

explore

Exail magazine

March 2023 | Maritime special issue

ALL-IN-ONE INS/DVL

Powering unmatched accuracy
and performance

COLLABORATIVE CAPABILITIES

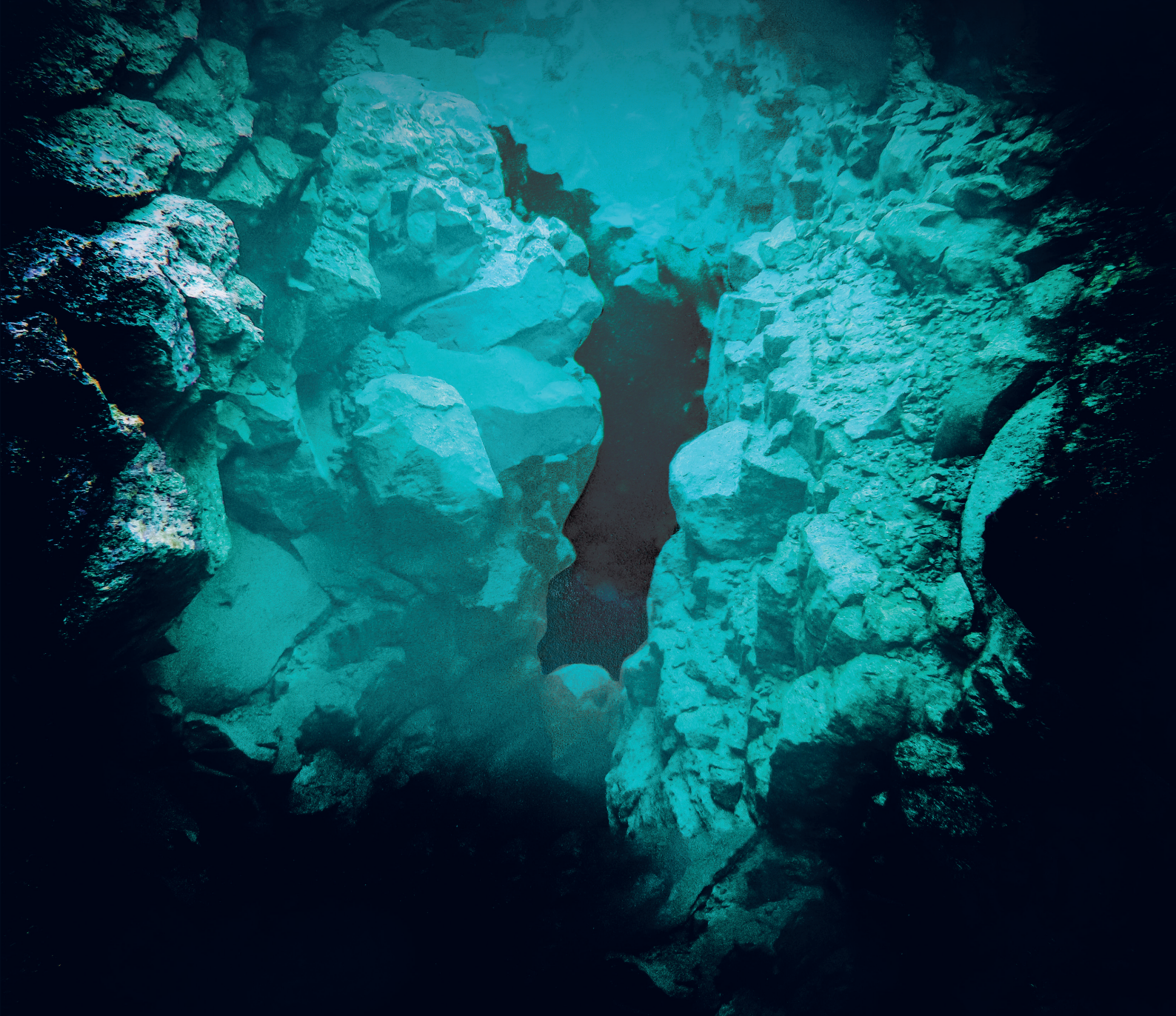
Deploying multiple uncrewed
vessels for ocean exploration

USBL PRECISION

Successful ROV tracking
in shallow water environment

R7 COMPACT ROV

Enhancing subsea exploration
and inspection





JEAN-MARC BINOIS

Chief Commercial Officer

The ocean is at the heart of the world's attention. Not only is it the core of an incredible and critical ecosystem, but its economics are expanding exponentially. From energy production and oceanographic sciences, to seabed exploration, fisheries and transportation, the activities it encompasses are vast, and with them comes an infinite source of innovation.

As pioneers of ocean technology, from sensors to autonomous platforms, both iXblue and ECA Group have, for the past decades, dedicated their efforts to pushing back the limits of science to venture into unknown territories. By joining forces and becoming Exail, our teams will continue to create innovative ocean technologies to deliver unrivaled performance and reliability to the industry.

This is why, today, an increasing number of maritime operators are placing their trust in the technologies developed by Exail. Our customer-base keeps growing year after year across a wide range of activities, from the coastline to the deep sea. By choosing Exail, our customers and partners seek very concrete operational advantages: reliability, operational efficiency, flexibility, data quality, endurance at sea, 24/7 technical support responsiveness and proximity from any of our 32 worldwide offices.

At Exail, not only do we offer cutting-edge technologies to expand our customers capabilities, but we also empower them through innovation and long-term partnerships. Moved by curiosity, we are committed to working together with our clients and partners to foster technological innovation and help them rise to the most complex challenges.

In the next few pages, you'll be able to discover the great stories our customers live everyday using our products and solutions. 2022 has indeed been a record year for Exail in the offshore and geoscience markets. Our aim has always been to bring operational efficiency to the industry, and the sheer number of our products deployed on the field is proof of that. As of today, over 80% of underwater vehicles are equipped with Exail subsea Inertial Navigation Systems. As we are expanding our range of USBL systems to meet clients' new requirements, our subsea acoustic positioning systems are also gaining more and more momentum. 2022 was incidentally a highly successful year for our Gaps Series. On the LBL side, our Canopus is also becoming increasingly popular in the O&G and geosciences markets for its unrivaled sparse array capabilities that are seen as a real revolution in an industry that is seeking more efficient and less costly ways to conduct robust subsea positioning. Finally, as the maritime industry makes its transition towards more efficient and environmental-friendly autonomous operations, we have positioned ourselves as key players in the field of maritime autonomy, offering industry-changing autonomous technologies such as our DriX USV, as well as our brand new R7 ROV.

Be assured that we will not stop there. We will accelerate our investments to continue developing our offer and better respond to your ever evolving needs. This is why this year, we are excited to be able to share with you many new products and innovations in the subsea navigation and positioning domains that will keep bringing even more efficiency to your maritime operations. Make sure to stay tuned!

THIS YEAR, WE ARE EXCITED TO BE ABLE TO SHARE MANY NEW PRODUCTS AND INNOVATIONS IN THE SUBSEA NAVIGATION AND POSITIONING DOMAINS THAT WILL KEEP BRINGING EVEN MORE EFFICIENCY TO YOUR MARITIME OPERATIONS.



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Deep-sea exploration

enabling access to greater
depths

ENHANCING
SUBSEA EXPLORATION
AND INSPECTION
CAPABILITIES



THE EXAIL'S R7 IS A COMPACT OBSERVATION-CLASS REMOTELY OPERATED VEHICLE (ROV) COMBINING THE PORTABILITY AND EASE OF DEPLOYMENT OF MINI-ROVS WITH THE PERFORMANCE, SPEED AND PAYLOAD CARRYING CAPACITY OF PROFESSIONAL OBSERVATION-CLASS ROVS.

Fast, modular and easy to deploy in less than 30 minutes, the R7 is designed for a wide range of users including oceanographers, hydrographers, fish farmers and operators of submerged structures for all their underwater missions down to 300 m, including inspection, observation, surveillance, maintenance and object recovery. In the Oil & Gas industry and ship maintenance sectors for example, the R7 is useful for inspecting the integrity of assets and UWILD operations. The compact yet powerful ROV is ideally suited for aquaculture applications such as inspecting nets, as well as anchorage points and cables, common to offshore windfarms too. Civil engineers make time and mission cost savings by using the R7 to efficiently inspect and maintain dams, bridge foundations, sub-structures and sewers.

➤ **100% digital connected architecture for unrivaled ease of use and image gathering**

The R7 incorporates the latest developments in digital technology giving operators some of the highest quality images on the market, thanks to a full HD video chain going from the camera sensors to the display screens. To facilitate navigation even in difficult visibility conditions, the R7's navigation camera is equipped with a very high sensitivity wide-angle video sensor. The camera is coupled with high performance LED lighting to provide an exceptional level of rendering - two 5000 lumen floodlights provide unrivaled light intensity to the camera, further increasing image quality.

The Full High Definition (FHD) 1080p observation camera with 4x optical zoom and vertical rotation movement +/-90° ensures that the R7 offers users optimum comfort and power during inspection.

The R7 can be fitted with up to four floodlights and four FHD cameras with the possibility of visualising and recording two video streams simultaneously, reducing mission time since two areas of interest can be studied in parallel. It only requires two people to carry and deploy the ROV, the CCU, PSU, umbilical and reel. Deployment and recovery are facilitated thanks to its ergonomic, compact design and integrated handles.

Switching payloads is quick and easy thanks to the ROV's plug-and-play connection, and its 100% digital architecture also makes it scalable to adapt to different customer missions.



© Babco

► The R7 incorporates the latest developments in digital technology giving operators some of the highest quality images on the market

› Intuitive Human Machine Interface

The R7 also stands out in terms of ergonomics: its highly intuitive Human Machine Interface and ease of use make it readily deployable at a moment's notice. The 15" touch-screen of the control unit and a second screen enabling the display of the cameras, USBL and sonar data sources simultaneously are high-luminosity and designed for use even in bright sunlight, giving the operator a high level of visual comfort. A USBL beacon and/or DVL are also available, tracking the ROV's position in real time.

› R7 combines power, stability and serviceability

The R7's maneuverability and power facilitates the operator's task, even in harsh environments. Operators benefit from the ROV's exceptional dexterity in flight mode thanks to its innovative propulsion system, comprised of four horizontal vectorized thrusters and three vertical thrusters. The latest generation Attitude and Heading Reference System (AHRS) coupled with the three vertical thrusters manage the attitude and provide the ROV with a high level of horizontal stability in all directions. This AHRS, integrated as standard, provides the R7 with advanced stability and control, enabling it to maintain the pitch & roll angles in dynamic mode. Automated heading, depth, altitude, and attitude functions give users advanced navigation capability.

› Unrivaled image quality even in low visibility

Operators use this new-generation ROV even in low visibility conditions. Using traditional cameras would be impossible in such conditions, but the R7's HD inspection camera performs remarkably, providing high-resolution data with superior positioning accuracy.

› Easy & fast maintenance

The R7 "open frame" design gives users and maintenance teams access to all the vehicle's sub-assemblies, including cameras, floodlights, thrusters, telemetry, and sensors. Exail manufactures the subassemblies in house and holds stocks of spare parts including thrusters, connectors, floodlights and cameras. The R7's HMI offers an auto diagnosis function of the whole ROV system.

› A range of easily interchangeable payloads catering for different mission requirements

The vehicle can also be equipped with a choice of manipulator arms with up to five functions to easily handle or recover objects up to 2 kg. Payloads include an altimeter, a FHD wide-angle rear camera with additional floodlight, a FHD wide-angle rear navigation camera with additional floodlight, an Ultra-short baseline (USBL) system, a USBL beacon compatible with Exail's Gaps USBL, a rotating grabber arm, a motorized brush with NDT probes to measure thickness and cathodic protection, as well as a double frequency imaging sonar and navigation sonar.

› Perspectives for further exploration and inspection capabilities

The R7 will soon integrate DVL, or DVL + USBL giving the operator greater capacity to control station keeping. An AUV functionality will also be available in the course of 2023 enabling the ROV to conduct autonomous missions with the capability to send images and data to the operator in real-time.

To overcome the common problems of turbidity and sun reflection are a common source of problems during shallow water missions, Exail will introduce a state-of-the-art underwater imaging camera in 2023, incorporating image processing to obtain high quality video images in real time. ■

R7 compact observation class ROV

A PERFECT BALANCE OF POWER AND PORTABILITY

- Enhanced navigability and stability due to high-performance embedded sensors
- Open frame design for easy payload integration
- Powerful, robust & easy to deploy

Operational performance

| | |
|-----------------------|--------------------------------------|
| Movements | In 3 axes + rotation on its own axis |
| Forward speed | 3 knots (in 0 knots current) |
| Operating depth | 300 m |
| Operating temperature | -2 / 37 °C (Water) |
| Storage temperature | -10 / 50 ° (Air) |

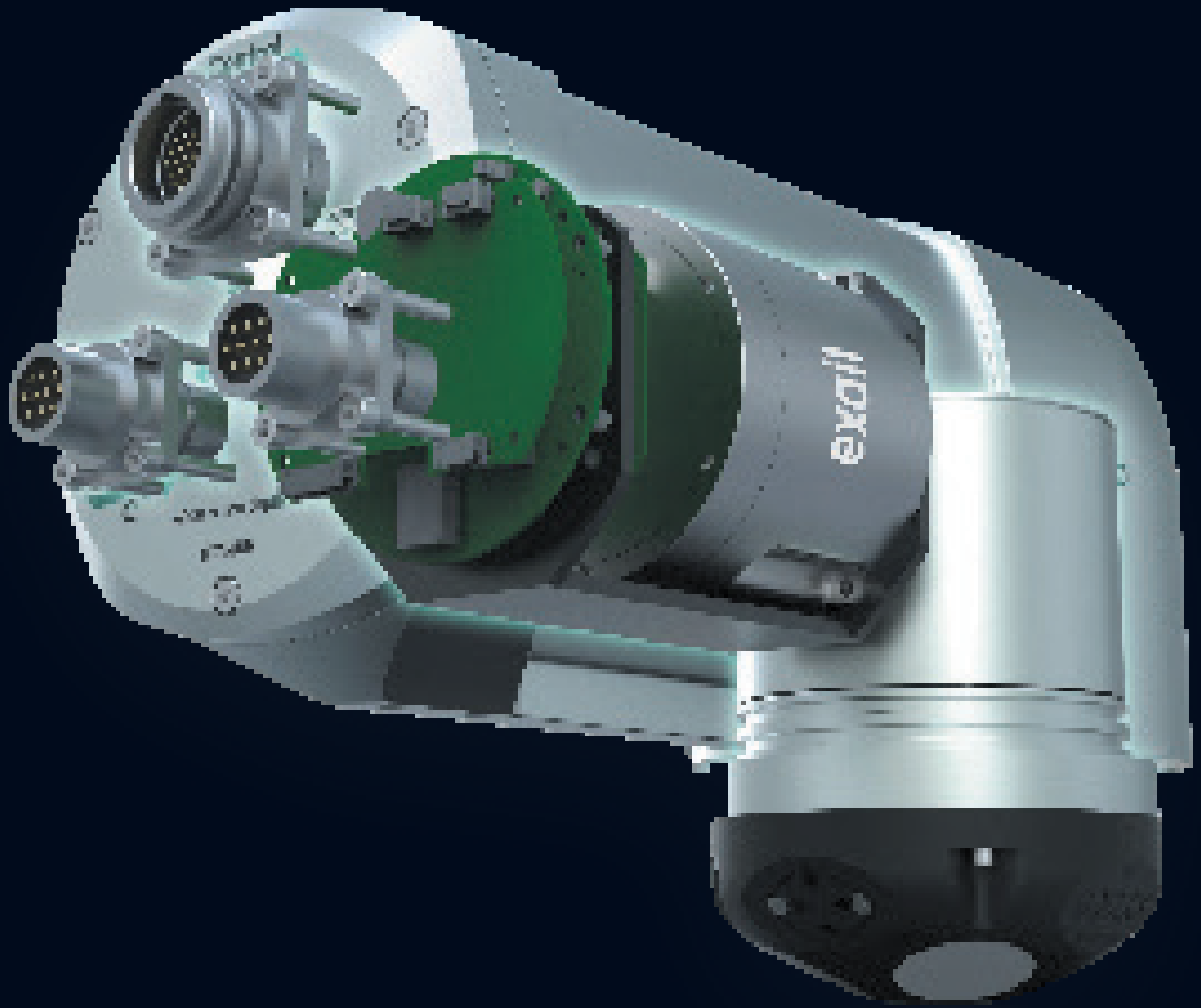
Characteristics

| | |
|-----------------|---|
| Dimensions (mm) | L 780 x W 551 x H 424 |
| Weight in air | < 35 kg w/o additional equipment |
| Material | Polypropylene frame, stainless steel fittings |
| Propulsion | 7 dc thrusters 4 horizontal (vectored) / 3 vertical (for attitude correction) |
| Payloads | Compatible with all modern payloads |

A user friendly HMI



UNPRECEDENTED
ACCURACY WITH
NEW ROVINS 9 DVL
ALL-IN-ONE
INS AND DVL



WHEN IT COMES TO UNDERWATER OPERATIONS, ACCURACY IS KEY. THAT'S WHY EXAIL HAS MADE IT ITS MISSION TO DEVELOP THE MOST ADVANCED INERTIAL NAVIGATION SYSTEMS (INS) FOR SUBSEA VEHICLES. BUT WE DIDN'T STOP THERE. INTRODUCING ROVINS 9 DVL, OUR ALL-IN-ONE SOLUTION THAT COMBINES INS AND DOPPLER VELOCITY LOG (DVL) TECHNOLOGY TO PROVIDE UNMATCHED ACCURACY AND PERFORMANCE.

Benefitting from Exail's proven Fiber-Optic Gyroscope (FOG) technology, which has revolutionized navigation in the last decades, and the latest DVL advancements from Nortek, Exail's new Rovins 9 DVL innovative solution merges the top navigation technologies available today. With its unique design and compactness, it is the ultimate tool for subsea companies looking to maximize efficiency and success.

➤ **The ultimate technology fusion in an all-in-one compact device**

Rovins 9 DVL is a flexible and plug-and-play system that combines an Exail INS based on UmiX Inertial Measurement Unit (IMU) and a Nortek Compact 500 DVL in a single compact housing. It is designed to be easily integrated in a variety of subsea vehicles such as ROV, AUV, and tow fishes and is suitable for operations from shallow to deep water depths down to 6,000 m.

Embedding Exail's UmiX, the most compact high-performance IMU, Rovins 9 DVL delivers unparalleled navigation performance in the smallest design available on the market. Compared to equivalent FOG systems, the Rovins 9 DVL IMU is half the size, half the power consumption, and twice the performance. Integrating miniaturized in house accelerometers, it also features new FOG gyroscopes custom-built for this system. With its cutting-edge performance and ultra-compact form factor, this new gyroscope expands the boundaries of what is possible in subsea navigation.



255 mm



150 mm

199 mm

Seacon connector 26 pin

Seacon satellite connectors 12 pin

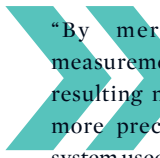
4000 m max depth

TITANIUM

Exail's UmiX is tightly coupled with Nortek DVL500-Compact, a universal DVL that combines a compact design with unprecedented functionality. With a bottom range detection capability of up to 175 m and a DVL frequency of 500 kHz, this DVL can fly higher in the water column and closer to the seabed (up to 0,3 m) than similar equipment. This makes it an ideal solution for small vehicles to conduct operations in challenging subsea environments.

➤ **Powering unmatched navigation performance and accuracy**

Tightly integrating raw sensor data from the IMU and DVL allows for higher levels of accuracy and reliability. Indeed, by combining the DVL measurements of the vehicle's velocity relative to the seafloor with the INS acceleration and rotation rate measurements, the system can estimate the vehicle's position more accurately, even in areas with complex or irregular seafloor conditions. The DVL can also help reduce the INS drift over time, while the INS compensates for external disturbances such as waves that can affect the DVL's velocity measurements. For further accuracy, the data collected can be processed with Exail Delph INS Subsea software, which enables users to access both DVL and IMU interfaces through a single user MMI.



“By merging the complementary measurements of the INS and DVL, the resulting navigation data becomes much more precise and accurate than either system used alone. And the ability to connect external sensors such as pressure sensors, through the satellite connectors available on the system, will provide even greater accuracy” says Maxime Le Roy, Product Manager at Exail. “Overall, this results in a more accurate and robust navigation solution that enables subsea vehicles to navigate and operate more efficiently in any sea conditions, even in areas where GNSS signals are weak or unavailable”.

➤ **Easy-to-use flexible solution, tailored to the challenges of the underwater environment**

Compact, lightweight, and versatile, Rovins 9 DVL has been specifically designed to greatly simplify the work of subsea operators in the field. Its unique horizontal design allows for easy integration into all types of subsea

platforms, from observation-class to work-class Underwater Unmanned Vehicles (UUV). The integration process is further simplified as fewer cables are required within the vehicle frame. Additionally, Rovins 9 DVL boasts an open architecture that enables connection to third-party sensors via standard straight or right-angled connectors - both of which are supplied with the system - allowing for maximum integration flexibility.

Rovins 9 DVL comes pre-calibrated and plug-and-play, making on-the-field calibration unnecessary and integration into vehicles fast and easy. It also features new electronic control units that enable self-alignment in motion, eliminating the static alignment time required by previous generations of Exail INS. This makes the system ready for immediate deployment, saving significant time and money in offshore operations, which is crucial for operational efficiency.

A cost-effective and hassle-free solution, Rovins 9 DVL relies on Exail's expertise and robust technology, requiring no maintenance. Thanks to its titanium housing, it is highly resistant to high pressure and harsh environments, enabling operations at water depths down to 6,000 m. It operates on low power consumption (< 18 W), making it an ideal choice for AUV manufacturers and latest e-ROVs operators seeking to save watts without compromising on data processing power.

“With decades of expertise in the underwater domain, Exail has leveraged its knowledge to create a unique and efficient solution that effectively addresses the operational challenges faced by subsea vehicle operators” outlines Stéphane Meyer, Subsea positioning and navigation division Director. “With its powerful technology integration, compact design, user-friendliness, and cost-effectiveness, the Rovins 9 DVL all-in-one system provides an exceptional size/performance ratio that has never been equaled in the market. This game-changing navigation system is poised to revolutionize the subsea vehicle operations landscape, enabling our customers to significantly improve their operational efficiency in all marine applications, ranging from offshore energy to seabed exploration.” ■

Rovins 9 DVL

ALL-IN-ONE INS AND DVL SYSTEM

Position accuracy

| | |
|---|-----------------------------------|
| Rovins 9 DVL straight line performance | 0.1 %TD (CEP 50) |
| Rovins 9 DVL optimal performances in typical conditions | 0.02 %TD (CEP 50) |
| No aiding for 60s / 120s / >8hrs | 0.6 m / 2.3 m / 0.47 Nm/h (CEP50) |

Heading accuracy

| | |
|---|------------------------------|
| With GNSS (or USBL/LBL) | 0.05 deg secant latitude RMS |
| Roll and pitch dynamic accuracy (no aiding) | 0.01 deg RMS |

Physical characteristics

| | |
|------------------------------|----------------------------------|
| Material | Titanium (depth rating: 6,000 m) |
| Weight in air/water | 11 / 5.3 kg |
| Mounting (Ø in mm) | 4 Ø 6.5 holes |
| Dimensions (Ø x L x h in mm) | Ø 150 x 255 x 190 mm |
| Connector | 2 x 6 pins, 1 x 26 pins SEACON |

Interfaces

| | |
|--------------------------|-------------------------|
| Serial | 5 ports: RS422 or RS232 |
| Data output rate | 0.1 Hz to 200 Hz |
| Power supply/consumption | 20 - 32 VDC / < 18 W |



EMPOWERING
AUTONOMY
AT SEA



AS THE MARITIME INDUSTRY MAKES ITS TRANSITION TOWARDS MORE EFFICIENT AND ENVIRONMENTAL-FRIENDLY AUTONOMOUS OPERATIONS, EXAIL, A WORLD-LEADING DEVELOPER OF INDUSTRY-CHANGING AUTONOMOUS AND UNCREWED TECHNOLOGIES, HAS BEEN RAMPING UP ITS PRODUCTION OF DRIX UNCREWED SURFACE VEHICLES (USV) TO MEET THE INDUSTRY GROWING NEED FOR EFFICIENT AND SEA-PROVEN UNCREWED PLATFORMS.

With over 20 DriX in operation worldwide, Exail USV, that was launched back in 2017, has been met with a strong interest from the industry and is benefiting from steadily growing commercial success. Certified by Bureau Veritas (BV) and Lloyd's Register, the USV has already been acquired, deployed or used by several private and public operators for hydrographic missions, scientific monitoring and other subsea positioning operations. Those includes governmental institutions such as the US National Oceanic and Atmospheric Administration (NOAA), British Antarctic Survey (BAS), the Polish Navy, the French Hydrographic Institute (SHOM), or the French Research Institute for Ocean Science (Ifremer), as well as survey contractors and operators in the energy market such as Total Energies, Ocean Infinity, Sulmara, WAMS and other rental companies including Unique.

In order to help its clients and partners in their transition towards remotely supervised maritime operations, Exail has developed a complete ecosystem around its DriX USV. Through certified launch and recovery systems, towed vehicles, purpose-made payload gondola adaptations, supervision software, as well as a comprehensive service offer, Exail provides a complete end to end uncrewed ecosystem, enabling efficient and successful uncrewed operations, from the coastline to greater water depths.

➤ **Best-in-class USV for hydrography, scientific monitoring and acoustic subsea positioning**

Leveraging 5 years of successful track record around the world, the DriX USV is now recognized as the leading Uncrewed Surface Vehicle in terms of operational efficiency and measurement quality. Owing to its unique sea keeping capabilities, the DriX USV can operate up to sea state 5. Its controlled dynamic, coupled with the tight integration of its acoustic payloads, leads to best-in-class measurements and data quality.

Thanks to its enhanced energy efficiency – DriX offers very low fuel consumption compared to traditional vessels – the USV further offers high endurance for multiday missions at sea, as well as a drastic reduction of marine operations environmental footprint.

Owing to these unique features, the DriX USV now benefits from a proven track-record of enhancing the overall end-to-end operational efficiency, from preparation and execution to client data delivery.



© OETNautilusLive

► The DriX USV is being deployed from the Ocean Exploration Trust E/V *Nautilus* during an exploration mission in the Pacific Ocean

› **CortiX software:
powering autonomy at sea**

At the heart of the DriX autonomy, lies the CortiX software framework; a comprehensive software solution that powers the USV autonomy, navigation safety, data management, as well as robust Over The Horizon (OTH) operations. Comprising both DriX on-board autonomy, as well as an Intuitive User Interface, CortiX relies on an advanced architecture with a web-based interface that can be accessed either as an Edge or Cloud solution.

Its core functional blocks include:

- CortiX Autonomy - for mission planning and execution
- CortiX Safety - for obstacle avoidance and vehicle health monitoring
- CortiX Data - for on-board data management and acquisition
- CortiX Horizon - for communication infrastructure management

Exail further provides various levels of API (Application Programming Interface) as per users' specific needs to enable a smooth integration with 3rd party software package.

› **Robust Over The Horizon operations**

With its multi-channels redundant communication system, the DriX can support both Line Of Sight (LOS) or Over The Horizon (OTH) operations. This system includes 4G, Kongsberg Broadband Radio, Silvus Network Radio, Iridium Certus, or Starlink Satellite. Over the past two years, the Exail teams have indeed put tremendous efforts into the development of a robust and highly performant communication infrastructure to support OTH operations. In full OTH mode, DriX is further able to select the best communication mode depending on the environment, while smartly managing the use of bandwidth to guarantee critical data priorities. Relying on those developments, the DriX USV is now routinely operated hundreds of nautical miles away from shore for multiday missions.

› **Sea-proven multi-vehicle collaborative autonomy capabilities**

Multi-vehicles operations that combine subsea and surface assets is one of the next frontiers in the field of maritime autonomy. Deploying multiple maritime drones working collaboratively indeed brings further operational efficiency and expand the operational envelop.

Used as a surface gateway that supports AUV and ROV subsea operations in terms of acoustic communication or positioning, the DriX USV has one of the most established track-record in supporting multi-vehicles collaborative operations and provides a high level of situational awareness to the crews that operate the subsea assets.

With its uniquely low acoustic signature, the DriX gondola, located 2 m below the surface, provides an optimal environment for the conveyance and operation of acoustic positioning and ACOM equipment. Acoustic equipment can thus be operated with the lowest surface interferences and be used at their best performance, resulting in highly reliable AUV/ROV communication and tracking while the subsea assets conduct their missions.

› **A comprehensive service offering**

From offshore and remote support, extensive training courses, as well as a comprehensive documentation, the Exail teams – whether in-house experts or highly skilled and trained freelancers – are there every step of the way, from mission planning and field mobilizations to operations and maintenance, helping our clients and partners deploy Exail technologies and smoothly transition towards uncrewed marine operations. ■

› The DriX USV is being deployed from Oceanographic survey vessel *Beauteemps-Beaupré* during sea trials with the Shom

› An Exail surveyor supervises a multi-DriX operation from the onshore Control Center





IMPROVING
EFFICIENCY AND FLEXIBILITY
WITH NEW IN-MOTION
ALIGNMENT FEATURE



An efficient INS alignment is crucial to ensure that the INS's measurements are accurate and reliable, especially in subsea navigation, where precision navigation is to be achieved over long periods of time without any form of aiding. On most INS, the first INS alignment phase, which aims at initializing the navigation algorithm, usually involves a static alignment period where the device shall be kept as stationary as possible for an extended period before the navigation can actually start. Depending on the type of vehicle and accuracy requirements, alignment times could be lengthy, making it unsuitable for some applications that require precise alignment within a short time.

To overcome this, Exail has recently incorporated new electronic control units (ECU) into their subsea navigation INS, together with a new algorithm, allowing them to self-calibrate while in motion. This feature enables Exail's customers to carry out their operations with greater efficiency and flexibility, with shorter alignment times.

➤ **Pushing alignment technology further to meet the demands of all subsea operations**

The purpose of INS static alignment is to establish the initial orientation (heading, roll, pitch) of the INS before it starts navigating. This is done using inertial sensors that measure movements (gyroscopes for rotation and accelerometers for linear acceleration) relative to a static frame in relation to the stars. Once the static alignment phase is complete, the navigation algorithm continuously refines additional parameters such as internal sensor biases, scale factors, or external sensor error model parameters, using external sensor observations to maximize navigation performance.

The static alignment process takes a few minutes during which the navigation system must be stationary before performing various tests and calibration procedures to ensure the accuracy of measurements. Once the complete alignment is performed, the INS can provide precise position, velocity, and attitude information to the vehicle's navigation system, even without external references. Failing to keep the system static enough during that phase can lead to navigation errors. This step is thus critical for accurate navigation.



▶ AUV being deployed at sea, ready to perform its in-motion alignment

However, this process may be time-consuming and not possible in certain environments or situations where vehicles have to operate in dynamic and unpredictable environments. As a result, in response to the need for faster and more robust alignment use cases, Exail has developed a new in-motion alignment feature for its INS. The latter allows the INS to be aligned while the vehicle is in motion, eliminating the need for stationary alignment, thus solving the efficiency concerns of many marine operators.

“It is crucial to align the INS accurately within a very short period in many subsea applications where efficiency is key, such as hydrography or military applications, in which a very rapid response time is often a prime requirement to achieve a very short, if not zero, reaction time. This new functionality was an important request from our customers and is already warmly welcomed by those who need great agility in their operations” outlines Stéphane Meyer, Navigation and subsea positioning division Director.

➤ **More robust alignment for greater flexibility and efficiency**

To enable the new motion alignment functionality, Exail has integrated new ECUs into its subsea INS, with a combination of more powerful and accurate sensor data and algorithms to determine the vehicle's orientation and position. Alignment in motion allows the system to continuously monitor the vehicle's movement and adjust sensor outputs in real-time, ensuring that the subsea navigation system is always accurately aligned.

One of the most significant benefits of in-motion alignment for subsea vehicle operators is greater efficiency. By eliminating the need for extended stationary periods, subsea vehicles can spend more time performing their critical tasks, improving overall operational efficiency. This is particularly important in industries such as offshore oil and gas exploration, where time is key and delays can be costly.

Additionally, in-motion alignment technology provides increased flexibility for subsea vehicles. With traditional static alignment methods, vehicles were often limited in their options for alignment locations. Unlike static alignment, which requires being positioned in calm sea areas with minimal boat movement, in-motion alignment enables operators to align their INS systems while in transit, regardless of weather conditions. Therefore, alignment can be performed anywhere, whether on the deck of a boat, at sea, or on the quay, which enhances operational adaptability and helps overcome challenging weather conditions.

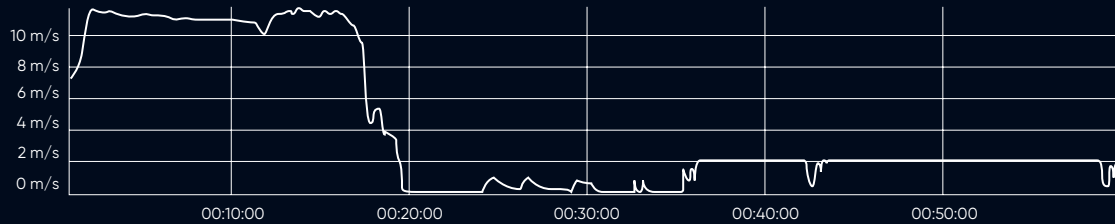
Last but not least, Exail's latest ECUs have a significant improvement in their INS alignment, as they now incorporate an optimized Kalman filter that works right out of the box, making INS alignment more robust and accurate than ever. The Kalman filter is a mathematical algorithm integrated into the Exail INS that processes sensor measurements, considers the noise and errors in the measurements, and estimates the state of the system. This filter plays a crucial role in ensuring the INS's accuracy and reliability, particularly when sensors are prone to disturbances, errors, or noise.

“The recent developments carried out by Exail which led to this new in-motion alignment functionality represent a significant step forward in the development of INS for the maritime industry. This feature has been added to the Phins Compact Series INS as of the beginning of 2023 and is scheduled to be available on all Exail INS by the end of 2023.” said Maxime Le Roy, Subsea INS Product Manager. “We are excited to see the impact it will have on our customers' operations. We are confident that this technology will provide significant benefits to our customers, improving accuracy, efficiency, and flexibility in their critical operations.” ■

New in-motion alignment feature

PHINS COMPACT C3 INS TESTED ON AUV

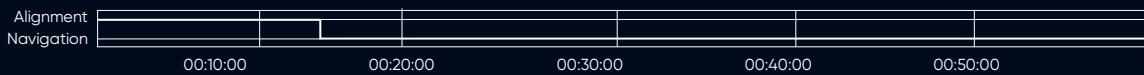
LINEAR SPEED



— Speed at "primary" - SOG

► The Zodiac's speed starts at 8 to 12 m/s from the beginning and remains constant for the first 18 minutes before deploying the AUV into the water

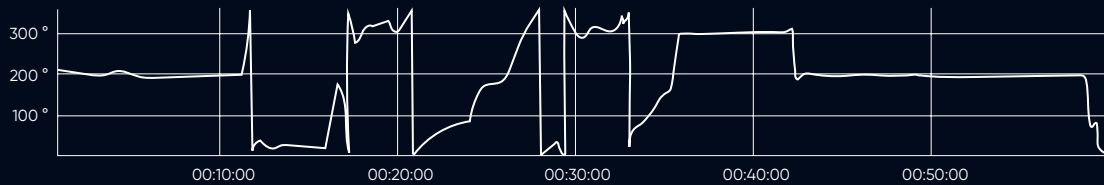
ALGORITHM STATUS



— Alignment

► The alignment phase, which lasts 13 minutes, shows that the plant is aligned before arriving on the test area

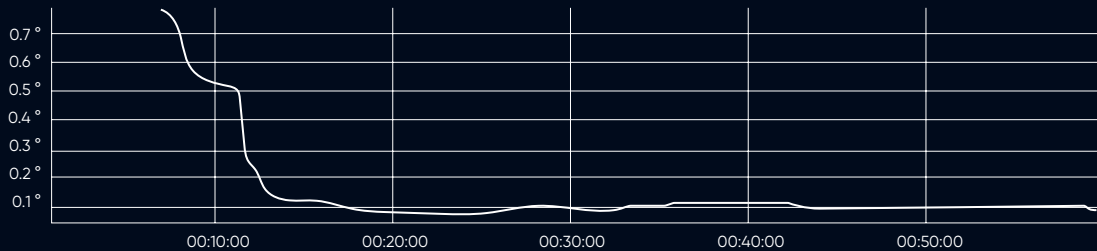
ATTITUDE



— Navigation at "primary" - attitude

► The INS's output indicates consistent heading data from the start, and it was possible to change orientation during alignment without any issues

ATTITUDE SD



— Navigation at "primary" - attitude sd

► The Kalman filter's estimated heading error confirms successful convergence and consistency with external sensors

GAPS M3
NEW USBL SYSTEM **FOR VESSELS'**
PERMANENT
INSTALLATION



EXAIL'S GAPS FAMILY IS EXPANDING! ALREADY CONSISTING OF GAPS M5 AND GAPS M7, THE USBL RANGE OF POSITIONING SYSTEMS HAS WELCOMED ITS LATEST ADDITION: THE GAPS M3.

Smaller, lighter, and more compact, it is still as powerful as ever. Offering the same capabilities and precision levels as its counterparts in the same range, the Gaps M3 embeds a MEMS Attitude and Heading Reference System (AHRS), making it a more affordable and ideal choice for operators seeking the best price/performance ratio in terms of positioning and tracking of subsea assets. With the Gaps M3 joining the Gaps M5 and Gaps M7, Exail now provides a complete family of USBL positioning systems to meet all customers' needs, from shallow to deep water operations, and from portable to permanent installations.

➤ **A reliable USBL transceiver designed for permanent installations**

Intended for permanent USBL installations, Gaps M3 is a USBL transceiver designed to track any subsea asset from all types of vessels, providing high-level precision to meet any operational requirement. It can be easily coupled with navigation systems already on board, such as Inertial Navigation System (INS) or AHRS, thanks to its compatibility with major gyros, AHRS, and motion sensors, which allows it to deliver absolute subsea positions or simply output relative positions over standard telegrams. In addition, Gaps M3 is compatible with major dynamic positioning (DP) systems providing USBL reference, range-aiding, and vessel LBL positions. As part of a turnkey DP solution, it can be complemented by reference transponders and a bespoke hoisting system also supplied by Exail.

➤ **Achieving maximum multiple target tracking and acoustic communication capabilities**

Gaps M3 is equipped with the same 3D, 4-hydrophone acoustic antenna as the Gaps M5, which provides maximum aperture and allows for a unique 200° omnidirectional coverage. This translates into true horizontal tracking capabilities with no need to tilt the antenna, making Gaps M3 perfectly suited for any type of operations from shallow to deep water, especially when multiple vehicles need to be located simultaneously at 360°.

Much more than a simple USBL system, Gaps M3 comes with new telemetry features, enabling advanced acoustic communication capabilities. This means it can use its robust telemetry link to command-and-control AUVs, operate and calibrate LBL-array and recover seafloor sensors data. It can simultaneously communicate and track up to 14 targets and remains compatible with third-party transponders. Gaps M3 is available in an export-free version with a 995 m maximum operating range and in an extended range version for operations down to 4000 m water depths to meet offshore specifications.

➤ **A compact and easy-to-use system suitable for opportunity deployment**

Benefitting from the renowned Gaps Series features, the Gaps M3 is compact, lightweight, easy to use, and can be utilized as a USBL system of opportunity on small survey vessels or even USVs. Its onboard MEMS AHRS unit allows easy deployment without time-consuming USBL calibration, giving a sufficient performance for shallow water or nearshore operations such as UXO surveys, search and recovery, as well as structure inspection.

“So far, our focus has been on offering calibration-free products with Gaps M7 and later with M5 back in 2020. However, in order to make the outstanding acoustic performance and versatility of Gaps accessible to more users, we are thrilled to introduce the Gaps M3. With its wide acoustic aperture, it delivers exceptional USBL performance, making it suitable for permanent installation on vessels for a wide range of shallow-water maritime applications, such as offshore wind, coastal marine construction, cable laying, and oil & gas operations” Explains Paul Urvoas, USBL systems Product Manager at Exail. ■

A full range of USBL systems

MEETING ALL SUBSEA POSITIONING NEEDS



Gaps M7



Gaps M5



Gaps M3*

**Pre-calibrated
USBL system**

**Pre-calibrated
USBL system**

USBL system

Performances

| | | | |
|--|---------|---------------|-------------------------------------|
| Range (m) | 4,000 m | 995 / 4,000 m | 995 / 4,000 m |
| Accuracy with internal AHRS (% of slant distance – CEP50)** | 0.06 % | 0.2 % | 1 % 0.2 % with external Dual RTK |
| Accuracy with external AHRS (% of slant distance – CEP50)** *** | - | - | < 0.1 % |

Internal AHRS/INS

| | | | |
|------------------------------------|---------|--------|------------------|
| Technology | FOG-120 | FOG-50 | MEMS |
| Heading accuracy (seclat – RMS) | 0.01° | 0.15° | Magnetic or GNSS |

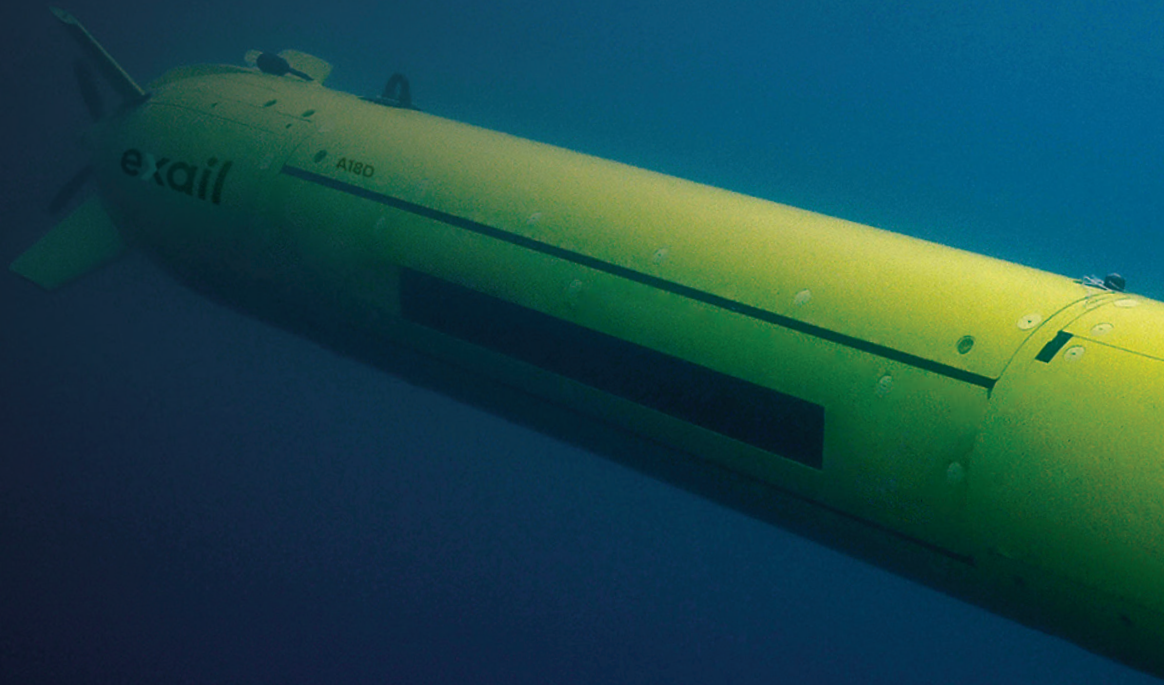
Mechanical

| | | | |
|-----------------------|-----------|-----------|-----------|
| Dimensions (HxØ) (mm) | 638 x 296 | 520 x 296 | 450 x 296 |
| Weight | 17 kg | 14 kg | 12 kg |

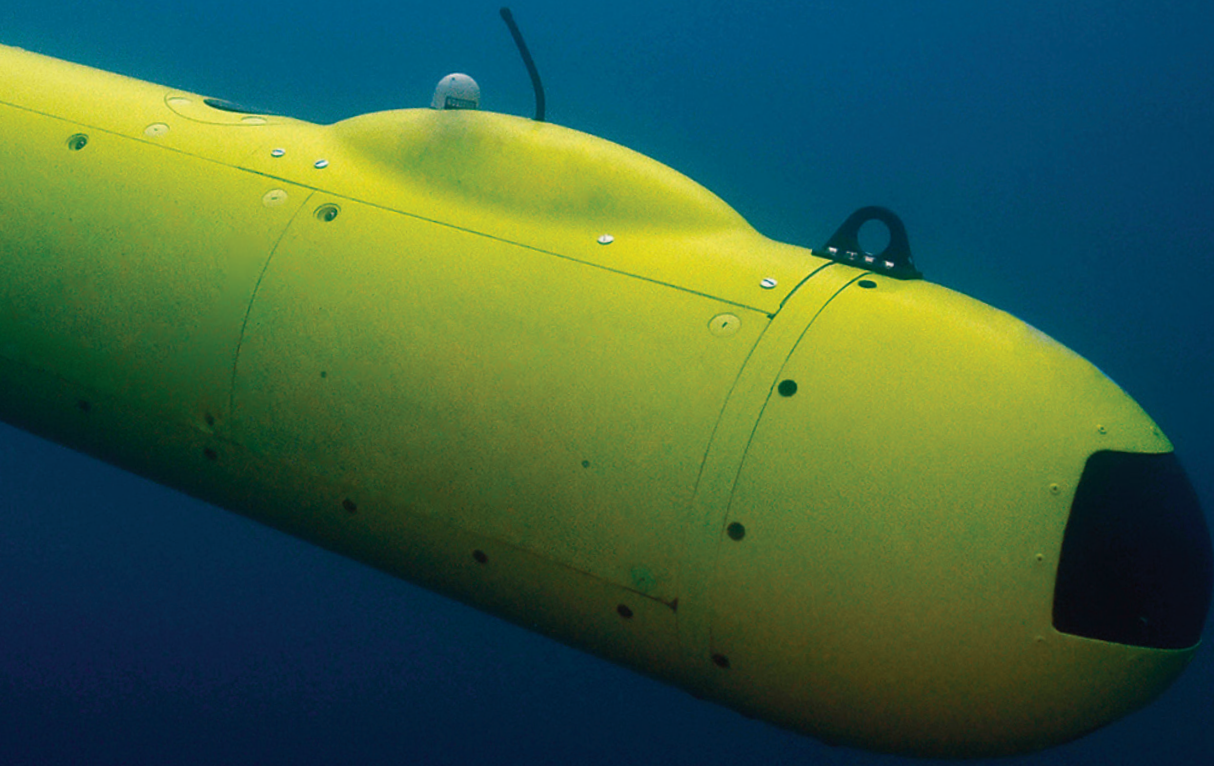
* Preliminary specifications, subject to modifications.

** In vertical conditions. Including GNSS error of 0.1 m. Sound velocity profile compensated. Transponder transmit level = 191 ref $\mu\text{Pa}@1\text{ m}$. Slant range of 900 m. SNR > 20 dB.

** Accuracy when fully optimized. Require a USBL calibration.



EMPOWERING **DEEP-SEA**
EXPLORATION



AS DEEP-SEA EXPLORATION ACCELERATES AROUND THE WORLD — WITH NATIONS, INSTITUTES AND COMPANIES SEEKING TO UNLOCK THE MYSTERIES OF THIS STILL LARGELY UNEXPLORED ENVIRONMENT — THE NEED FOR CUTTING-EDGE TECHNOLOGIES THAT MAKE IT POSSIBLE TO LAUNCH EXPLORATION MISSIONS HAS BECOME CRITICAL.

Leveraging over forty years of experience in ocean exploration, Exail, as a global leader in the fields of robotics and maritime autonomy, masters all the technological bricks needed for deep water exploration. The industrial company, that has end-to-end control over the entire value chain, from components and sensors, through to complete drone systems, thus offers:

- Uncrewed Surface Vehicles (USVs), Autonomous Underwater Vehicles (AUVs) and Remotely Operated Vehicles (ROVs) capable of operating in deep water.
- Inertial navigation systems, as well as subsea acoustic positioning systems allowing the tracking of underwater drones and the communication between the surface and the underwater world down to 6,000 m.
- Subsea imagery solutions for high-resolution mapping of the ocean depths.
- All software suites necessary for conducting exploration missions, drone control and mission planning, through to the acquisition, post-processing and interpretation of the acquired data.

Thanks to this high level of expertise, Exail today positions itself as a global player capable of enabling access to ocean depths down to 6,000 m.

Exail maritime drones and sensors have already been widely adopted by various manufacturers, scientific organisations and government institutions around the world and are deployed on multiple missions today. By way of example, Exail has developed and manufactured, for the French Research Institute for Ocean Science (Ifremer), two emblematic underwater vehicles used by the Flotte Océanographique Française (French Oceanographic Fleet), the Victor 6,000 m ROV (in 1998), and more recently the Ulyx AUV (delivered end 2020), an underwater drone capable of diving down to 6,000 m for totally autonomous missions lasting more than 48 hours and already deployed at depths of 4,500 m. The Ulyx drone is incidentally equipped with underwater imaging solutions developed by Exail for mapping the ocean depths and studying sediment layers with precision. Its precise navigation and positioning in great depths are also performed by inertial navigation systems and subsea acoustic positioning systems from Exail.

The high potential of the company's deep water exploration solutions has also already been identified by the French government which is currently testing them as part of several programmes. The DriX USV, able to map the ocean depths and position and exchange information with one or more AUVs simultaneously from the surface, to then transmit it to a control station on the shore or a vessel – and that has already

been deployed by US National Oceanic and Atmospheric Administration (NOAA), British Antarctic Survey (BAS), Ifremer, as well as TotalEnergies, Ocean Infinity or Sulmara to name a few – has also been tested by the Shom (Naval Hydrographic and Oceanographic Service) and the French Navy as part of armament programme within the “Future Hydrographic and Oceanographic Capacity” (CHOF). It is within this same context that Exail's A18D underwater drone, capable of operating at depths of 3,000 m, was also tested.

Drawing from these experiences and its unique know-how in the development and deployment of maritime drones and sensors, Exail, global leader in robotics, instrumentation, and services for marine and underwater applications, positions itself as a pioneering manufacturer that will expand current capabilities and make underwater exploration possible, from the coastline to the ocean depths down to 6,000 m. ■



► Ifremer new 6,000 m rated AUV was developed by Exail

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Improving cable lay installation

with Exail heavy duty acoustic releases

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Ulyx deep-sea AUV

a first dive to 4,500 m for Ifremer



NAUTILUS
IMO 6711883



INCREASING THE PACE OF OCEAN
EXPLORATION
THROUGH MULTI-VEHICLE
COLLABORATION

THE OECI TECHNOLOGY CHALLENGE SET OUT TO TEST COLLABORATIVE CAPABILITIES OF MULTIPLE UNCREWED VESSELS FOR OCEAN EXPLORATION EXPEDITIONS, WITH THE AIM OF INCREASING THE PACE OF OCEAN EXPLORATION AND FINDING WAYS OF IMPROVING EXPLORATION EFFICIENCY.

OECI is a partnership between The University of Rhode Island, The Ocean Exploration Trust (OET), The University of Southern Mississippi, the University of New Hampshire (UNH), Woods Hole Oceanographic Institution (WHOI) and primary funding partner National Oceanic and Atmospheric Administration (NOAA) Ocean Exploration.

The OECI Technology Challenge took place on 6-22 May 2022 in the Pacific Ocean. The aim of the Challenge was to develop approaches to having multiple uncrewed vehicles communicate and collaborate with each other, improving the efficiency of operations and expanding the exploration footprint. The challenge was also to find out if it was possible to adjust the mission of a robotic vehicle well away from the mother ship.

Until now, an expedition would typically conduct only one science operation at a time. Even when it was possible to embark several vehicles on the mother ship, only one vehicle could be operated at a time, and the mother ship had to suspend mapping operations in

order to deploy a vehicle. The expedition set out to send robots on simultaneous, independent missions while the mother ship carries on performing its own mapping operations.

Four vehicles were showcased in the Challenge:

UNH's Uncrewed Surface Vessel, DriX, WHOI's mid-water slow-moving remotely-operated underwater vehicle, Mesobot designed to explore the mesosphere, WHOI's remotely operated hybrid vehicle Nereid Under-Ice, NUI, which has a fiber optic cable allowing it to act as a standard ROV as well as an AUV if the fiber optic cable breaks. And last but not least, the OET E/V *Nautilus*, the main research platform.

With all these robots embarking on the E/V *Nautilus*, the real challenge was to have these vehicles in the water at the same time and have them communicate with each other, when they didn't all have the same protocols. Teams wanted to check these communications means, opening up the possibility of multi vehicle tracking and positioning.



© OETNautilusLive

► Exail DriX USV mapping the seafloor during the OECI technology challenge

› Exploring vast areas in a single mission becomes reality

The DriX USV was launched on its own to map the water column to track diurnal migration of the deep scattering layer. To do this DriX used its Kongsberg EK80 multibeam echosounder within its gondola, 2 m below the hull and thus clear of wave activity and bubbles, the necessary conditions for optimum data acquisition.

DriX's Marine Broadband Radio enables it to send data in real time to E/V *Nautilus* up to 20 km away. The MBR allows the ship and DriX to sail far from each other and carry out mapping in different areas simultaneously, multiplying the size of the area they can cover in a given timeframe. Once DriX identifies a target during its mapping operations, Mesobot AUV is sent to the target to sample the migration. DriX is able to track, monitor and even re-task Mesobot by circling above it, maintaining its acoustic communication with real-time data links established between them. DriX acts as an "aircraft control center" to maintain acoustic communication with Mesobot.

Thanks to this acoustic communication link via a USBL system installed within DriX's gondola, teams were able to monitor Mesobot's position in real time and send the information to the display systems onboard *Nautilus*, giving full situational awareness of both vehicles and the mother ship. DriX can then redirect Mesobot in real-time, from miles away, to new features revealed by DriX and obtain real-time information on water column properties and areas of interest.

Thanks to this acoustic communication capability DriX can also retrieve the data collected by the AUV without having to wait for it to resurface, enabling fast data transmission to the operations center through high-bandwidth communication.

› Launch of the NUI vehicle

› Mesobot team members deploy the vehicle over the edge of the E/V *Nautilus*

› Intelligent collaboration between DriX, Mesobot and NUI

NUI dives down below Mesobot to explore the seabed. When NUI uses its fiber optic tether linking it to *Nautilus*, DriX acoustically tracks NUI and reports its positions to display systems onboard *Nautilus*, again offering complete situational awareness to *Nautilus* crews. As with Mesobot, DriX relays acoustic commands to NUI, and receives acoustic data from it, which it then forwards to the mother ship.

When NUI is in full AUV mode and is no longer attached to E/V *Nautilus* via the tether, freeing it for other missions, DriX provides long-range tracking for NUI, and long-range relay between NUI and *Nautilus*. So *Nautilus* can receive real-time data mapping from NUI via DriX without NUI needing to resurface, greatly improving efficiency.

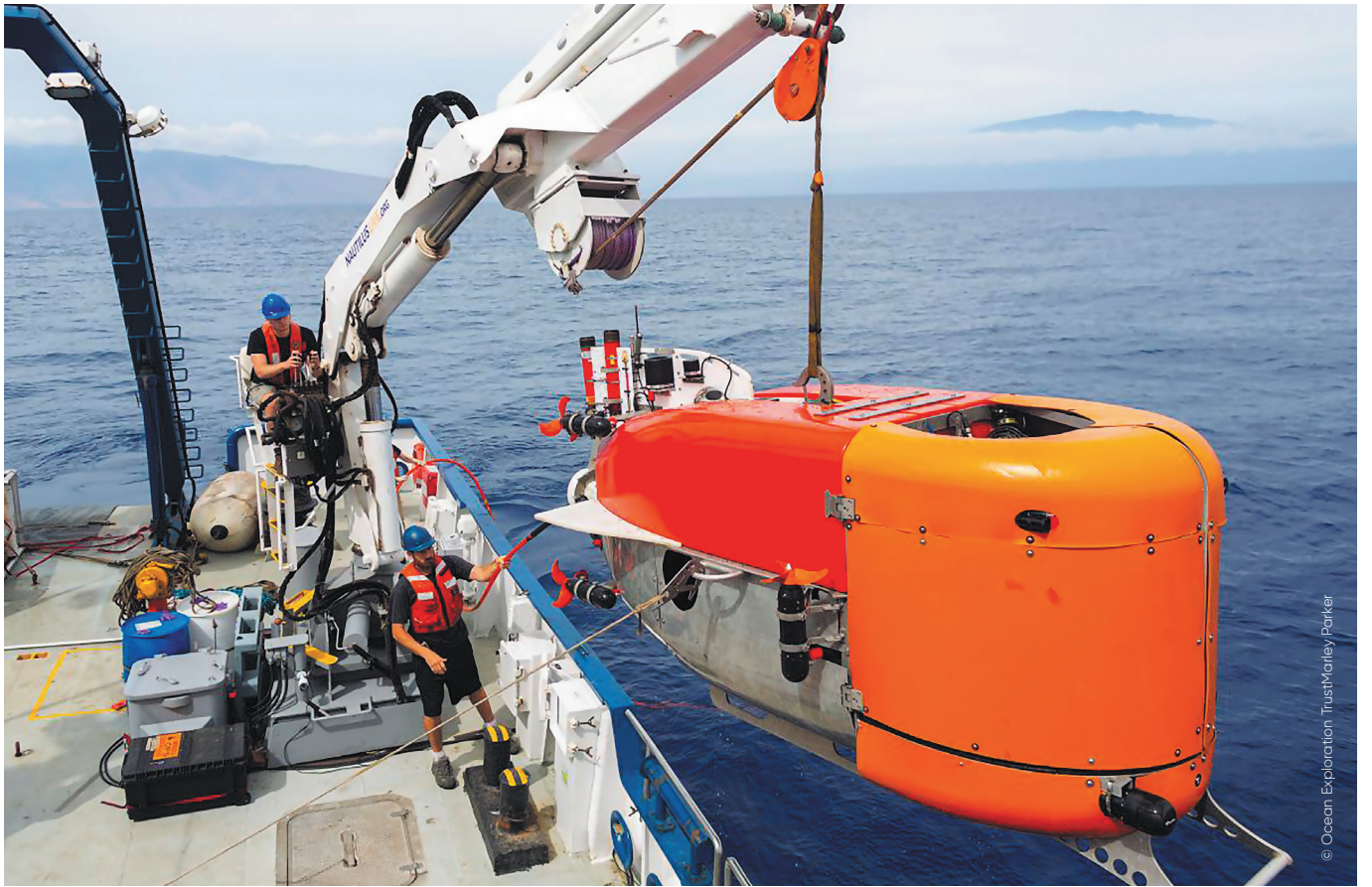
› Expanding mission capabilities

The mission was a great success, exceeding expectations. It illustrates how it is possible to explore seafloor, mid-water and surface simultaneously leaving the mothership free to perform other mapping tasks and other operations, drastically reducing downtime.

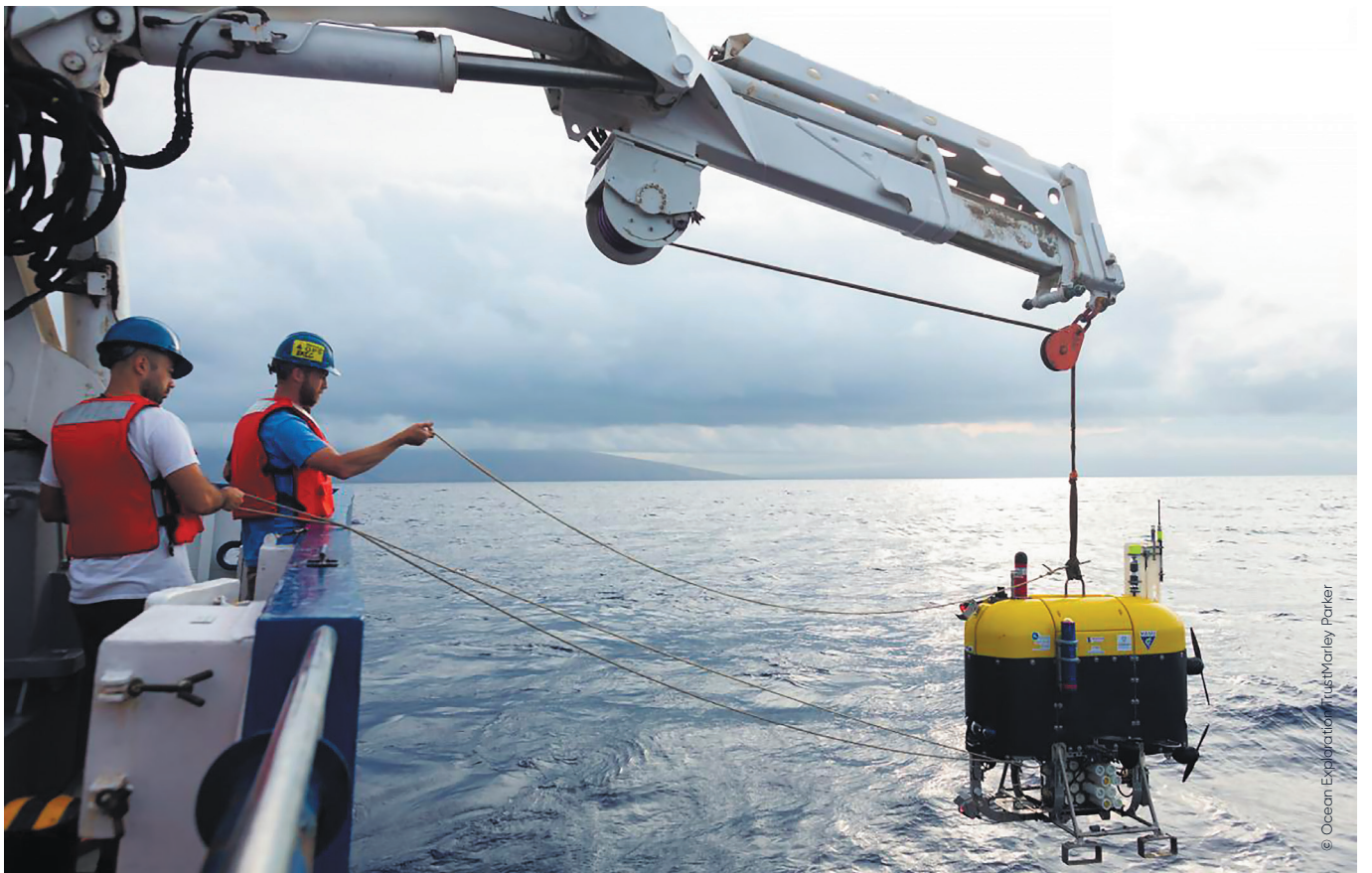
Research teams and oceanographers can use autonomous systems such as the DriX USV in conjunction with manned vessels, multiplying the surface that can be mapped and improving mission efficiency and the amount of data that can be gathered in a minimum of time.

"These technologies are already great on their own but so much more powerful when working together" said Jason Fahy Expedition Lead, NA1389 Technology Challenge, OECL.

Researchers and engineers alike are eagerly anticipating the endless possibilities that multi-vehicle collaboration offers, taking ocean exploration to a whole new level. ■



© Ocean Exploration Trust/Marley Parker



© Ocean Exploration Trust/Marley Parker



OVERCOMING CHALLENGING SHALLOW WATERS WITH GAPS M5 USBL SYSTEM

In mid-2022, Fugro, the world's leading provider of geo-intelligence and asset integrity solutions for large constructions, infrastructure, and natural resources, used Exail's Gaps M5 USBL acoustic positioning system to locate an ROV to install weight bags over a cable touchdown point (TDP) in the shallow waters of the North Sea. Despite the typical task, the operation was carried out under challenging conditions. Limited visibility, a noisy environment, and extremely shallow water required adjustments to the positioning procedure but the Gaps M5 system demonstrated its precision, effectiveness, and reliability in successfully completing the task.

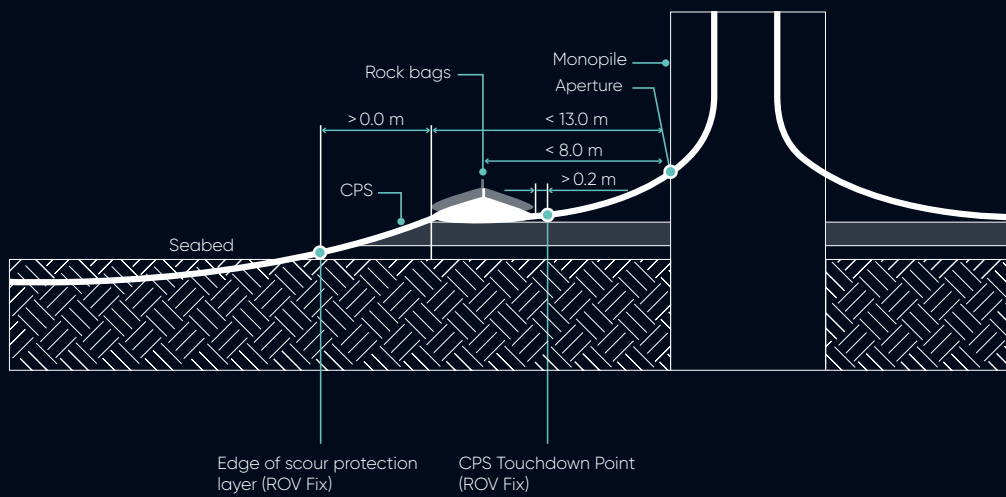
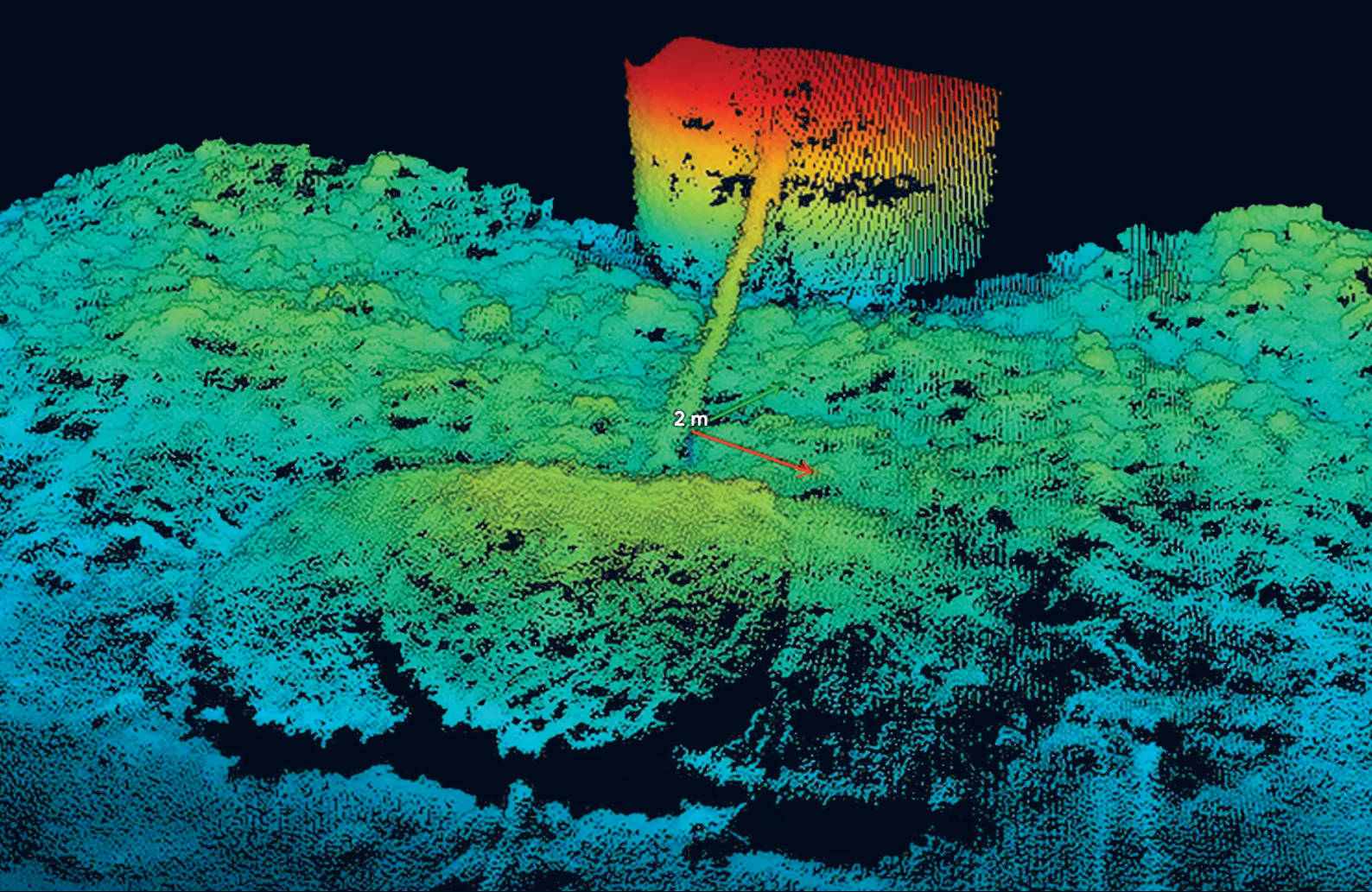
> Securing underwater cables in shallow water with USBL technology precision

The safe and reliable operation of underwater cables, whether used for telecommunications, oil and gas exploration, or renewable energy projects, relies on stabilizing their touchdown points (TDPs) so they don't move from their intended location. However, stabilizing TDPs can be a challenging task due to a variety of factors, such as limited visibility, precise positioning requirements, engineering complexity, and difficult marine conditions.

In a recent operation to stabilize a TDP in the shallow waters of the North Sea, Fugro deployed an ROV to position rock bags on the cable and secure it in place from a vessel of opportunity. Although the operation didn't seem particularly complex, the primary challenge was the extremely poor visibility in the shallow sea conditions. This made it difficult for the ROV operator to locate the TDP accurately and perform the necessary stabilization tasks.

To address this challenge, Fugro first considered a vision-based solution but ultimately opted for a USBL positioning method due to the visibility challenges. While the vessel was already equipped with a competing acoustic positioning system, Fugro chose to use Exail's Gaps M5 USBL positioning system, which they had used in previous operations and found to be ideal for shallow water operations.

“As a long-time user of the Gaps system, we know that Gaps, very reliable in shallow water environments, offering exceptional vertical and horizontal tracking. Its ease of use, pre-calibration, quick deployment, and exceptional support from Exail convinced



› 3D representation of the 3 rock bags placed on the cable touch down point, near the monopile

us to choose this system over the positioning system already on board” said Stephanie Hague, Project Manager at Fugro. Indeed, the Gaps M5 is capable of accurately positioning underwater objects within a few centimeters. This makes it ideal for locating the ROV used for stabilizing underwater cables. Moreover, with an extensive driver library, Gaps M5 can be connected to navigation software and provide real-time data, allowing for immediate adjustments to be made to ensure the stability of the cables.

› **Enabling successful ROV positioning by overcoming harsh conditions with agility**

The Gaps M5 system was initially lowered into the water on a pole attached to the boat, but it was discovered during the initial tests that it was not operating correctly. Fugro and Exail’s support team showed operational agility by promptly identifying and addressing the issue due to noise source observed through the Gaps interface. It soon became apparent that the environment posed an operational challenge due to the shallow water depths ranging from 15 to 40 m, strong currents, and high tides. Furthermore, the vessel being used measured over 150 m in length with a draft of 8 m and with 6 thrusters, 2 operating cranes, an ROV, and work being conducted near a monopile, the heightened acoustic noise in the water made the positioning task extremely challenging. Taking all of these factors into consideration, it was obvious that the conditions were much too rough for conducting this type of operation, despite the strong capability of Gaps in noisy environments.

However, after addressing the environmental conditions of the operation,

by waiting for the high tide to turn to neat tides, which allowed the crew to operate under more favorable conditions, the Gaps M5 system got the job done. It demonstrated continuous performance and excellent interference cancellation capabilities while maintaining a superior level of acoustic reception and emission. By generating accurate positioning data, it proved to be an ideal solution for Fugro’s specific requirements and facilitated the successful completion of the ROV positioning operation.

› **Challenging the approach to address complex operational settings**

Despite challenging operating conditions, the ROV tracking was ultimately successful, due to the reliable performance of the Gaps M5 system and the operational agility of both the vessel’s crew and Exail’s support team. “The Gaps M5 worked consistently throughout the operation. Thanks to its adaptability and ease of deployment, it was able to be installed on the side of the vessel and successfully fulfill its tracking mission with its 200° opening” underlines Stephanie Hague. “Through great collaborative efforts, operational agility, and effective methodology, we were able to complete this operation with all the resources we had at our disposal.”

Overall, this experience highlights the importance of anticipating difficult environments and being open to questioning established methods to address unpredictable conditions. Operational flexibility is crucial when dealing with unpredictable nature, and such issues may become pressing in the field and require immediate solutions, given the high cost of keeping a construction vessel at sea per day. Successful operations require striking a balance between utilizing the best available technologies and effective operational methods by the operators. ■

› Exposed scour protection design locations (elevation view)



EVALUATING IMPACT OF WIND FARMS ON FISH BIOMASS



OFFSHORE WIND ENERGY DEVELOPMENT, EXPANDING RAPIDLY ALONG THE EAST COAST OF THE UNITED STATES, HAS THE POTENTIAL TO PLAY AN IMPORTANT ROLE IN U.S. EFFORTS TO COMBAT THE CLIMATE CRISIS AND BUILD A CLEAN ENERGY ECONOMY.

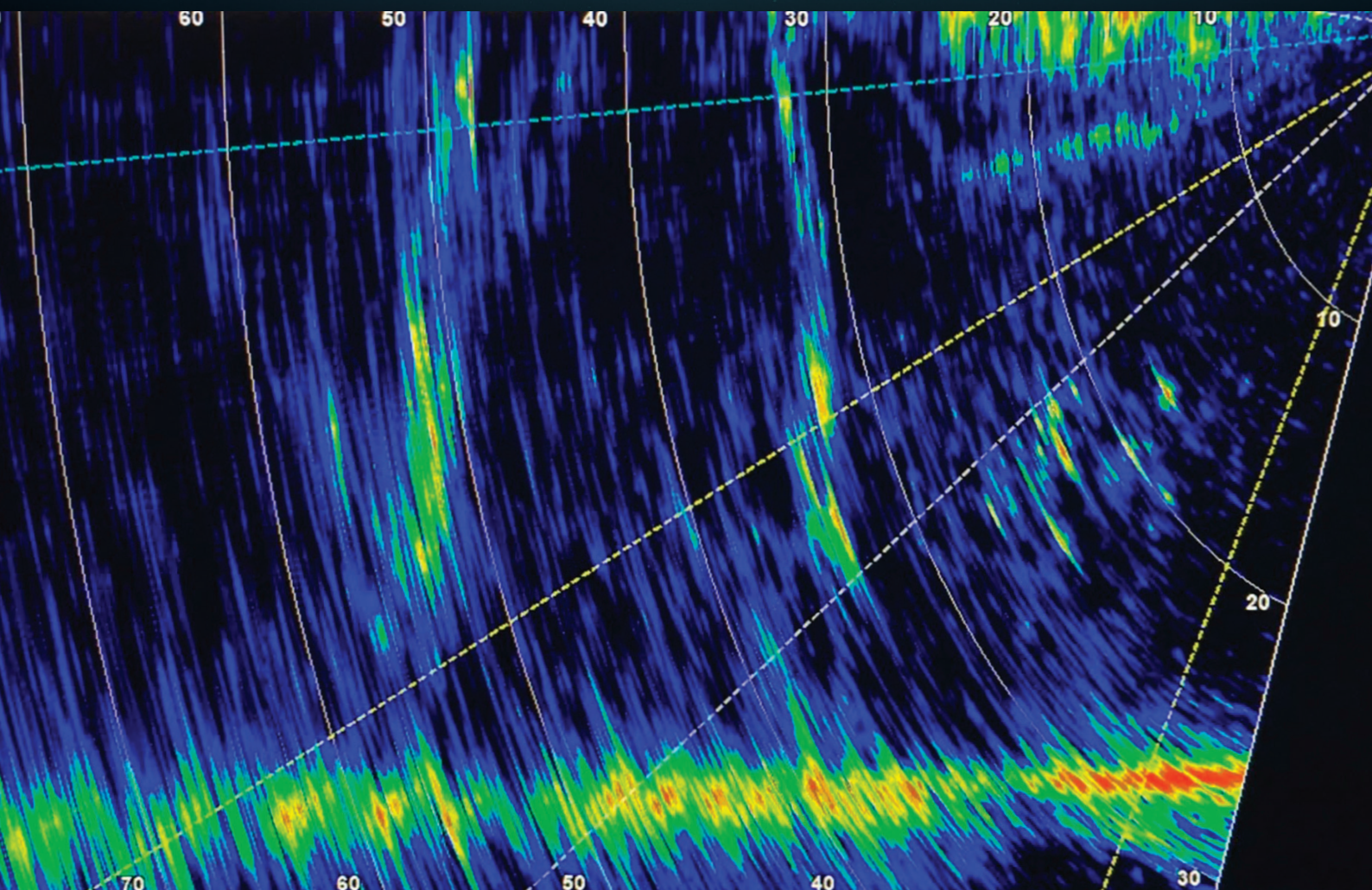
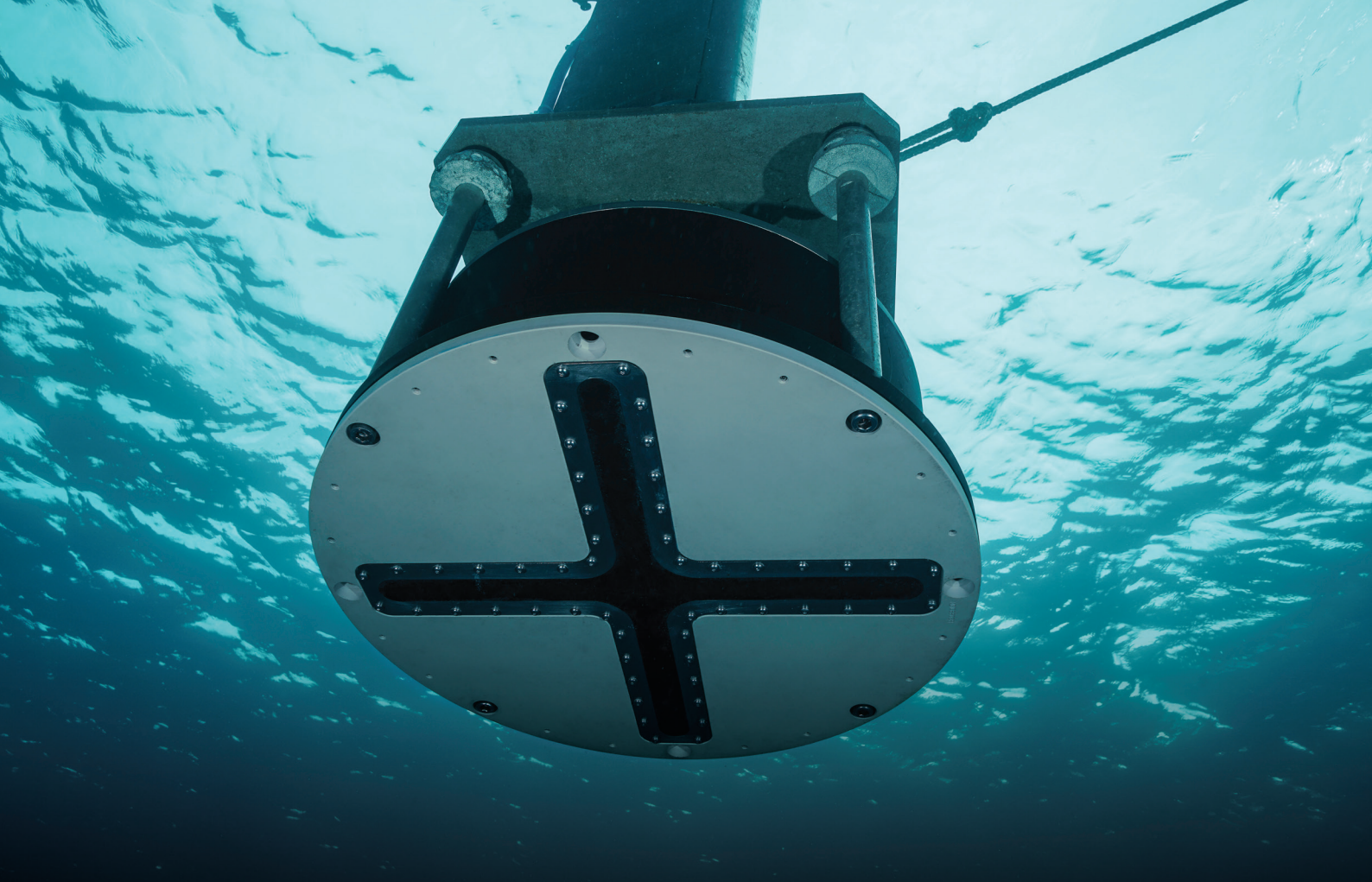
› SeapiX sonar
deployed on a pole

In the Northeast alone – historically a fishing area contributing to the economies of several coastal states and providing a livelihood for thousands of local fishermen – these wind farms will be spread across 2.4 million acres within the next ten years. The installation of fixed and floating turbines will have an effect on the ecology and biology of these areas, as well as on human activities (commercial and recreational fishing).

NOAA Fisheries Northeast Fisheries and Science Center (NEFSC) has been conducting research and monitoring to better understand the potential effects of offshore wind energy development on fish, shellfish, fisheries, protected resources, and their ecosystems as well as providing BOEM (the US Bureau of Ocean Energy Management) and other federal agencies, states, tribes, and stakeholders with information on fisheries operations and the potential socioeconomic impacts of offshore wind projects on fishing communities.

› Objectives

As offshore wind farms will soon become an integral component of the New England seascape, it will require novel, state-of-the-art methods to survey and monitor the fish that reside and migrate through these areas. Observing and monitoring the pelagic ecosystem can often be overshadowed by the demersal and benthic communities, yet it is a critical component of the life history of many commercially and ecologically important species. Limited capability to physically sample the biota with capture gear in and around offshore windfarms necessitates using complementary sampling methods to monitor the pelagic ecosystem. Active acoustic technologies, such as Exail SeapiX multi-split beam echosounder, can survey large areas quickly and efficiently and has decades-long track record of mapping spatiotemporal distributions and estimate abundance and biomass.



› Block Island Wind Farm Survey

Exail collaborated with NOAA Northeast Fisheries Science Center (NEFSC) on a 4-day acoustic and biological survey of the Block Island Wind Farm – a five-turbine, 30 MW windfarm located 6 km off the coast of Rhode Island, which has been operational since 2015 – to gain insight into the spatial distribution of fish species in and around the turbines using the SeapiX multibeam system.

Designed and developed for fisheries research as well as commercial fishing, the SeapiX is a 150 kHz solid state multi-split beam sonar consisting of dual antennas in symmetric Mills Cross architecture covering 2° x 120° on several swath.

During the mission, the SeapiX sonar was pole mounted on NOAA's R/V *Gloria Mitchell*, a 72-foot (22 m) stern trawler also outfitted with a hull-mounted, downward looking Simrad ES70, 38/200 kHz echosounder. The SeapiX was oriented both downward and sideways to characterize fish aggregation in middle and near surface waters in and around each turbine. A variety of survey designs were conducted, for instance spiral and straight line transect, to map 2D and 3D distribution. The volumetric acoustic data provided compatible data with historical fisheries data of fish aggregation sizes, shape, density and locations. The SeapiX can indeed provide an estimation of avoidance behavior which may significantly reduce measurement bias on stock estimates.

Fish were also collected using hook and line to verify the sources of acoustic backscatter as well as measure length, sex and diet. It was determined that Black Sea bass (*Centropristis striata*) were the most commonly caught species and appeared to be the primary constituents of the fish aggregation mapped by the acoustic systems.

Acoustic data were also analyzed in reference to the turbines to investigate utilization of the turbines and/or surrounding areas as habitat. Data were also collected during the day (first three days) and night hours (final day) to obtain pilot data on the spatial and

temporal distributions in and around the turbine structures.

The SeapiX sonar, given its frequency range, allows for safe operation in the wind farm areas and offer sufficient resolution to observe animals very close to the turbine structures.

› Conclusion

This Block Island wind farm survey operation was the first step in NOAA's plan to observe and understand fish distributions in a wind farm and to be able to provide answers to the underlying scientific questions on whether wind farm turbines have an aggregation or repulsive effect on biomass, or no effect at all. In the absence of "before" data, it is impossible to offer a definitive conclusion. However, the preliminary conclusions from this study suggest that these structures enhance abundance at the scale of individual turbines, but do not seem to have an effect on the biomass on the scale of the wind farm area.

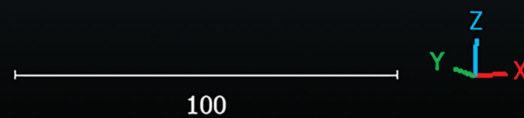
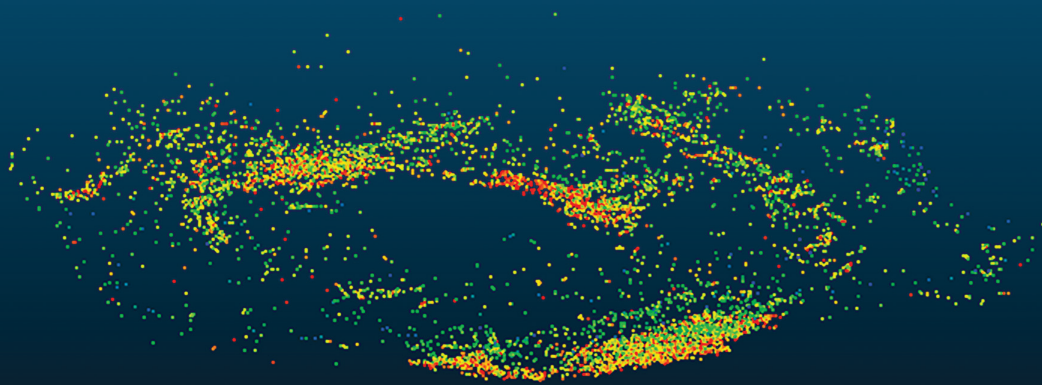
The next step in this study requires surveying a future wind farm construction site and planning is currently underway to conduct a survey using the SeapiX sonar integrated on Exail's DriX Uncrewed Surface Vehicle (USV).

Guillaume Matte, R&D manager for SeapiX at Exail comments: "it was a fantastic opportunity to run these tests together with NOAA experts. Marine Renewable energy installations require specific assessment surveys to qualify their impact on biomass, and we believe that SeapiX adds real value to this application. It offers a more insightful experience for fish detection and mapping and provides valuable information on fish behavior as well. We are grateful to the NOAA fishery scientists on-board during this survey for discerning conversations and for sharing their enthusiasm about SeapiX."

"The SeapiX expanded our ability to map fish distribution in and around turbines and was a great complement to the traditional single-beam echosounder" said Michael Jech, Research Fisheries Biologist at the NEFSC. ■

› 3D representation of the spatial position of fish around turbine 5 of the Block Island wind farm as acquired by SeapiX-R

› Screenshot of the turbine base as well as fish detections from the survey



The SeapiX expanded our ability to map fish distribution in and around turbines and was a great complement to the traditional single-beam echosounder.

> MICHAEL JECH, RESEARCH FISHERIES BIOLOGIST AT THE NEFSC



EXAIL AS
TOP CHOICE
FOR UNDERWATER
EQUIPMENT RENTAL
COMPANIES



MMG
M500013

Canopus

EXAIL HAD A RECORD YEAR IN 2022 IN THE RENTAL MARKET, SECURING MULTIPLE CONTRACTS WITH RENTAL COMPANIES GLOBALLY.

› Ashtead Technology takes delivery of Exail subsea system

With the objective of providing their customers with efficient and dependable technology to meet the diverse requirements of their operations, rental companies are increasingly turning to Exail's comprehensive range of high-end subsea navigation and positioning solutions, renowned for their reliability and state-of-the-art technology. 2022 was major vote of confidence for Exail's navigation technology, strengthening the company's position as a leader in the subsea navigation field and opening the door to continued success.

› Exail's reputation and dependable solutions inspire confidence in forming enduring partnerships

Exail is a well-established and reputable company providing subsea navigation, positioning, and imaging solutions to global maritime operators. Its reputation for delivering high-quality and reliable equipment gives rental companies the confidence to offer their clients the best solutions. Therefore, partnering with companies like Exail is often part of their strategic focus.

One such company is **Ashtead Technology**, a leading international subsea equipment rental and solutions provider for the global offshore energy sector. Since 2022, Ashtead Technology has invested significantly in

Exail navigation and subsea positioning technologies, including the Gaps M5 USBL acoustic positioning system, Octans Attitude and Heading Reference System (AHRS), in addition to Phins Surface, Rovins and Rovins Inertial Navigation Systems (INS). These systems are now available to rent from the company's nine international technology and service hubs.

According to Brett Lestrage, Ashtead Technology's Regional Director for Europe "with over 17,000 assets in our subsea equipment rental fleet, we offer one of the largest pools of subsea navigation and positioning systems for rent worldwide. This latest investment in Exail equipment is a direct result of listening to our customers' requirements and ensuring we have the broadest and most technologically advanced subsea equipment from leading manufacturers to support our customers' projects worldwide." In 2022, Ashtead Technology invested more than £7 million in new subsea equipment and technology to expand its rental fleet, further strengthening both its position in the offshore energy subsea equipment rental sector and its long-term partnership with Exail.

Subsea Technology & Rentals (STR) is another UK-based rental company that strives to offer an extensive inventory of marine and subsea technology from leading manufacturers to their customers worldwide.



STR has a longstanding partnership with Exail and has been consistently investing in its latest marine technology to deliver superior solutions to its customers. Recently, STR acquired Exail's Rovins and Rovins Nano INS, as well as the Gaps M5 USBL system, bolstering its significant investment in subsea navigation technologies. These new systems are now included in their global rental pool, which can be accessed through their five international service hubs. By providing these advanced subsea solutions, STR enables their customers to gather highly precise and dependable subsea navigation and positioning data, facilitating offshore operations even in the most demanding environments. "As a global leader whose proven technology is recognized worldwide within our industry, their systems are great assets to have and they've always met our customer's requirements" said STR's Chief Operating Officer, Scott Johnstone. This investment is set to enable the UK subsea rental equipment provider to further expand

its geographical reach, with the Americas, mainland Europe, and Southeast Asia being a key focus, supporting the expanding wind energy market.

In addition, a project to supply Canopus transponders for an operation in Australia at the end of 2023 is currently being studied with STR. Part of Exail's sparse LBL solution, Canopus intelligent transponders work with Ramses transceivers, INS, and Delph Subsea Positioning software to achieve highly accurate subsea positioning and monitoring capabilities down to 4,000 m. These advanced solutions enable operators to perform deep-sea operations with centimetric positioning accuracy.

➤ **Meeting customers' demands with the best subsea navigation and positioning technologies available**

Subsea equipment rental companies aim to understand their customers' needs and furnish them with cutting-edge technology and

equipment, guaranteeing that all their subsea operations can be accomplished with optimal efficiency, precision, and safety.

Unique Group, a global innovator in subsea technologies and integrated engineering solutions across renewables, oil and gas, and defense industries, has worked in partnership with Exail for decades. In 2022, the company placed significant orders with Exail as part of Unique Group's strategy to enhance its asset portfolio. This includes several units of Gaps M5, Octans Surface, Subsea, and Nano AHRS, as well as Rovins INS, and Oceano HD15 Cable Lay acoustic releases which are now located across Unique Group's global rental pool. This equipment will enable the company's clients to carry out their offshore operations with a complete range of products suitable for both shallow and deep-water environments.

The Gaps M5 systems recently purchased reflect the strong demand for this high-precision and reliable positioning equipment.

Indeed, with exceptional horizontal tracking capabilities, Gaps M5 is especially well-suited for shallow water operations up to a maximum depth of 995 m, making it an ideal solution for Unique's customers operating in the shallow waters of the Arabian Gulf or in worldwide coastal areas. Last but not least, Gaps M5 does not require an exportation license, making it free of export restrictions for fast and easy shipment. To complete their large fleet of Gaps systems, in early 2023, Unique Group ordered multiple Oceano MT9 beacons, which can be operated at various water depths, up to 3,000 m, and are compatible with most third-party equipment.

Unique Group also increased its pool of Exail Oceano Acoustic Releases with the addition of several Oceano HD 15 Cable Lay acoustic releases, capable of deploying and retrieving loads up to 10 t (15 t SWL). Highly reliable, these acoustic releases will be a great asset for Unique Group's customers for conducting their cable laying and maintenance as well as offshore marine construction operations efficiently.

Chris Blake, Vice President - Survey at Unique Group, said: "We are thrilled to further strengthen our partnership with Exail as we expand our fleet of high-precision positioning equipment. The acquisition of Gaps M5 systems and Oceano MT9 beacons, as well as the addition of Oceano HD 15 Cable Lay, demonstrates our commitment to providing our customers with the best solutions for their shallow water and offshore marine operations. And as we navigate the thriving energy sector in 2023, we look forward to working closely with Exail to meet the evolving needs of our clients".

In early 2023, **Rental Technology & Services (RTS)**, a leading rental equipment provider for the subsea industry, added Exail's Gaps M5 USBL acoustic positioning system to its rental pool of equipment, as part of its commitment to offering the latest and most innovative solutions to customers from its newly established UK offices. According to Dale Townend, UK Technical Manager at RTS "by bringing the Gaps M5 USBL system to our UK office, we are once again looking to respond to what we know our customers are demanding. This investment [...] represents a valuable addition of assets that we haven't previously held in our rental pool. We are excited to now have access to these advanced systems going forward, continuing our close relationship with Exail, and supporting our customers' project requirements for accuracy and efficiency on a global scale".

Indeed, the Gaps M5 is a powerful USBL positioning system that uses high-performance acoustic technology to accurately track underwater objects, with a wide 200° opening angle and outstanding vertical and horizontal tracking capabilities. This addition will thus allow RTS customers to perform all offshore operations in shallow water, including the installation of wind platforms, with greater accuracy, efficiency, and reliability, while reducing their operating costs.

In 2022, **Oceanscan**, a rental marine equipment provider, acquired Exail's Gaps M5 USBL positioning system, Octans Subsea and Octans Nano AHRS as well as Rovins and Phins Subsea INS. These products, which are part of a reliable line of subsea inertial navigation and positioning solutions, are crucial for effectively navigating ROVs and ensuring their correct positioning for

various tasks. Widely considered to be the most efficient systems available, Exail's AHRS and INS provide very accurate real-time ROV positioning, heading, and attitude measurements in all sea conditions, including shallow water, deep water, and rough sea conditions. Their robustness and ability to withstand harsh subsea conditions make them suitable for use in the most challenging environments. Additionally, the systems' compatibility with various software and equipment, and ease of integration with existing ROV systems contribute to improving ROV navigation efficiency and reliability, ultimately resulting in reduced task completion time and cost.

By incorporating Exail's navigation and positioning systems into their rental fleet, Oceanscan offers their customers very effective and high-precision solutions with advanced navigation and motion-sensing capabilities for a variety of subsea operations, including subsea construction, hydrographic and geophysical surveys, Inspection, Repair and Maintenance (IRM) of subsea assets, and pipeline and cable laying.

After a strong 2022, Exail has positioned itself to continue to address the needs of the rental market. A vertically integrated supply chain allows Exail to deliver high-quality and robust systems consistently to the market, while defending against some supply chain issues seen by other manufacturers in the market. With an exciting product roadmap, Exail will continue to deliver best-in-class technology into the rental market. ■



▶ Exail Canopus transponders being deployed during a sparse positioning operation off the coast of Africa



As a global leader whose proven technology is recognized worldwide within our industry, their systems are great assets to have and they've always met our customer's requirements.

▶ **SCOTT JOHNSTONE, STR'S CHIEF OPERATING OFFICER**



A18D UNDERWATER DRONE CHOSEN BY FRENCH DGA FOR SEABED OPERATIONS

Exail has signed a contract with the DGA (the French defense procurement agency) for the rental of an AUV (Autonomous Underwater Vehicle), the A18D, for the French Navy. The contract is expected to last approximately two years and includes academic and operational training for 12 sailors.

The A18D is designed to perform missions at depths of up to 3000 m for mapping, sonar imaging and high-resolution inspection of pipelines and cables. Capable of carrying out its missions in total autonomy during 24 hours, it can reach a speed of 6 knots and carry out up to 40 km² of imaging per mission.



The French Navy will use this autonomous multi-sensor vehicle to conduct experimentations with a view to defining its future needs, with the DGA's technical support, as part of the French ministry for armed forces' strategy to understand and monitor seabeds.

The A18D AUV and its onboard sensors will allow the French Navy to:

- Detect and identify objects thanks to a high-resolution sonar SAS (Synthetic Aperture Sonar)
- Chart the form of the seabed using an MBES (Multi-Beam Echo Sounder) bathymetric sonar
- Characterize the nature of the seabed thanks to an SBP (Sub-Bottom Profiler) sonar and a video camera

The AUV can be embarked on several types of ship. The AUV, which is very versatile and easy to install thanks to its compact design, will be delivered with a software suite to manage missions, and recover and analyze the data obtained. A command-control container will also be installed on board the mother ship, providing operators with a dedicated and sheltered space from which to command and control the drone. Finally, the Gaps portable USBL system produced by Exail will enable extremely accurate positioning of the recorded data even at a depth of 3,000 m.

Support is an essential aspect of this turnkey delivery; the theoretical and operational training provided by Exail's experts will make crews autonomous in the deployment and operation of the AUV, as well as in the recovery and processing/post-processing of the data obtained.

Observing and monitoring what is happening in the deep ocean has become a real necessity to ensure the protection of national interests. This is the reason behind the ministry for armed forces unveiling its seabed strategy last February. It is within this framework that the contract has been awarded. It follows on from an initial operational evaluation campaign of Exail's A18D conducted last year by the French Navy and the Naval Hydrographic and Oceanographic Service (SHOM).

Dominique Giannoni, CEO of Exail, is delighted with this contract: "We are proud to participate in this seabed program and to put all of Exail's technology and the know-how of our teams at the service of France's ambitions in this area of sovereignty." ■

A large blue and white research vessel is shown from a high-angle perspective on the ocean. The ship has a prominent red lifeboat on its deck and various pieces of equipment. The sky is a mix of blue and grey, suggesting an overcast day. The text is overlaid on the left side of the image.

ASN FLEET
UPGRADED
TO THE LATEST
ACOUSTIC
RELEASES



➤ **A successful 20-year history with Exail's Oceano acoustic releases**

It has already been 20 years since Alcatel Submarine Networks (ASN), a leader in the manufacturing and installation of underwater optical systems, has chosen Exail to equip its fleet of 6 cable ships, managed by Louis-Dreyfus Armateurs (LDA). With two releases per ship, ASN owns as many as 23 Exail Oceano acoustic releases, to help deploy equipment underwater, whether in shallow waters or on the continental shelf. Their main advantages are their reliability, extreme resistance to corrosion and, ease of use.

Today, 20 years after their first acquisition, ASN has decided to upgrade to the latest generation of Oceano Series to take advantage of its brand-new features. Moreover, following the purchase of 2 new vessels in 2021, ASN has completed its pool of equipment with 2 additional Oceano acoustic releases. Further to several months of development and qualification, the new design now integrates a full positive drive-off release mechanism to provide even more reliability and efficiency for cable laying operations.

➤ Telecommunication cables installed on the seabed

➤ **Exail's Oceano Series: a material of choice for cable ship activities**

Installing a submarine transmission cable is a costly and challenging activity, and so are the technical interventions for its repair in case of faults. These operations can be even more difficult, depending on the type of cable, the complexity of the cable configuration, and the depth and properties of the seafloor. Therefore, a successful submarine cable installation requires a carefully selected and integrated assembly of reliable vessels, crews, and auxiliary equipment, such as acoustic instruments.

In case of malfunction of the acoustic release system, cable-laying operations can become dangerous and time-consuming: loads must be retrieved without knowing whether they are properly attached or not. "The risk of mishandling and random releases at any time

can devastate a cabling campaign, resulting in a big loss of time and money" warns Augustin Vandenhove, Offshore Solution Manager at LDA for ASN. "This is why we decided to switch to new Oceano HD15 Cable Lay acoustic releases, which we are fully satisfied with. They are extremely reliable and safe as well as easy to use. They work now with 100 % efficiency, successfully releasing on the first try every time, which is outstanding."

Specially designed and customized for use in cable laying and maintenance operations, but also for offshore marine construction operations, Exail's Oceano HD15 Cable Lay acoustic releases can deploy payloads up to 10 t. Highly robust and accurate, this heavy-duty unit uses the well-proved secure, low-frequency acoustic command code structure for reliable deep-sea operations, at depths up to 6,000 m. It comprises the well-proven and reliable AR861 series acoustic actuator fitted with a compact stainless-steel frame to pass over rollers and davit under tension, which not only ensures efficient, reliable, and safe releases, but also allows to overcome the challenges posed by concretion or biological deposits.

➤ **ASN and Exail both committed to the development of innovative technologies in marine and underwater fields**

The retrofit campaign of these acoustic releases reinforces the relationship of trust that has been established between ASN and Exail over the past years. In 2021, ASN and Exail had already joined their forces within the AMSSI (Agora for Maritime & Submarine Sustainable Innovations), to develop innovative technologies adapted and respectful of the underwater environment.

This partnership, along with their trusted business relationship, holds the promise of leading to many more successful marine and subsea projects. ■



The risk of mishandling and random releases at any time can devastate a cabling campaign, resulting in a big loss of time and money. This is why we decided to switch to new Oceano HD15 Cable Lay acoustic releases which [...] are extremely reliable and safe as well as easy to use. They work now with 100% efficiency, successfully releasing on the first try every time, which is outstanding.

> AUGUSTIN VANDENHOVE, OFFSHORE SOLUTION MANAGER AT LDA FOR ASN





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> The Ulyx AUV being deployed from research vessel *Pourquoi Pas?* during sea trials

AFTER SUCCESSFUL SEA TRIALS DURING TECHNICAL CAMPAIGNS IN THE MEDITERRANEAN SEA, ULYX, THE FRENCH NATIONAL INSTITUTE FOR OCEAN SCIENCE (IFREMER) NEW DEEP-SEA EXPLORATION AUV (AUTONOMOUS UNDERWATER VEHICLE), WAS RECENTLY DEPLOYED ON BOARD OCEANOGRAPHIC VESSEL *POURQUOI PAS ?* DURING A 50-DAY SCIENTIFIC CAMPAIGN ON THE MID-ATLANTIC RIDGE.

IFREMER DEEP-SEA EXPLORATION ULYX AUV DIVES TO

4,500 M

> Although not directly involved in the actual campaign – Ifremer’s aim being to combine sea trials with real scientific missions to optimize their use of vessels – Ulyx was deployed by the teams to evaluate the AUV’s behavior in real operational conditions, over a long period of time, and within complex environments.

During the campaign, the Ulyx AUV made a total of 15 dives, collecting additional data and reaching new depths of 4,500 m off the Guadeloupe island. While this is Ulyx deepest dive to date, the 6,000 m rated-AUV will continue to be tested. According to Ifremer, the fact that it has not yet dived to 6,000 m is due more to operational than technical considerations.

Developed by Exail within the framework of the CORAL (Constructive Offshore Robotics Alliance) program and according to Ifremer’s specific needs and requirements, Ulyx is an AUV designed to dive autonomously down to 6,000 m and with an autonomy of 48 hours. Associating multiple payloads with navigation capabilities for either long range survey or close-to-bottom hovering, Ulyx can conduct, in a single dive configuration, wide area acoustic mapping as well as target-based local inspection with optic imaging, photogrammetry and in-situ scientific measurements.

To conduct those missions, Ulyx is equipped with advanced payloads, including Exail’s very own underwater imaging solutions, dedicated to mapping the ocean depths and studying sediment layers with precision. The AUV precise navigation and positioning in great depths are also performed by inertial navigation systems and subsea acoustic positioning systems from Exail.

Following the Mid-Atlantic Ridge campaign, Ifremer will continue to test the AUV in various operational conditions in the coming months and, after reaching 6,000 m, Ulyx should be officially commissioned in the second half of 2023. ■

> During the campaign, the Ulyx AUV made a total of 15 dives

