"We have standard connection interfaces including Ethernet, I2C, RS232 and UART, so we can accommodate a whole range of sensor packages. If a customer has a sensor they wish to integrate, either we can , but we have designed the body to make it easy for anyone to incorporate it.

Dalhousie University in Canada, for example, use standardised AML sensors, so we give them the bulkhead penetration and the interface code, and they simply insert the device and plug it in. In another example, however, they bought a smart Hydrophone from Ocean Sonics, (with whom we happen to work with). It was free issued to us and we implemented it on the vehicle. Both things are possible.

> come to us when in the process of designing new

Two ecoSUB-m5 Power+. AUVs

BCO MALPO

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"We do find manufacturers sensors and ask how to make it eco-subcompatible?

The

reasoning

behind it

SUBMARINE LAUNCH

Last August, Cellula Robotics, demonstrated the launch of a ecoSUBu5 micro-AUV from its Solus-LR while submerged and underway.

Following the launch, the micro-AUV surfaced and transmitted a status message to Solus-LR's command and control centre via Iridium satellite. The operation was the first of its kind and demonstrated near real-time. over-the-horizon communications from a submerged AUV.

Built on a research and development project originally sponsored by DRDC under the All Domain Situational Awareness (ADSA) Science and Technology (S&T) Program that developed Solus-LR, the mission also re-enforced the capabilities and potential of a long-range, hydrogen fuel cell powered AUV designed for submerged missions in excess of 2000 km.

"At 4kg and maintaining a cylinder shape, the ecoSUBu5 is ideal for autonomous launch systems such as this," said Sloane. "The ecoSUBu5 has previously been launched by uncrewed surface vehicles and fixed winged aerial drones, so launch by a mother-ship AUV completes Air, Surface and Underwater autonomous deployment- a first for an AUV system."

is that if we can use it, anyone can use it because we are so constrained in terms of size, power, weight and cost. If they can get that right, it is going to be suitable for an Autosub or Hugin..

ALASTAIR MCKIE

Reach Subsea has appointed Alastair McKie as the new Managing Director for its Aberdeen office, Reach Subsea UK Ltd. This strategic leadership change marks an important milestone in the company's commitment to driving growth and delivering exceptional results in the Scottish and UK markets.

With Aberdeen's pivotal role in Reach Subsea's global operations, the appointment of Alastair McKie brings significant experience and expertise to the table. He will play a key role in steering the company's strategic growth, driving operational excellence, and strengthening customer relationships in the region.

Alastair joins Reach Subsea with an impressive track record of success in the subsea and survey industry. He brings a wealth of knowledge in operations across Europe and Africa including the commercialisation of innovative solutions and marine robotics and autonomy, having held senior leadership positions in renowned organizations previously.

VideoRay, a global leader in underwater robotic systems, is proud to welcome U.S. Navy veteran Mario Pais as the company's new Program Manager. Pais is responsible for leading and managing a multidisciplinary team to exceed customer expectations on cost, performance and scheduling.

He also manages the production, services tasks and delivery orders on all VideoRay programs, including the U.S. Navy's Maritime Expeditionary Standoff Response (MESR) MK 20 Program of Record and related R&D efforts.

Pais retired from the U.S. Navy after serving 21 years supporting Navy Explosive Ordnance Disposal (EOD) Operations, specifically in Mine Countermeasures (MCM), as a Marine Mammal Systems Operator and Unmanned Maritime Systems (UMS) Operator. During his service, he initiated new programs and Units of Action for the Navy's UMS program and was a pioneer in EOD Expeditionary MCM (ExMCM) company development.

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