explore

KEEPING CREWS SAFE
With the Inspector 125 USV

ASTUTE-CLASS SUBMARINES
Tackling underwater navigation challenges

UMIX SERIES IMU
Unlocking high-precision navigation

MARITIME DOMAIN AWARENESS
Powered by the DriX USV

exail

REGIS BLOMME
REGIONAL SALES DIRECTOR

In the face of evolving challenges, in Northern Europe and worldwide, the importance of robust defense capabilities backed by cutting-edge technologies is more apparent than ever. As we gather at DSEI 2023, we cannot overlook the current geopolitical context, which reminds us of the defense industry's critical role in preserving peace and stability. At Exail, we firmly believe that the development of disruptive technologies is vital, and as a global technology leader, we are committed to providing them.

Exail's solutions have played a leading role in powering major naval advancements and expanding land defense capabilities for numerous armed forces worldwide. Our dedication to innovation and long-term collaboration has earned us the trust and respect of defense forces who rely on our technologies to enhance their operational effectiveness.

In the naval sector, we highlight, in this magazine, the Royal Navy's choice to equip its Astute-class submarines with Exail's high-performance Marins Inertial Navigation Systems (INS). Likewise, the French Navy has been relying on our WECDIS navigation software for two decades to ensure safe navigation and conduct demanding naval missions. Another iconic example of our disruptive technologies is the next-generation stand-off mine countermeasures integrated system, chosen by the Belgian and Royal Netherlands Navies for their rMCM program. In the following pages, you will learn how our autonomous drones empower them with the capacity to detect, classify, identify, and neutralize mines and other potential hazards while keeping crews out of harm's way.

As for the field of Maritime Domain Awareness (MDA), the deployment of our DriX USV (Unmanned Surface Vehicle), and A9 AUV (Autonomous Underwater Vehicle) by the US and French Navies for major military exercises testifies to our advanced capabilities in safeguarding critical waters.

In the field of land defense, as we acknowledge the challenges arising from an overreliance on GNSS signals, we are confident that our technologies, developed through years of experience in the naval domain, are best suited to address these challenges. Exail offers land forces the means to operate safely and with high precision in GNSS-denied environments, knowing where they are at all times, and also prepares them for the most challenging operations with our driving simulation equipment. In the upcoming pages, you will learn about our range of scalable and highly reliable Advans INS and gyrostabilized platforms, as well as our latest offering in driving simulators. Furthermore, you will discover how our smart land and air robotics revolutionize reconnaissance and inspection tasks, providing land forces with a tactical advantage while minimizing risks to personnel.

As you explore the pages of this magazine, you will witness the tangible impact of Exail's technologies on the field. From enhancing naval capabilities to advancing land defense operations, each article showcases our commitment to excellence and our partners' unwavering trust in our capabilities.

We hope these next pages will trigger your interest and we eagerly look forward to meeting you at DSEI to discuss how we can collaborate on your future projects! ∎

> OUR DEDICATION TO INNOVATION AND LONG-TERM COLLABORATION HAS EARNED US THE TRUST AND RESPECT OF DEFENSE FORCES WHO RELY ON OUR TECHNOLOGIES TO ENHANCE THEIR OPERATIONAL EFFECTIVENESS.

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PRODUCT
news

SAFEGUARDING LAND NAVIGATION

FROM GNSS DISRUPTIONS

IN THE CHALLENGING LANDSCAPE OF MODERN LAND DEFENSE ENVIRONMENTS, EXAIL'S ADVANS SERIES INERTIAL NAVIGATION SYSTEMS (INS) PRESENT A COMPELLING SOLUTION TO ENHANCE LAND FORCES' NAVIGATION. BY ELIMINATING THE RISKS ASSOCIATED WITH GNSS DISRUPTIONS, THESE STATE-OF-THE-ART INS EMPOWER MILITARY UNITS TO NAVIGATE WITH CONFIDENCE, MAINTAIN OPERATIONAL TEMPO, AND SAFEGUARD THEIR TROOPS' SAFETY.

Modern conflicts, modern threats

Modern conflicts are characterized by a dangerous duality. On one hand, contemporary equipment is becoming increasingly technologically advanced, with a growing emphasis on network-based inter-connectivity. This is particularly evident in blue force tracking and collaborative combat, where transmitting one's own location and target designation via the combat network is crucial for maintaining operational tempo and preventing fire incidents against its own troops.

On the other hand, electronic warfare is playing an increasingly significant role on the battlefield, leading to complete disruptions of the GNSS signal, which includes systems like GPS and Galileo, over large areas. This disruption, which has become commonplace in conflicts between peer or near-peer nations, comes mainly into two forms: GNSS jamming, which renders the signal unavailable, and GNSS spoofing, which has the potential to mislead unsuspecting GNSS-based navigation devices and guide them to undesirable locations.

Relying solely on the GNSS signal for real-time positioning is therefore hazardous. Entire military units are at risk of losing track of their position, forcing them to rely on outdated navigation methods. These methods not only require additional cognitive effort from operators who are already under critical workload, but they are also less accurate and prone to human errors. As a result, the operational tempo and the effectiveness against the enemy are degraded, while the vulnerability of friend troops reaches unacceptable levels.

Exail's Advans Series range of inertial navigation systems (INS) addresses the risks posed by jamming and spoofing without resorting to such degraded methods. The Advans Series INS does not rely on any external signals to generate navigational data, making it immune to jamming and spoofing. This guarantees that the vehicle and its crew remain on a safe path and are aware of their location at all times.

Using an INS to preserve critical navigation

The Advans Series consists of three different INS models, each offering varying levels of performance while ensuring accurate positioning in all environments, with or without GNSS.

Advans Ursa represents a departure from traditional tactical navigation concepts by providing complete independence from GNSS. Unlike devices reliant on GNSS, Advans Ursa can autonomously align itself and maintain navigation without any time limitations. Its limited drift can be easily corrected by repositioning the INS using a reference point on the map. With its cost-effectiveness, Advans Ursa is an ideal solution for equipping fleets of several hundred vehicles. Advans Lyra follows with even higher performance in inertial navigation, while Advans Vega represents the top-grade INS in the range. Advans Vega offers navigation performance compatible with high-value capabilities such as Main Battle Tanks (MBTs) or artillery launchers with first-round strike capabilities.

In addition to their navigation capabilities, the Advans Series excels in accurate pointing, catering to a range of requirements from short-range targeting in collaborative combat to long-range capabilities such as howitzers, air defense systems, and counter-battery radars. The Advans Series is highly reliable, designed to withstand the harshest environments. They can operate within a wide temperature range, ensuring functionality regardless of the operation's location. These INS units can endure high stresses, including strong shocks and intense vibrations, commonly experienced by land platforms during combat. Furthermore, all critical subcomponents, from the fiber-optic gyroscopes to the accelerometers, are manufactured by Exail in France. Consequently, the Advans Series does not contain ITAR/EAR-restricted components and is solely subject to French export control. ∎

THE ADVANS SERIES INS DOES NOT RELY ON ANY EXTERNAL SIGNALS TO GENERATE NAVIGATIONAL DATA, MAKING IT IMMUNE TO JAMMING AND SPOOFING.

Undisturbed navigation
IN GNSS-DENIED ENVIRONMENTS
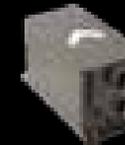
	Advans Ursa	Advans Lyra	Advans Vega
Horizontal position (without GNSS)	0.4% DT	0.2% DT	0.1% DT
Heading	4 mils	1 mil	0.5 mil
Roll and pitch	1 mil	0.5 mil	0.2 mil

Enemies

Electronic warfare unit denying GNSS signal

Village

Allies

EW

Inertial navigation in GNSS denied environment

Hybrid GNSS/Inertial navigation
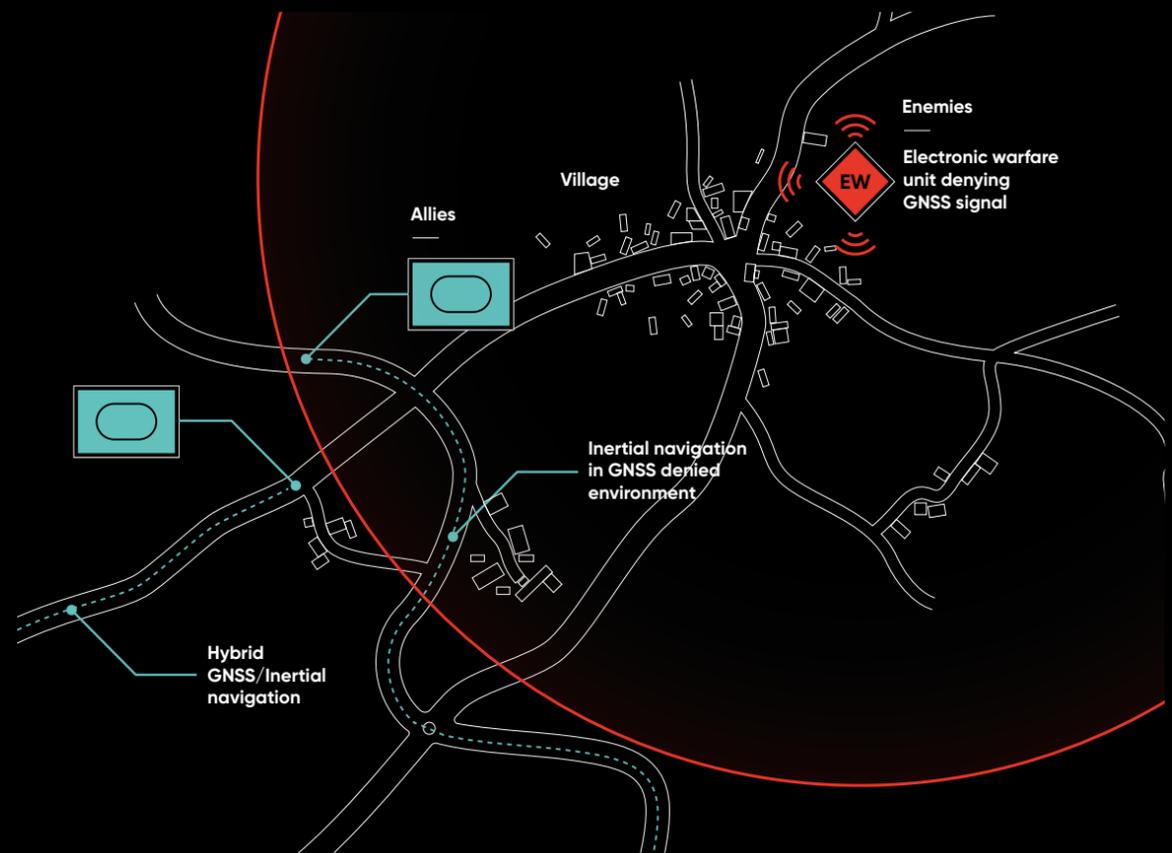
> Advans Series INS can't be jammed or spoofed, which guarantees the vehicle and its crew remain on a safe path and aware of their location at all times

INSPECTOR 125:
KEEPING CREWS
OUT OF THE DANGER
ZONE

BELGIUM AND THE
NETHERLANDS SELECTED
EXAIL AND NAVAL GROUP
FOR THEIR NEXT GENERATION
MINE COUNTERMEASURES
PROGRAM. THIS INNOVATIVE
PROJECT COMBINES SEVERAL
CREWED MOTHER SHIPS WITH
AUTONOMOUS VEHICLES AND
ADVANCED SENSORS. ONE THE
CORNERSTONE OF THIS UNIQUE
SYSTEM IS EXAIL'S USV CALLED
INSPECTOR 125.

D etecting and neutralizing maritime mines without sending a ship into the minefield has long been considered science fiction. However, thanks to Exail's Inspector 125 Unmanned Surface Vehicle (USV) and its payloads, this concept has now become a reality.

The first Inspector 125 which is currently undergoing a comprehensive test campaign in the South of France incorporates the best of Exail's technology in mission systems, sensors, and naval architecture. Its delicate mission consists in deploying autonomous or teleoperated vehicles to detect, classify, identify, and neutralize mines, while acting as a communication relay to the land or the mother ship stationed safely outside the danger zone.

The Inspector 125 is one of Exail's most ambitious projects in terms of multi-mission surface drones. This 12.3 m long for 4.2 m wide boat has a full composite hull. Like all mine-hunting vessels, it is designed to have the lowest acoustic and magnetic signatures while being able to withstand underwater explosions.

To ensure the success of its missions, the Inspector 125 is packed with advanced technology sensors and systems. Its standard equipment includes a powerful propulsion system, a radar, an Automatic Identification System (AIS), infrared and conventional cameras, and an Exail's FLS-5 forward-looking sonar.

The accuracy of navigation and positioning has been considered a high priority from the beginning of the program. The USV is equipped with a GPS unit, an Exail's Phins inertial navigation system, and a Doppler Velocity Log. Secure radio and satellite communication systems enable the unmanned vehicle to maintain constant contact with deployed units on the surface while an Exail's Gaps USBL susbea positioning system ensures the positioning of the autonomous underwater vehicles (AUV) operating in the area, and their communication with the USV.

❯ The Inspector 125 USV are the cornerstone of the rMCM program. They will be delivered to the Royal Dutch Navy and Belgium's "Composante Marine" from Exail's facility in Ostend

Inspector 125 Unmanned Surface Vehicle

A VERSATILE USV FOR NEXT GENERATION MCM MISSIONS

> **Two versions for an unrivaled efficiency**

The Inspector 125 comes in two versions: USV125, propelled by water jets, is specialized in deploying unmanned devices such as the A18-M, T18-M, Seascan, and K-Ster C, while the USV125-S, equipped with propellers, specializes in mine sweeping. This next generation USV is designed to operate with different levels of autonomy and supervision, ranging from full teleoperation to complete autonomy during communication blackout or when mission requirements demand it.

Engineers at Exail emphasized versatility during the surface drone's design, allowing users to precisely configure it according to their operational needs at any given time.

During a typical mission, the Inspector 125, already configured, equipped, and programmed, is deployed from its mother ship that remains at a safe distance. Once it reaches its designated, potentially mined area, it deploys an AUV called A18-M. This AUV equipped with Exail's UMISAS synthetic aperture sonar moves around its patrol area for hours searching for mines.

After having launched the A18-M, the Inspector 125 continues its mission using its onboard Exail's FLS-5 sonar, looking for mines and obstacles in the water column down to 300 m deep.

> **Communication relay**

In the same time, another Inspector 125, equipped with the T18-M towed sonar, can carry out another mine detection mission in a different area. The T18-M is equipped with the same UMISAS sonar as the A18-M but its data are transmitted permanently in real time to the Inspector 125 through a cable. The data are then seamlessly sent to the mother ship via the radiocommunication system of the USV.

During its mission, the Inspector 125 can also act as a communication relay between all underwater vehicles on-site and the mother ship. Once the mines have been accurately detected and located by the towed T18-M and various AUVs deployed in the area, it's time for precise identification and neutralization. The Inspector 125 is then reconfigured to carry and deploy remotely operated vehicles (ROVs) called Seascan, which use sonars for mine location and high-resolution cameras for identification. Once this process is complete, the Seascan ROV is automatically retrieved by the USV. It is then time to launch the last phase of the mission: neutralizing the threats.

For mine neutralization, two methods are used from the USV. The first involves using the K-Ster C expendable mine disposal ROV, which approaches the identified mine closely and triggers an explosive shaped charge. Another method is equipping the Inspector 125 with a towed mine sweeping device. This system contains magnetic and acoustic generators that trigger the mines' explosion by activating their firing mechanism, like what a ship would do.

A first prototype of Inspector 125 has been undergoing tests at Exail in the South of France since 2021, and the other 16 USVs will be delivered from Exail's workshops in Ostend (Belgium) to Belgium "Composante Marine" (Maritime Component) and the Royal Netherland's Navy. Meanwhile, Naval Group and Kership are preparing 12 mother ships of the M940 Oostend-class, with the first in series nearing completion. ∎

Characteristics	Inspector 125
Hull	Glass Reinforced Plastic (GRP)
Length	LOA: 12.33 m Hull: 11.98 m
Beam	BOA: 4.20 m Hull: 3.85 m
Max height	3.70 m (from keel to folded mast) 5.25 m (mast deployed)
Weight	Light: 13 355 kg Full load: 19 455 kg
Propulsion	Engines: Cummins QCB 8.3 Engines power: 2 x 442 kW Waterjets: MJP X310

Operational performance	
Endurance	up to 40 hours
Max speed	25 kts through water

DETECTING THE BEST HIDDEN THREATS

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THE A9-M IS A COMPACT AUV (AUTONOMOUS UNDERWATER VEHICLE) DESIGNED BY EXAIL IN THE 2010s FOR THE DETECTION OF UNDERWATER THREATS. ITS OUTSTANDING PERFORMANCE AND EASE OF OPERATION HAVE BEEN DEMONSTRATED BY ITS END USERS DURING NUMEROUS INTERNATIONAL EXERCISES.

When designing the A9-M in the 2010s, Exail relied on the requests of mine countermeasures units who needed a high-performance system optimized to operate between 0 and 100 m or in inaccessible areas for specialized ships. Moreover, the AUV had to be silent, easy to transport, and simple to deploy from a small vessel such as a Rigid Inflatable Boat.

Specifications well understood by Exail engineers in La Garde (France), who have developed a 70 kg vehicle measuring 2 m in length and 23 cm in diameter, as well as the entire system for mission preparation and data processing. The system is highly portable by air, sea, or land, as it fits into two approximately 200 kg cases. The drone is compatible with Exail's UMISOFT DM mission software known for its user-friendly interface.

During a typical mission, the A9-M is deployed from a lightweight boat. Prior to deployment, the mission parameters, which can last for about ten hours, are loaded into its memory. As soon as it is immersed in water, the AUV dives and starts using its sensors in the potential mined area. The task is clear, the A9-M must detect, classify, identify, and precisely locate all the threats in the area. To accomplish this, it is equipped with a highly efficient multifunction side-scan sonar and a high-definition camera.

To define mines position with precision, the A9-M is equipped with an Exail's Phins Compact C3 advanced inertial navigation system. This navigation system is complemented by a Doppler Velocity Log, a GPS unit and an obstacle avoidance system.

As an optional feature, the drone can be equipped with an Exail-designed Ultra-Short Base Line (USBL) subsea positioning system. At the end of its mission, while operating at speeds between 3 and 5 knots, the drone slows down and ascends to the surface at a predetermined location for retrieval by specialized teams. Subsequently, its data are downloaded and analyzed using Exail's UMISOFT software. After undergoing processing operations, the system provides precise and georeferenced images of all the mines present in the A9-M's patrol area. This valuable data can be immediately used by MCM unit to carry out their neutralization mission. Another advantage of the autonomous drone is its quick reconditioning. It takes only 2 hours and 30 minutes to have the A9-M ready for its next mission.

The first six units were commissioned in 2013 by the French Navy. Since then, they have been regularly and successfully deployed in international exercises. The most recent exercises, IMX 23 and Artemis Trident, took place between February and April 2023.

The A9-M put to the test in Bahrain
In these exercises, which took place from Manama, Bahrain, and on a British ship, teams from multiple countries were tasked with implementing a wide range of means to accurately detect, classify, and locate dummy mines. They were then required to exchange their findings and enhance their interoperability by conducting dives in the mined areas. The A9-M consistently demonstrated its ease of deployment, even in the harshest environmental conditions, and its ability to provide high-quality information to its end users. For Exail, participating in these international operational exercises is of utmost importance to ensure the desired customer support, which is key to mission success, and to gather valuable feedback for maintaining the excellence of its products. ∎

A9-M mine detection AUV

LIGHT AND SILENT AUV PROVIDING OUTSTANDING ACCURACY

	A9-M
Operational performance	
Endurance	up to 20 hours (with 2 energy sections)
Max speed	over 5 knots
Nominal speed	3 knots
Operational depth	down to 300 m
Characteristics	
Body diameter	9 inches (23 cm)
Length	200 cm
Weight	70 kg
Energy section	2.1 kWh
Navigation	INS (Inertial Navigation System), DVL, depth sensor and GPS
Communication	Radio (UHF), WiFi, Ethernet, Acoustic, Iridium on request
Standard	STANAG 1364 compliant
Payload	Side Scan Sonar, Video, SVP

UNLOCKING HIGH PRECISION NAVIGATION

UMIX IS AN INNOVATIVE INERTIAL MEASUREMENT UNIT (IMU) RECENTLY DEVELOPED BY EXAIL TO REVOLUTIONIZE THE FIELD OF NAVIGATION AND PROVIDE UNPARALLELED ACCURACY AND RELIABILITY. ACCLAIMED BY NUMEROUS CLIENTS FACING A STRONG NEED FOR PRECISION IN HIGH-DEMANDING APPLICATIONS, THE FIRST UNITS OF UMIX HAVE BEEN SUCCESSFULLY DELIVERED TO SEVERAL EUROPEAN AND AMERICAN CUSTOMERS.

The development of UmiX was driven by the growing demand for high-precision navigation and stabilization across various industries. Designed to cater to a wide range of applications, including subsea operations, airborne missions, and real-time stabilization and navigation, UmiX has become an indispensable tool for sectors such as defense, maritime, aerospace, and autonomous vehicles. With its compact form factor, UmiX can indeed be seamlessly integrated into diverse manned and unmanned platforms in all industries requiring precise positioning and motion data to navigate complex environments and overcome challenging conditions effectively. "This IMU is half the size, half the power consumption, and twice the performance of other available IMUs" said Sébastien Ferrand, UmiX Series Product Manager at Exail. "Combining north-seeking performance level with a highly compact form factor, the new fiber-optic gyroscope we have developed pushes even further the technology's possibilities".

After successful delivery to first customers in Europe and the United States, across both civil and military sectors, UmiX is now ready to offer its multitude of benefits to its early adopters. One of its key strengths lies in its unparalleled precision, offering users highly accurate measurements that empower them to make informed decisions,

leading to improved operational efficiency and outcomes. Furthermore, UmiX's real-time stabilization capabilities allow users to navigate complex environments with exceptional stability and control. Minimizing undesired movements and ensuring optimal performance, even in challenging scenarios, this feature makes UmiX particularly suitable for high-end stabilization and pointing within airborne and land sensor payloads. Additionally, customers will benefit from UmiX's capabilities for georeferencing, facilitating precise positioning and spatial awareness. This proves particularly valuable in applications such as mapping, surveying, and geospatial analysis, where the collection and analysis of accurate data are crucial.

"Exail's successful delivery of the first UmiX IMUs for demanding subsea, airborne, navigation, and stabilization applications in both civilian and defense sectors marks a significant milestone in advancing precision navigation," said David Cunningham, Global Director of Partnerships & OEM at Exail. "We are proud and grateful to our European and American customers for choosing our UmiX technology to achieve exceptional results, enabling them to excel in their respective fields. By providing unparalleled accuracy, versatility, and reliability, Exail reaffirms its commitment to pushing the boundaries of sensor technology." ∎

	UmiX 40		UmiX 90	
Fiber-optic gyroscopes				
Angular random walk	0.01 °/√h		0.005 °/√h	
Input range (dual use / military grade)	490 °/s	2,000 °/s	490 °/s	2,000 °/s
Bandwidth	5 kHz		5 kHz	
Day to day bias repeatability	0.01 °/h, 1σ		0.005 °/h, 1σ	
Bias thermal residual	0.05 °/h, 1σ		0.03 °/h, 1σ	
Scale factor thermal residual	40 ppm, 1σ		40 ppm, 1σ	
ACC performance				
Input range (dual use / military grade)	30 g	± 100 g	30 g	± 100 g
Bias instability @ 300 s	5 µg, 1σ		5 µg, 1σ	
Day to day bias repeatability	150 µg, 1σ		100 µg, 1σ	
Bias thermal residual	300 µg, 1σ		100 µg, 1σ	
Scale factor thermal residual	40 ppm, 1σ		40 ppm, 1σ	
Mechanical & electrical interface				
Size	Ø88.9 x H 75 mm		141.5 x 114 x H 120.5 mm	
Weight	< 0,770 kg		< 2 kg	
Power supply	+5 Vdc		+5 Vdc	
Consumption	4/7 W room/full T° range		5/9 W room/full T° range	
Connector	micro D 21 pin - socket		SAMTEC LSHM 20 pin	
IO	RS422		RS422	
Datarate	100 to 10,000 Hz		100 to 10,000 Hz	

MARITIME
DOMAIN AWARENESS

AS A WORLD LEADING DEVELOPER OF MARITIME SENSORS, SYSTEMS AND AUTONOMOUS PLATFORMS, EXAIL OFFERS A COMPLETE ECOSYSTEM OF STATE-OF-THE-ART DATA ACQUISITION SOLUTIONS WHICH, BY MAXIMIZING AWARENESS OF MARITIME THREATS, ARE CRITICAL ENABLERS FOR NATIONAL AND INTERNATIONAL MARITIME SECURITY.

I t is an undeniable fact. 70.8 % of our planet is covered by the ocean. It is through the ocean that most consumer goods and raw materials are transported. However, oceans are also the scene of numerous illegal trafficking and potentially dangerous activities. Today, many countries wish to have a real-time global picture of what is happening above and beneath the surface of the sea. This is precisely what Exail offers its clients through a comprehensive range of products and systems perfectly suited for ocean monitoring.

Turnkey solutions and products for Maritime Domain Awareness (MDA)

Exail leverages its advanced expertise in autonomous, surface, and subsea platforms, as well as maritime sensors such as subsea acoustic positioning systems and solutions for subsea imagery, to offer a complete ecosystem of data acquisition solutions contributing to an effective understanding of the maritime domain.

"Exail is one of the few industrial players that masters the entire value chain of naval systems, from sensor design to vehicle development, including software and artificial intelligence. This system-oriented approach allows us to offer our clients solutions that enable them to fulfill the most demanding missions" says Guillaume Eudeline, Head of Naval Autonomy Systems at Exail.

The DriX Unmanned Surface Vehicle: a smart mission proven USV for MDA

DriX is a versatile, fast, persistent, and efficient USV perfectly suited for ISR (Intelligence Surveillance and Reconnaissance) missions. Able to conduct both remote controlled and supervised autonomous operations, DriX offers outstanding seakeeping capabilities. This USV can host a wide range of payloads including radars, cameras, LiDAR, and sonars, magnetometers, in addition to its complete set of communications devices. The DriX is fitted with a state-of-the-art collision avoidance system for long endurance autonomous patrol missions.

With its outstanding reliability and stability, the DriX is an excellent platform to gather high quality data anytime, anywhere. This new generation USV has been successfully tested by the US Navy during MDA operational exercises in the Gulf Region.
Its main qualities are:
• An outstanding ability to be deployed from land or a vessel (deployment system provided by Exail)
• Amazing seakeeping, endurance, and speed
• Highly accurate surface and subsea data acquisition
• Multi autonomous underwater vehicle (AUV) control and positioning from the surface
• Optimized for both offshore and coastal missions
• Communications gateway between subsea drones and remote operations center
• Capability to use a wide range of payloads thanks to its open architecture
• Advanced obstacle avoidance system
• Able to conduct remotely controlled or supervised autonomous missions.

FlipiX: a high performance ROTV

Thanks to its modern and open architecture, Exail's DriX can integrate the most advanced payloads, such as the brand new FlipiX, to carry out its missions.

FlipiX is a remotely operated towed vehicle (ROTV) capable of autonomously conducting surveillance missions down to 100 m depth. Deployed from a USV or a conventional vessel, FlipiX can carry out multiple missions simultaneously. For example, it can perform bathymetric and geophysical measurements while searching for UXOs (UneXploded Ordnance) on the seabed. It can be equipped with state-of-the-art side-scan sonars and magnetometers.

FlipiX stands out with precise control of its movements to provide unparalleled data quality, as well as the capability to work in tandem with a USV as well as with a traditional crewed vessel.
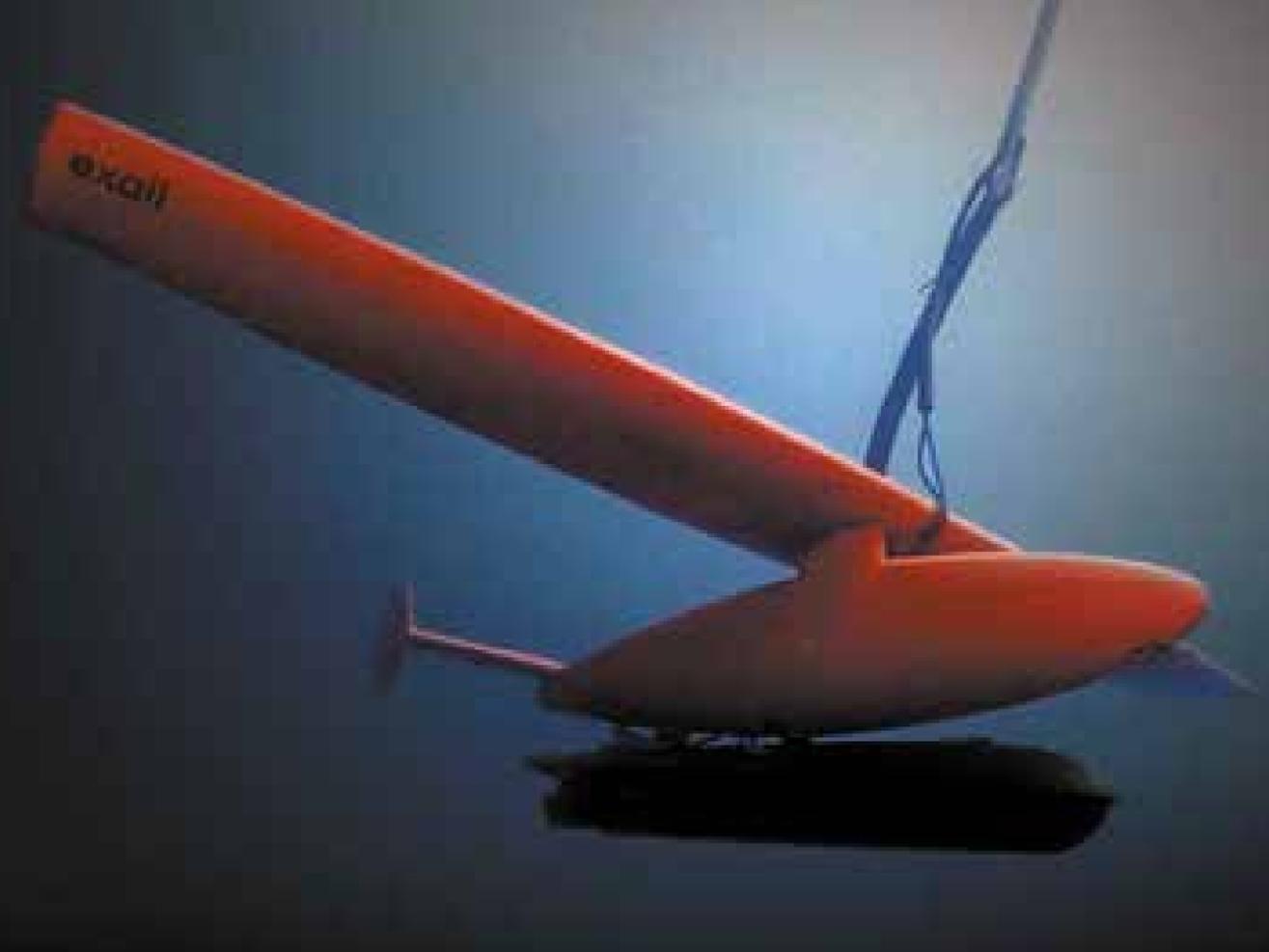
> FlipiX new generation ROTV can be towed by a USV to conduct very accurate geophysics and UXO operations

© Exail - Baloo

❯ A18-D: an Autonomous Underwater Vehicle able to operate at 3,000 m depth

Autonomous underwater drones like Exail's A18-D are essential for ocean surveillance, packed with cutting-edge technology. The A18-D is a next generation drone capable of operating down to 3,000 m depth during missions that can last up to 24 hours. It can be equipped with a wide variety of sensors, including high-performance sonars tailored to the end users specifications. The A18-D has been designed to be easy to transport by air and even easier to operate. Exail offers its clients a LARS (Launch And Recovery System) for a safe and easy launch and recovery of the drone, even in adverse weather conditions. Once its mission is completed, the drone's data are processed quickly and accurately using Exail's UMISOFT software.

The main qualities of the A18-D are:
- Ease of deployment even in adverse weather conditions
- Easy transport in standard containers
- High endurance to cover a large search area
- User-friendly mission system
- A wide selection of advanced sensors

"One of Exail's strengths is its ability to master all the technological components for the MDA mission. As a true system integrator, Exail is an expert in the design and integration of various types of sensors on a wide range of underwater and surface vehicles." adds Guillaume Eudeline.

❯ SeapiX-FLS sonar: long range and precision for threat classification

Among the new generation sensor range offered by Exail today is the Seapix-FLS sonar. The Seapix-FLS is a 3D multibeam sonar optimized for mine detection and obstacle avoidance, it is effective from the surface to the seabed. This sensor, able to be integrated on a wide variety of platforms, incorporates a high performance IMU (Inertial Measurement Unit), it provides its end users with a real-time clear picture of its environment. Its 3D coverage of the water column and bathymetry function enables it to detect and classify surrounding objects with unparalleled precision. Like all Exail's products, special attention has been given to the human-machine interface in order to facilitate a smooth interaction with the sonar and easy analysis of its data.

❯ Sams Series: wide area coverage with no compromise on performance

For a comprehensive coverage and precise mapping of vast areas, Exail has developed the Synthetic Aperture Mapping Sonar (Sams). The Sams combines powerful processing capabilities with navigation and positioning information to provide real-time, high-definition, georeferenced maps of the seafloor. This sonar can be mounted on a wide variety of platforms such as AUVs, ROVs, and ROTVs. It can also be towed behind a vessel down to 6,000 m. The Sams sonar comes with a dedicated software for real-time data analysis.

We often say that we know more about the surface of the moon than the Earth's oceanic expanses. This adage is becoming less true every day, thanks to the sensors and systems designed by Exail. ∎

❯ The A18-D is a high performance AUV designed to operate at 3,000 m for 24 hours, exploring the oceans with Exail's UMISAS synthetic aperture sonar
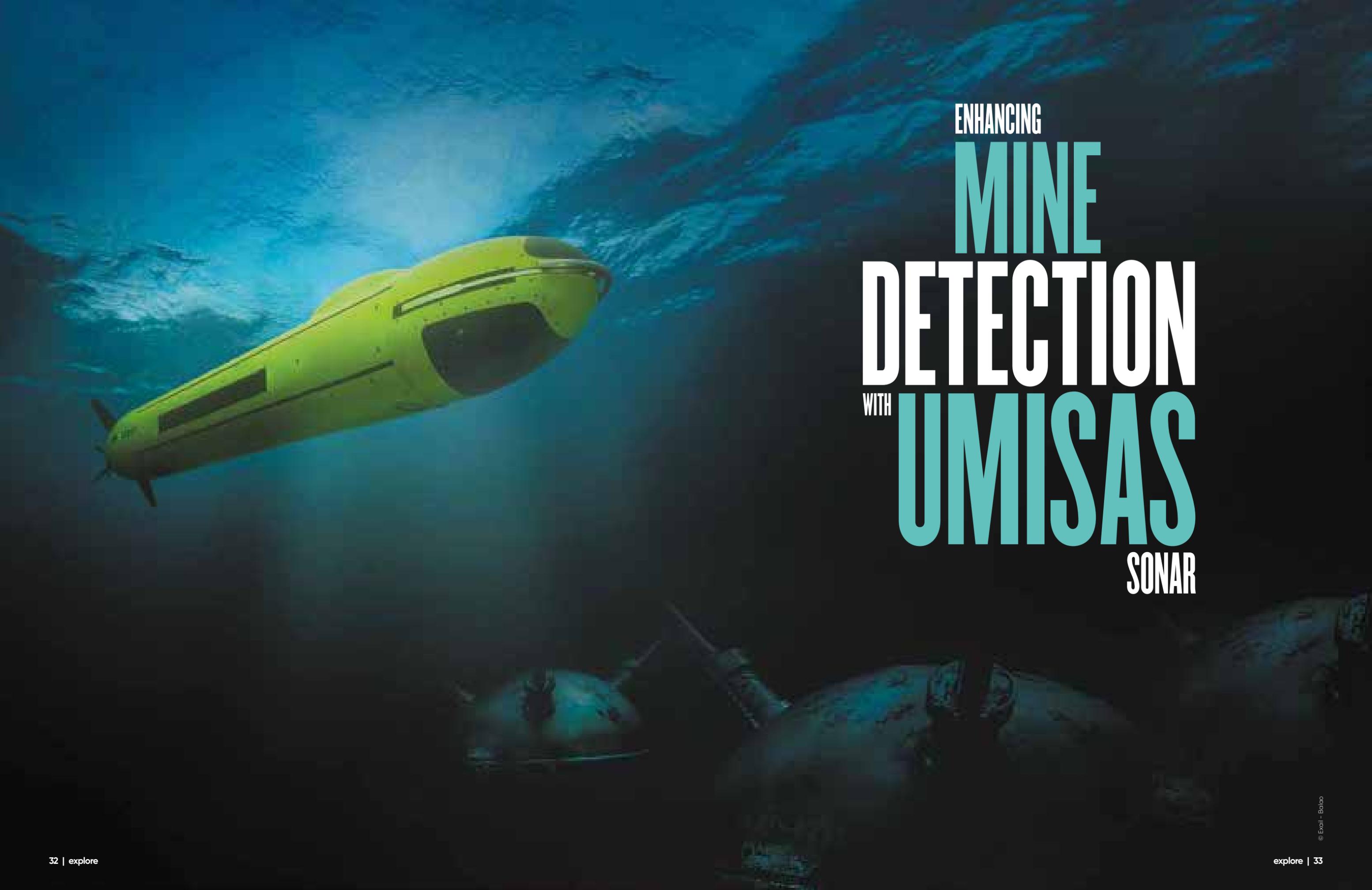
MINE DETECTION

WITH UMISAS

SONAR

© Exail

> The UMISAS sonar can produce high resolution pictures of the mines on the seabed even in shallow and warm waters. The object pictured here is a dummy mine used as a reference point on the seabed for sonars testing

WHILE MOST OFF-THE-SHELF SONARS OFFER GOOD PERFORMANCE IN RANGE OR RESOLUTION, EXAIL'S UMISAS SONAR FITTED ON THE A18-M AUV AND T18-M TOWED VEHICLE OFFERS BOTH SIMULTANEOUSLY, EVEN IN THE MOST DEMANDING CONDITIONS SUCH AS SHALLOW AND WARM WATERS.

After several months of testing, the next generation UMISAS Synthetic Aperture Sonar (SAS) is about to start its acceptance tests. This sensor has been designed by Exail to provide advanced mine detection capabilities to its A18-M and T18-M underwater vehicles, powering highly efficient and accurate stand-off Mine Countermeasures (MCM) operations. It is at the heart of the Belgian-Dutch replacement Mine Countermeasures (rMCM) program. The first systems are due to enter service within the Belgian-Netherland and the Latvian Mine Countermeasures forces.

Exail started to work on this next generation sonar back in 2014 to meet naval forces ever increasing MCM technological requirements. At this time, the company's engineers were seeking an advanced sensor able to detect any type of mine in the most demanding conditions such as shallow waters or warm waters. As no satisfying off-the-shelf solution was available, Exail chose to innovate!

After several years of hard work, UMISAS is now ready to demonstrate its performance. For the final acceptance tests, UMISAS' first prototype has been integrated on one of Exail's A18-M. For several months, the engineers tested all key parameters of the sensor and the quality of the pictures obtained.

Typically, the design resolution is 1.5 cm x 3 cm in range x azimuth, including the necessary shading needed to reduce image sidelobe levels. The area coverage rate (ACR) for the A18-M AUV is 0.5 nm²/hr, including nadir gap coverage by overlapping tracks. Typical operating parameters are 3-4 knot ground speed for a range between 180 and 220 m. Special attention has been paid to maintain ACR in the most demanding environmental conditions, such as shallow waters where multipath degrades synthetic aperture sonars (SAS) performance and warm waters where the sound absorption can become very high, or when facing strong currents which limits ground speed. This makes UMISAS a very robust and reliable sonar on which navies can rely for their most demanding MCM operations.

> **Two frequency bands for the best performance in its class**

To address these challenging conditions, UMISAS exploits a dual row sonar array. Two frequency bands are used simultaneously, the VHF centered at 330 kHz and the HF centered at 250 kHz, with 60 kHz bandwidth around each center frequency. The use of the additional HF narrow elevation beam steered at long range, both on transmission and reception, allows to effectively reject the multipath seabed echoes which arrive at the same time as the direct path echoes from long range, but arrive or depart at steeper elevation angles. The narrow HF vertical beam also allows a very high source level of 220 dB, thanks to the gain in the directivity index. This is to be compared to the 211 dB source level of other synthetic aperture sonar systems which operate only in the VHF band. The combination of the higher source level together with the use of the lower UMISAS frequency gives a unique advantage to Exail's sonar to keep the same area coverage rate in warm and cold waters, which is not the case for other existing SAS sonars.

In addition, UMISAS was optimized for use on 18" mid-size AUVs such as the A18-M. This led to a relatively large array of length x height (42"x 8") while also maintaining power, weight and cost within acceptable limits. Indeed, SAS performance scales with array size: the SAS ACR, a key operational metric, is proportional to the length of the receiver array. Tall arrays also allow advanced vertical beam management techniques for a better signal to noise ratio as well as long interferometric baselines. This gives UMISAS a great potential for hydrography, allowing co-registered imaging and bathymetry.

UMISAS' outstanding performance have demonstrated Exail's ability to design advanced sensors for the most demanding MCM missions in the most challenging operational environments including shallow and warm waters. ∎
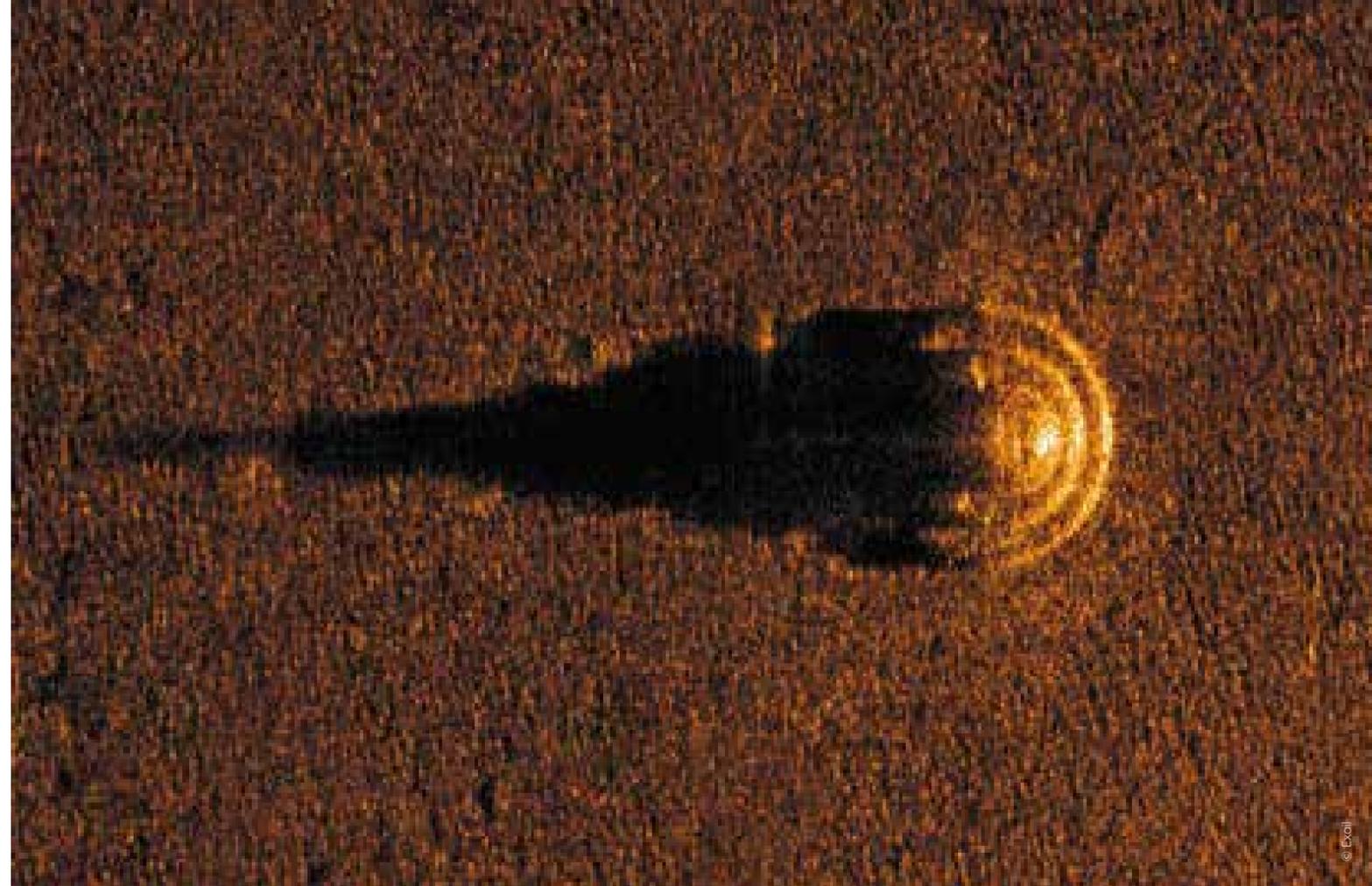
POWERING
ULTIMATE
GYROSTABILIZATION
FOR DEMANDING
OPTRONICS

IN TODAY'S EVER-CHANGING DEFENSE
LANDSCAPE, MAINTAINING SUPERIOR
OBSERVATION, TARGETING, AND
IMAGING CAPABILITIES IS CRUCIAL.
EXAIL LEADS THE WAY IN OPTRONICS
APPLICATIONS DRIVING INNOVATION
WITH STAB LEOS S, ITS LATEST
COMPACT GYROSTABILIZED PAN AND
TILT SYSTEM DESIGNED FOR HIGH-
RESOLUTION ACTIVE SENSORS.

Leos S: smaller, lighter, and equally powerful

Leos S is a two-axis pan and tilt system with impressive performance features. It represents the next generation of compact gyrostabilization technology. Crafted with precision engineering and attention to detail, this platform sets a new standard for portability and performance.

Its compact size fits within a Ø 379 x 365 mm-wide cylinder and it can accommodate payloads of up to 25 kg on the move. Despite its smaller and lighter form factor, Leos S packs a powerful punch, delivering uncompromising stability and accuracy for high-demanding optronics applications. With an impressive gyrostabilization line of sight of < 100 µrad, it provides smooth and jitter-free observations and targeting capabilities, ensuring that sensors, cameras, and optronic equipment accurately maintain their focus even in the most challenging environments and under dynamic conditions.

Leos S is designed to seamlessly integrate into a wide range of sea-based and land defense mobile platforms such as armored personnel carriers, infantry fighting vehicles, main battle tanks, etc. Its compact size ensures agility and maneuverability, making it an ideal choice for missions requiring quick adaptability. From surveillance and reconnaissance operations to search and rescue missions, border control, and more, Leos S caters to a diverse set of defense operations, enhancing the efficiency and effectiveness of operations.

Leos L: unparalleled stability

For defense applications where absolute stability and accuracy are critical, the Exail Leos L stands as a beacon of excellence. This larger and more robust two-axis platform sets the industry benchmark for gyrostabilization, delivering unmatched performance in the most demanding scenarios.

Boasting excellent gyrostabilization capabilities, achieving stabilization down to 20 µrad, Leos L is meticulously engineered to provide the highest level of stabilization, ensuring highly precise and reliable results for on-the-move optronics sensors, whatever the movement of the platform. With a position accuracy of 0.01°, Leos provides swift and precise positioning. With its angular speed of up to 120°/s and acceleration of up to 150°/s², it enables longer detection, reconnaissance, and identification (DRI) ranges, granting defense professionals greater situational awareness and operational advantage.

Qualified with various industry and military standards, Leos L has been built to withstand extreme shocks, vibrations, temperatures, and intense environmental factors. It is thus a dependable companion for naval and land defense missions requiring rugged performance.

Empowering defense professionals worldwide

The Stab Leos S and Leos L Series include several platforms equipped with various MEMS and FOG gyroscopes, providing customers with a range of options based on their tolerance to bias drift and desired level of gyrostabilization. This adaptability empowers defense customers to select the platform that precisely suits their missions' unique requirements. On top of this comprehensive range, Exail also offers tailor-made solutions for projects that require extra customization.

"As defense technology continues to advance, Exail remains committed to empowering navies and armies worldwide with state-of-the-art gyrostabilization solutions. With its exceptional performance, Leos Series enables military platforms to maintain optimal sensor capabilities while in motion, significantly enhancing operational effectiveness, survivability, and situational awareness" says Bruno Crépy, Head of Stabilized Platforms at Exail. By providing superior stabilization, extended detection ranges, and support for high-resolution sensors, Leos Series empowers defense forces with the tools they need to excel in modern warfare scenarios. ∎

Stab Leos Series
TWO-AXIS PLATFORMS FOR OPTRONIC SENSORS ON-THE-MOVE

	Leos S5	Leos S6	Leos L5	Leos L6	Leos L7
Axis number	2	2	2	2	2
Gyrostabilized line of sight (up to/µrad RMS)	< 100	< 100	< 100	< 100	< 20
Type of payload (#pieces)	1	1	1	1	1
Gyro drift	< 3,000 µrad during 10sec	< 400 µrad during 10sec	< 3,000 µrad during 10sec	< 400 µrad during 10sec	< 250 µrad during 10sec
Nominal payload (ground fixed system (up to/kg)	< 25	< 25	40	40	40
Nominal payload (ground mobile system (up to/kg)	< 25	< 25	20	20	20
Position accuracy (°)	≤ 0.01	≤ 0.01	≤ 0.01	≤ 0.01	≤ 0.01
Angular speed (up to °/sec)	115	115	120	120	120
Angular acceleration (up to °/sec²)	115	115	150	150	150
Dimensions (mm)	Ext Ø379x365 Intrusion Ø120x135	Ext Ø379x365 Intrusion Ø120x135	diameter 530, height 540	diameter 530, height 540	diameter 530, height 540
Weight (kg)	25	25	45	45	45

NEXT GENERATION K-STER C AND SEASCAN READY FOR PRODUCTION

EXAIL'S SEASCAN AND K-STER C ARE TWO REMOTELY OPERATED VEHICLES (ROV) SPECIALIZED IN IDENTIFICATION AND NEUTRALIZATION OF MINES. THESE TWO ROVS ARE PART OF THE TOOLBOX DESIGNED FOR THE rMCM PROGRAM. AFTER AN EXTENSIVE TEST CAMPAIGN NEAR HYÈRES, DURING 2022-2023, EXAIL HAS STARTED THEIR SERIAL PRODUCTION IN ITS OSTENDE FACILITY.

E xail has increased the performance of the Seascan lightweight long range ROV. "This 50 kg device was initially designed in 2014", explains Guillaume Novero, Head of Project at Exail. "At this time, we chose an analog architecture, and we equipped the ROV with 3 commercial off-the-shelf PAL standard, "state-of-the-art" cameras. But since then, the technology has made some significant progress and it was time to upgrade the Seascan in order to provide our customers with the top performance they deserve in terms of picture definition" he adds.

> **From analog to digital**

"In 2022, Exail switched from analog to digital architecture, and the ROV was equipped with three new generation low light High Definition (HD) digital cameras and HD sonar. With these three cameras, the Seascan has a 180° field of view and excellent acoustic sonar." For the customer, these changes mean better quality pictures in order to better identify the potential threats.

In addition, the Seascan's software has been upgraded with an automatic target acquisition and lock mode. From now on, the ROV will be able to autonomously detect, identify and approach its targets. And once it is close to its target it will automatically maintain its position. "This automatic mode is absolutely unique" explains Guillaume Novero.

Exail has been testing the Seascan at sea near Hyères (South of France) in 2022-2023. During dozens of sea trials, the Seascan demonstrated its capability to search for several dummy mines hidden on the seabed with its HD 40 m range multibeam sonar, before approaching them at very close range.

> **High definition cameras for better target identification**

Then the Seascan relies on its 3 low light HD cameras in order to identify the mines, while sending its data in real time to the operator through its reinforced fiber-optic cable.

"The quality of pictures obtained even at 100 m depth without having to switch on the lights was amazing", explains Guillaume Novero. With its 50 kg weight, its 3 hours endurance and its high-performance sensors, the Seascan is today an unvaluable asset for Mine Countermeasures. At the same time, Exail decided to revamp its K-Ster C expendable mine disposal system with a new HD camera and to install the same auto-acquisition and lock mode as on the Seascan. Thanks to this new target acquisition mode, the K-Ster C will be more accurate while approaching its targets and more efficient in its mine neutralization missions.

"With this new upgrade package, the Seascan and K-Ster C, currently in production in Exail's Ostend facility, are ready to counter the mine threat for the next decades", concludes Guillaume Novero. ∎

THE SEASCAN AND K-STER C ARE ABLE TO AUTOMATICALLY APPROACH THEIR TARGETS AND MAINTAIN THEIR POSITION, THIS LOCK ON MODE IS UNIQUE.

Seascan identification ROV

LIGHTWEIGHT LONG RANGE MINE IDENTIFICATION VEHICLE

Characteristics	Seascan
Length	1,580 mm
Height	430 mm
Width	500 mm
Weight	50 kg
Propulsion	2 horizontal thrusters and 2 vertical thrusters
Maximum operating depth	300 m
Speed	4 knots
Payload	High resolution sonar, 3 digital Low Light cameras Led search light

K-Ster C mine disposal system

HIGH PRECISION ROV FOR MINE NEUTRALIZATION

Characteristics	K-Ster C
Length	1,500 mm
Height	430 mm
Weight	50 kg
Propulsion	2 horizontal thrusters and 2 vertical thrusters
Speed	up to 6 knots
Maximum operating detph	down to 2,000 m
Payload	Dual frequency sonar for long range detection and accurate approach Digital Camera Warhead: shaped charge fitted with insensitive explosive

AIR & LAND ROBOTICS: REVOLUTIONIZING LAND DEFENSE

Air & land robotics solutions

ENSURING HUMAN SAFETY BY KEEPING THEM AWAY FROM THE DANGER ZONE

Cargo 15
Rugged Unmanned Aerial Vehicle (UAV) for 15 kg cargo missions

Teleoperation System
Advanced system for remote Unmanned Ground Vehicle (UGV) command and control

Iguana
Unmanned Ground Vehicle (UGV) with multi-mission robotic arm and high obstacle clearance capabilities

Cameleon MK3
Portable Unmanned Ground Vehicle (UGV) with multi-mission robotic arm capabilities

Cameleon LG
Backpackable Unmanned Ground Vehicle (UGV) with robotic arm capabilities

Cobra
Ultra-light backpackable Unmanned Ground Vehicle (UGV)

IT180-60
Low noise and long endurance modular VTOL Unmanned Aerial Vehicle (UAV)

THE INTRODUCTION OF ROBOTIC SOLUTIONS WILL BE ONE OF THE MAIN BREAKTHROUGHS IN AIR & LAND DEFENSE IN THE NEXT YEARS TO COME.

Today, these solutions provide the capability to conduct and fulfill a wide range of missions from Explosive Ordnance Disposals (EOD), Chemical Bacteriological, Radiological & Nuclear (CBRN), Intelligence & Surveillance. Tomorrow, these capabilities will extend to Last mile logistics, soldier companions, and many other missions to support operational forces. Leveraging 80 years of expertise in robotics, Exail solutions – that range from Unmanned Ground Vehicles (UGVs), Unmanned Aerial Vehicles (UAVs), and teleoperation systems for large UGVs to advanced mission systems – already save lives by keeping human beings away from the danger zone. Exail is at the edge of innovation to support this technological breakthrough that will expand capabilities.

❯ Advanced mission system

The advancement of new reliable and robust UGVs has revolutionized the way land warfare is being conducted. Leveraging its extensive robotics expertise to help land forces in this transition, Exail has developed an advanced mission system able to control multiple UGVs and UAVs and bring safer operations by keeping troops away from the danger zone. Offering complete situational awareness, Exail mission system can be tailored to specific needs and for any existing land vehicle, expanding land forces capabilities.

❯ Teleoperation systems for large UGVs

Exail's advanced teleoperation systems allow converting existing manned defense vehicles into unmanned teleoperated vehicles to remotely control them from a secured area. Our teleoperation systems provide intuitive situational awareness and easy control of all vehicle functionalities.

❯ Zone Demining System (SDZ): a zone clearance system developed by CEFA

The SDZ is a remotely controlled multipurpose and efficient UGV able to respond to all demining needs. The SDZ, able to be fitted with a wide range of tools, is specially designed to mechanically clear extensive explosive contaminated areas or to quickly create safe lanes. For this vehicle, Exail provides an advanced control system based on a set of high-resolution cameras and a console integrated into a protected vehicle. This teleoperation system allows operators to easily switch from beyond-the-horizon to line-of-sight control. ∎

❯ Exail's wide range UGVs can be deployed within the most challenging environments and offer high maneuverability and stability to overcome the toughest obstacles
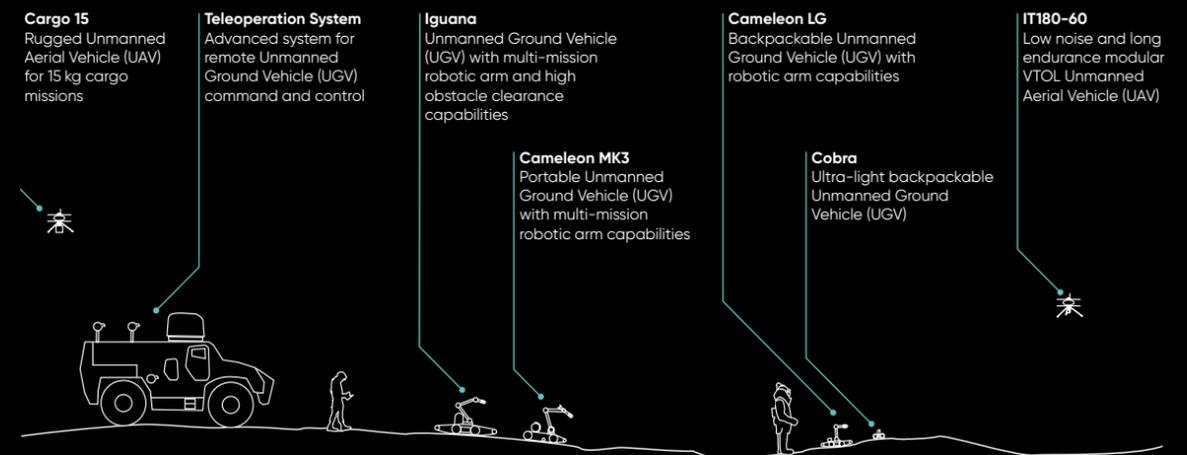
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Unmanned Ground Vehicles (UGVs)

Exail provides a wide range of reliable and robust UGVs dedicated to Intelligence, EOD/IEOD, and CBRN applications. Offering high maneuverability and stability through the toughest obstacles (mud, snow, sand, dirt, etc.), Exail's UGVs can be deployed within the most challenging environments. Their modular architecture and remote capabilities make them the perfect platforms to conduct a wide range of missions with the utmost flexibility and security.

Cobra: an ultra-light backpackable UGV

The Cobra is a 6 kg combat-proven UGV. Ultra-light, compact and backpackable, it is easily deployable for rapid interventions. Its user-friendly and ultra-light Operator Control Unit (OCU) further facilitates operations.

Cameleon LG: a backpackable UGV with robotic arm capabilities

The Cameleon LG is a lightweight and compact UGV easily deployable in the context of rapid intervention. Offering 20 cm obstacle clearance capabilities, it is equipped with a manipulator robotic arm able to be fitted with various tools, making it a highly versatile UGV adaptable to a wide range of missions.

Cameleon MK3: a portable UGV with multi-mission robotic arm capabilities

The Cameleon MK3 is a lightweight multi-mission UGV for specialized intervention. With its advanced manipulator robotic arm and comprehensive tools capacity, it can conduct a wide range of missions. Easy to deploy by a single person or from a standard vehicle, it is highly maneuverable and offers obstacle clearance capabilities up to 25 cm.

Iguana: a UGV with multi-mission robotic arm and high obstacle clearance capabilities

The Iguana is a two-man portable UGV for specialized intervention. Its robotic arm, which can be fitted with a comprehensive set of tools (X-RAY systems, disrupters, lasers, etc.), offers multi-mission capabilities. Highly maneuverable and narrow, it benefits from high obstacle clearance capabilities (up to 50 cm) and can operate in highly confined spaces.

Unmanned Aerial Vehicles (UAVs)

Exail's range of UAVs is suitable for intelligence or last-mile logistics missions. Offering unrivaled robustness in extreme weather conditions, it operates with low noise and can carry up to 15 kg of payloads.

IT180-60: a low-noise and long-endurance modular VTOL UAV

The IT180-60 is a long-endurance electrical Vertical Take-Off and Landing (VTOL) UAV which can carry multiple payloads. Offering robustness, reliability and performance, the IT180-60 can be operated in harsh weather conditions (wind gusts up to 60 km/h, rain, sand, extreme temperatures, etc.). It offers live and enhanced vision, low noise pollution, as well as superior tracking capabilities for intelligence missions.

Cargo 15: a rugged UAV for 15 kg cargo missions

The Cargo 15 is an electrical VTOL UAV derived from the IT180-60 architecture, offering enhanced payload capacity. Especially designed for logistic missions, it can quickly transport goods up to 15 kg with very high reliability, even in harsh weather conditions. ∎

A full range of UGVs and UAVs

POWERING INTELLIGENCE, EOD/IEOD, CBRN, AND LAST-MILE LOGISTICS MISSIONS

	Cobra	Cameleon LG	Cameleon MK3	Iguana
Obstacle clearance	9 cm	20 cm	25 cm	50 cm
Weight (base)	6 kg	14 kg	28 kg	52 kg
Manipulator robotic arm	–	5 axis	6 axis	6 axis
Vertical x horizontal reach	–	0.9 m x 0.9 m	1.5 m x 1.2 m	2.2 m x 1.2 m
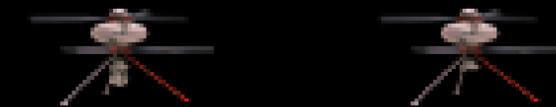
	IT180-60	Cargo 15
VTOL automatic take-off and Landing	Yes	Yes
Weight (unloaded)	21 kg	21 kg
Max payload	5 kg	15 kg
Max speed	72 km/h	72 km/h
Endurance	Up to 60 mn	20 mn @ 15 kg payload 30 mn @ 10 kg payload 60 mn @ 5 kg payload
Transportation range	–	10 km return @ 15 kg payload 16 km return @ 10 kg payload 24 km return @ 5 kg payload

R7 ROV: REDEFINING OBSERVATION AND INSPECTION

THIS NEW ROV FROM EXAIL BRINGS TOGETHER THE BEST OF DIGITAL TECHNOLOGIES TO MEET THE CHALLENGES OF MODERN MILITARY OPERATIONS.

© Exail - Baloo

T oday, several services such as military navies, special forces, coast guards, customs agencies, rescue services, and police departments are looking for a compact, versatile, user-friendly system for their missions. The R7 has been designed to meet these requirements. Despite its compact size, the R7 can fulfill a wide range of missions, such as: search and rescue, black box recovery, retrieval of objects for investigative purposes, assistance to divers, detection, identification, and depollution of unexploded ordnance (UXOs), harbour surveillance and protection.

❯ Easy to deploy and operate anytime, anywhere

"This next-generation remotely operated vehicle (ROV) is very compact, measuring only 78 cm in length and weighing 32 kg. It is therefore easy to transport and deploy by a team of just two people," explains Philippe Roumegue, Sales Director at Exail. Typically, each system includes an electrical power unit, a 327 m long umbilical cable, an R7 ROV vehicle, and a control unit that includes guidance controls and a mobile console that displays data from the ROV and its sensors.

To achieve such versatility, Exail conceived the R7 as a sturdy and lightweight platform, with a digital architecture that enables easy integration of high-performance sensors and a wide range of equipment based on the mission at hand for more versatility. In order to provide its end users with the best data while operating in the most challenging conditions, the R7 boasts an unparalleled power-to-weight ratio and agility, thanks to four vectored horizontal thrusters and three vertical thrusters. It can carry significant payloads and remain operational even in the presence of strong currents.

❯ A comprehensive set of equipment for increased versatility

One of the main qualities of the R7 is its extensive equipment. It comes equipped from the factory with high-performance full HD cameras and a powerful 4x zoom, providing high quality pictures even in low-light conditions. The optical sensors are capable of real-time image enhancement to compensate for water turbidity, providing operators with incredibly sharp images. These state-of-the-art optronic sensors are complemented by two 5,000-Lumen LED projectors to ensure powerful illumination in all circumstances.

In underwater environments with low visibility, sonar remains the reference sensor. The R7 can be equipped with imaging sonars, navigation sonars, and side-scan sonars.

"The digital architecture of this next generation ROV explains its outstanding versatility. Thanks to it, we have been able to design a drone that caters to all the needs of our clients. Simply choose from the vast array of equipment and sensors available for installation, make the necessary connections, and start the mission. It's as simple as that," assures Philippe Roumegue.

Recently, Exail qualified the integration of a Doppler Velocity Log (DVL) for greater ROV movement precision. "The R7 can be equipped with a multifunctional arm for object manipulation," adds Philippe Roumegue. "The choice of a digital architecture will facilitate future developments of the ROV, allowing the R7 to adapt to operators' evolving needs for decades to come."

❯ An intuitive interface for easy operations

One of the main advantages of the R7 is its intuitive Human-Machine Interface (HMI). The ROV's and sensors' data are displayed on two 15" touchscreens that remains highly readable even in bright light, while a multifunction joystick provides vehicle guidance. "We consider that an operator can achieve perfect efficiency with the R7 after just two days of training," explains Philippe Roumegue.

Operating Exail's R7 is relatively straightforward, it can be done from a land-based point or a very small vessel. Once the ROV is in the water, the operator activates the seven thrusters of the R7, as well as the sensors and projectors. The vehicle then begins its mission while transmitting data in real time to the operator. It can cover a large search area and operate at depths of over 300 m, ensuring the success of its missions.

"Tests have shown that the R7 is naturally agile, fast, enduring, and above all, incredibly stable on all axes," emphasises Philippe Roumegue. "It can maneuver through narrow openings in order to enter a wreck or orient itself nose-up to inspect a hull. Very few ROVs can achieve such performance today." This outstanding performance is achieved through the coupling of the motors with a state-of-the art Attitude and Heading Reference System (AHRS) in order to enhance the ROV stability and the capacity to accurately control its pitch and roll.

"Finally, a crucial aspect for our clients is support," Philippe Roumegue emphasizes. The R7 is designed from the ground up to facilitate maintenance operations. The ROV control system features a self-diagnostic function, while the different components of the vehicle are easily accessible. "As we have fully designed the ROV, we are the single point of contact for our clients, providing them with the service, spare parts, and technical expertise they need when they need it. The performance of the products and the quality of customer support are Exail's great strengths." ∎

Next generation compact ROV

OUTSTANDING VERSATILITY FOR INSPECTION AND OBSERVATION

	R7
Operational performance	
Movements	In 3 axes + rotation on its own axis
Forward speed	3 knots (In 0 knots current)
Operating depth	300 m in sea water
Operating T °C	–2 / 37 °C (Water)
Storage T °C	–10 / 50 °C (Air)
Payload	
Inspection TV camera on tilt unit	4x Optical Zoom 1080p Full HD color TV camera
Lighting	2 LED spotlight of 5000Lm each 2 additional spotlights available as option
Sensors	Integrated Inertial Motion Unit (IMU) Depth sensor with auto depth function Altimeter with auto altitude function
Human machine interface	Screen designed for sunny and harsh environments Monitoring of all ROV's subset functions (T°, voltage, current...) Auto heading, auto depth, auto altitude and auto attitude corrections Self-diagnosis of the whole system Ergonomic joystick controller
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)

OPTIMIZING LAND FORCES DRIVERS TRAINING WITH ADVANCED SIMULATION

AS THE GLOBAL LANDSCAPE OF MILITARY OPERATIONS EVOLVES, THE NEED FOR HIGHLY SKILLED AND WELL-PREPARED LAND FORCES DRIVERS HAS NEVER BEEN GREATER. TO MEET THIS DEMAND, EXAIL HAS DEVELOPED AN INNOVATIVE DRIVING SIMULATOR COUPLED WITH A CUTTING-EDGE MIXED-REALITY HEADSET. THIS SYSTEM AIMS TO ENHANCE THE OPERATIONAL PREPARATION OF LAND FORCES DRIVERS WHILE STREAMLINING TRAINING COSTS AND LOGISTICAL REQUIREMENTS.

© Exail

When driving simulation meets mixed reality

Exail driving simulator represents the pinnacle of realism and immersion in military vehicle training. Through meticulous visual and physical modeling of military vehicles, the simulator is perfectly adapted to Exail's training system mobility and maneuverability. Trainees can expect an authentic and dynamic experience, as they navigate virtual replicas of military vehicles, each offering a distinct set of challenges.

To augment the training experience, the driving simulator integrates seamlessly with a mixed-reality headset. This groundbreaking device takes simulation to new heights by merging the virtual and real worlds. Based on off-the-shelf VARJO helmets, the headset allows trainees to see both the virtual vehicle and the physical simulator simultaneously. By superimposing virtual controls onto the trainees' hands, accessing controls becomes intuitive and realistic.

Enabling modular and realistic scenarios

Exail understands that no driving scenarios are the same. Therefore, the simulator boasts a scenario editor to challenge and refine specific driving skills. This editor allows users to be fully autonomous in designing and evolving their scenarios while maintaining utmost doctrine confidentiality. The created scenarios can include different virtual terrains and realistic reproductions of offroad driving conditions such as rocks and sand, all of which can be adapted with tactical enrichment to cater to the customer's specific requirements. The training is adjustable based on operational feedback, providing a flexible and fast learning experience in tactical contexts without exposing the drivers to any real risks.

In addition to offering a variety of scenarios and terrains, the driving simulator enables the simulation of different sizes of military vehicles on the same equipment, ensuring versatility and cost-effectiveness. This modularity allows trainees to gain expertise across a diverse range of military vehicles, honing their skills and adaptability.

Enhanced immersion

Exail driving simulator, coupled with the mixed-reality headset, offers unparalleled immersion. Trainees find themselves fully engaged in the training scenarios, responding to dynamic situations with increased situational awareness. "Realism is at the core of Exail's training philosophy. The mixed-reality headset provides a point-of-view relative to the position in the vehicle, immersing trainees in an authentic driving experience. Perimeter views offer a genuine sense of speed, enhancing the feeling of being in a real-world scenario," emphasizes Louis Elcabache, Driving Simulation Sales Manager at Exail.

Moreover, the simulator can be enhanced when combined with an advanced dynamic platform. This feature enriches the training experience by simulating the movement and vibrations experienced during actual military vehicle operations. The result is a comprehensive training package that thoroughly prepares land forces drivers for real-world challenges.

A tailored solution for military training

With a rich history of collaborating with vehicle manufacturers upstream of acquisition programs, Exail ensures that its simulation training systems for military vehicles are specifically tailored to meet the unique requirements of armed forces. This comprehensive set of training equipment encompasses high-end military

vehicle simulators, interconnected with an Instructor Operating & Debriefing Station. This sophisticated system allows entire crews to train independently or together, facing realistic situations that simulate the complexities of real-world military operations. It ensures comprehensive training management, providing valuable feedback to enhance trainees' performance and skills.

In conclusion, Exail driving simulator and mixed-reality headset have ushered in a new era of military vehicle training. "Our driving simulator not only allows drivers to experience the technological advancements of the latest generation of armored vehicles but also addresses the pressing need for comprehensive driver training amidst increased vehicle mobilization. It offers a vital solution to maintain skills in constrained environments, where factors such as budget restrictions and personnel mobility can pose challenges" states Louis Elcabache. Through its unique combination of modularity, realism, and immersion, this groundbreaking training solution equips land forces drivers with the skills and adaptability required to tackle the challenges of modern military operations. By raising the standards of military training, Exail plays a pivotal role in ensuring the readiness and effectiveness of land forces drivers in safeguarding global security. ∎

> Exail driving simulator and mixed-reality headset have ushered in a new era of military vehicle training

02 CUSTOMER stories

ROYAL NAVY'S
ASTUTE-CLASS
SUBMARINES'
NAVIGATION

AS THE LARGEST AND MOST POWERFUL ATTACK SUBMARINES OPERATED BY THE ROYAL NAVY, THE ASTUTE-CLASS PLAY A CRITICAL ROLE IN MAINTAINING THE UK'S UNDERSEA DOMINANCE. EQUIPPING THEM WITH TOP-OF-THE-LINE SENSORS IS THUS CRITICAL TO ENSURE A POTENT AND STEALTHY UNDERSEA CAPABILITY. OVER THE LAST DECADE, THEIR UPGRADE TO EXAIL'S MARINS INERTIAL NAVIGATION SYSTEMS HAS RESULTED IN REMARKABLE IMPROVEMENTS IN ACCURACY, RELIABILITY, AND OPERATIONAL EFFICIENCY.

Exail Marins INS provide the Astute-class submarines with enhanced stealth, endurance and flexibility, giving them unrivaled freedom of action worldwide, in support of national and coalition operations

The Royal Navy Submarine Service has been pleased with the level of performance that the Marins INS offers. The system itself represents a significant capability, allowing us to further exploit navigational advantage to achieve operational success.

LT CDR CHRISTOPHER POLLEY, SUBMARINE FLEET NAVIGATION OFFICER FOR THE ROYAL NAVY

Delivering unparalleled navigation performance for operational effectiveness

Exail technology provides the Royal Navy's Astute-class submarines with significant operational advantages, particularly in navigation. Utilizing Fiber-Optic Gyroscope (FOG) technology and advanced algorithms, the Marins INS offers the highest positioning accuracy available. By continuously measuring the submarine's acceleration and rotation, the system enables precise determination of its heading, roll, pitch, speed, and position. On the field, this leads to a better situational understanding of the environment, empowering crews to make well-informed decisions and adapt swiftly to changing circumstances, optimizing their operational strategies.

Moreover, the accurate positioning data enables precise targeting and maneuvering, reducing errors and increasing the likelihood of accomplishing assigned tasks successfully. Whether engaged in intelligence gathering, surveillance, or offensive operations, the Astute-class can execute their missions more effectively. "The Royal Navy (RN) Submarine Service has been pleased with the level of performance that the Marins INS offers. The system itself represents a significant capability, allowing us to further exploit navigational advantage to achieve operational success" states Lt Cdr. Christopher Polley, Submarine Fleet Navigation Officer for the Royal Navy.

Enhancing stealth for absolute discretion

Another key benefit of implementing Marins INS on the Royal Navy's Astute-class submarines is enhanced stealth capabilities. Built upon silent solid-state FOG technology, Marins INS eliminates mechanical movements, minimizing wear and noise. This absolute discretion enables the submarines to maintain their stealth during underwater maneuvers, reducing the risk of compromise by adversaries and providing a significant tactical advantage, ensuring undetected critical operations.

Powering unmatched autonomy and reliability over time for extended mission endurance

The Astute-class also benefit from increased autonomy and unmatched reliability over time. By compensating for sensor biases and incorporating high-resolution algorithms, Marins INS minimizes errors and provides reliable position updates even in the absence of external references. Coupled with FOG technology's robustness against disruptions, the Astute-class can now undertake extended missions independently, without relying on frequent navigation updates, enhancing their operational effectiveness and flexibility even in challenging scenarios.

Eliminating maintenance for cost-effective ownership

Marins INS is based on solid-state FOG system that does not involve any movement of mechanical parts. Operating as a single component and relying only on the motion of light, it is highly resistant to external disruptions and can operate in extreme environments. These features make it highly reliable, requiring no periodic maintenance, and resulting in a low cost of ownership for the Royal Navy. "From a maintenance perspective, it also offers more reliability at a component level than previously seen due to the solid-state design philosophy," adds Lt Cdr. Christopher Polley.

A comprehensive and seamless integration

Besides its operational benefits, the integration of the Marins INS into the Astute-class submarines is seamless and comprehensive. The system can interface with other onboard systems, including sonar, and weapons enabling efficient coordination and synchronization of operations and contributing to the overall combat readiness.

In conclusion, the Royal Navy has greatly benefited from Exail Marins INS, with improved navigation, heightened stealth, and unmatched autonomy. This advanced technology has enhanced operational effectiveness and flexibility across flagship aircraft carriers, HMS Queen Elizabeth, globally deployed Offshore Patrol Vessels, and Astute-Class submarines. The widespread adoption of Exail INS across these key platforms attests to the trust and satisfaction of the British Royal Navy. "We are deeply grateful to the Royal Navy for their trust and our enduring partnership. With utmost confidence in our Marins INS, we are committed to further enhancing the capabilities of the Royal Navy's submarines, solidifying their undersea dominance, and upholding British national security," says David Cunningham, Global Director of Partnership and OEM at Exail. ∎

BRINGING US NAVY'S MARITIME DOMAIN AWARENESS TO A NEW LEVEL

CONFRONTED TO THE NEED TO BETTER MONITOR ITS AREA OF RESPONSIBILITY WITH FEWER MANNED SHIPS, THE US NAVY'S TASK FORCE 59, BASED IN BAHRAIN, CONTEMPLATES THE USE OF UNMANNED FLEETS.

In order to refine its concepts of operations, they organized two military exercises, Digital Horizon 22 and IMX 23 involving several types of drones, from various companies, including Exail's DriX Unmanned Surface Vessel (USV).

❯ Digital Horizon 22: drones and reality

As part of the Digital Horizon 22 Exercise, that took place in December 2022, the DriX, operated by the Exail teams, was integrated into a group of 15 different drones employed by TF59. For this three-week mission, the DriX, like the other unmanned assets, was tasked with continuously collecting data using its sensors in its patrol zone in order to contribute to the establishment of a robust tactical situation. In a nutshell, the USV had to identify all the ships in the Gulf region, a strategic area for international maritime transport.

In order to achieve its goals, at any time, the DriX had to communicate and interact with the other drones in the area while transmitting real-time data on surface activities to the US command center.

During this campaign, the DriX demonstrated the full extent of its capabilities. Beyond its outstanding seakeeping qualities, the US Navy appreciated the drone's ability to autonomously avoid obstacles in its path and interface with American command and control systems (including Certus, 4G, Wifi, and Silvus). The drone also demonstrated its capacity to provide immediately actionable data with its radar and electro optic sensors. For the US authorities, the outcome is very positive. As they conclude that Exail's DriX is a platform that can be used alone or in support of any Maritime Domain Awareness (MDA) system.

The USV is particularly suited for:
- Maritime security threats detection
- Ship identification
- Operations against illegal traffic and smuggling
- Persistence at sea for long endurance missions
- Pursuit of highly mobile targets during long duration missions
- Operations against illegal fishing.

❯ Exail's DriX USV has been successfully tested by US Navy's Task Force 59 in the Gulf Region

© Exail

Following the success of the Digital Horizon 22 Unmanned & Artificial Intelligence Exercise, Exail's DriX, was selected by the 5th fleet's task force 59 to take part in the two-week 2023 International Maritime Exercise (IMX23), held in Bahrain and Jordan from March 5th to 16th 2023.

Middle East region's largest naval exercise, IMX23 is a multinational event involving more than 50 partner-nations and international organizations operating in the Arabian Gulf, Arabian Sea, Gulf of Oman, Red Sea, Indian Ocean and East African coastal regions. The exercise involved 7,000 personnel, 35 ships and more than 30 unmanned and artificial intelligence systems, including Exail DriX USV.

As part of this exercise, the DriX USV – along with the industrial partners brought together by the unmanned task force TF59 –operated in Maritime Domain Awareness (MDA) and Mine Countermeasures Missions (MCM) tactical environments. This exercise was aimed at evaluating the use of combined unmanned technologies for deployment by the inter-allied forces in the Gulf region.

In total, the DriX spent 242 h, covering more than 1,000 NM, successfully completing each mission one after the other. Its missions involved surface surveillance while mapping the seafloor to search for mines with its multibeam sonar.

In addition, the DriX had to demonstrate its interoperability, using the American Silvus communication network and interact with the US Navy's Minotaur Command and Control (C2) system. For the US Navy, the mission objective is clear, the unmanned systems, operating together and interacting with the US Navy'C2 are essential for the establishment of a complete tactical situation displayed in real-time on a single screen (under the "SPOG" or Single Pan of Glass concept).

Throughout the exercise, despite occasionally challenging weather conditions with 2 m swells and winds exceeding 25 knots, Exail's USV transmitted radar, LiDAR, and AIS data to TF59. The drone also conducted investigations on several suspicious objects on the seafloor. Lastly, in the final test, several orders were sent to the DriX from the C2 Minotaur, and the drone executed them perfectly.

In conclusion, despite challenging weather conditions, Exail's DriX achieved all objectives set by the US Navy, demonstrating its usefulness for MDA missions. For the US Navy, the lessons learnt with Digital Horizon 22 and IMX23 are a major step towards the future deployment of an unmanned fleet in the Gulf region to supplement manned ships.

For Exail, the highly positive feedback gathered from this experience will be unvaluable for the ongoing development of purely military versions of the drone. ∎

© DR

❯ The DriX USV is an unvaluable complement of unmanned assets and manned ships to ensure optimal maritime domain awareness
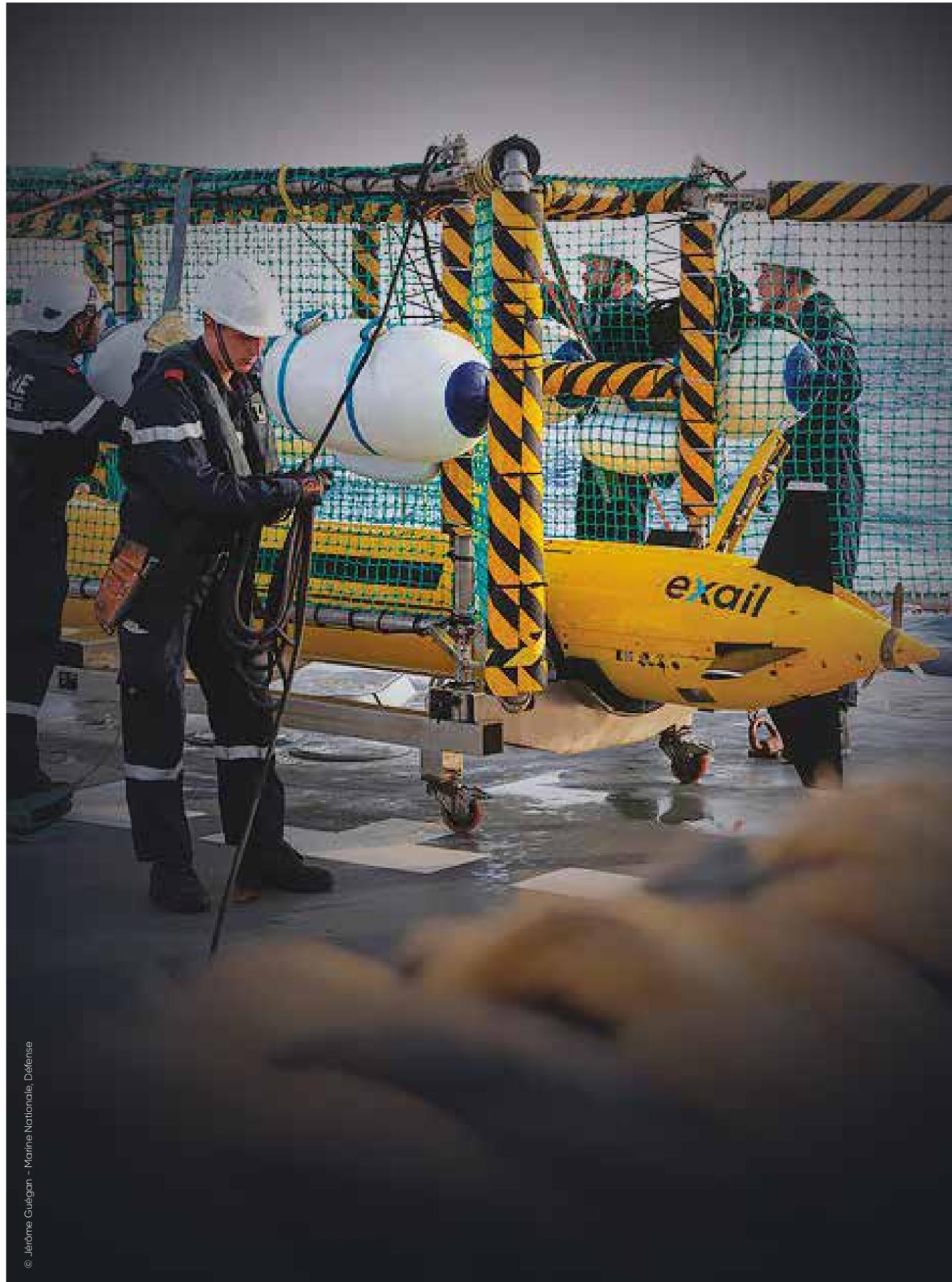
A French Navy crew operates the A18-D from the "Loire" support ship during mission "Calliope"

THE FRENCH NAVY TESTS THE A18-D AUV

BETWEEN JUNE 12TH AND JUNE 24TH, THE FRENCH NAVY CONDUCTED A COMPREHENSIVE TEST CAMPAIGN CALLED "MISSION CALLIOPE" FROM THE SUPPORT VESSEL "LOIRE" WITH AN EXAIL'S A18-D AUTONOMOUS UNDERWATER VEHICLE (AUV).

Thanks to its overseas territories, France has the second largest maritime zone in the world. 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 French ministry for armed forces unveiling its seabed strategy back in February 2022. It is within this framework that the contract for the A18-D test campaign has been awarded. It follows on from an initial hydrographic evaluation campaign of Exail's A18-D conducted in 2021 by the French Navy and the French Naval Hydrographic and Oceanographic Service (Shom).

A high performance AUV for inspection missions

The A18-D is designed to perform missions at depths down to 3,000 m for mapping, sonar imaging and high-resolution inspection of pipelines and cables. Capable of conducting its missions in total autonomy for 24 h, it can reach speeds of 6 knots and carry out up to 40 km² of imaging per mission. The "Calliope Mission" started on June 12th, 2023, with the departure of the French Navy's Support Vessel "Loire" from its Toulon home port, in the South of France. Its mission aimed to test and evaluate the multi-sensor A18-D AUV to conduct experimentations with a view to define its future needs, with the DGA's technical support, as part of the French ministry for armed forces' strategy for seabed warfare.

The A18-D AUV and its onboard sensors is one of the systems evaluated by the French Navy. The objectives of this A18-D campaign were to:

• Detect and classify objects thanks to a high-resolution SAS (Synthetic Aperture Sonar) sonar;

• Chart the seabed using an multi-beam echosounder (MBES) bathymetric sonar;

• Characterize the nature of the seabed thanks to an sub-bottom profiler (SBP) sonar and a video camera.

The AUV was operated for several days, looking for underwater points of interest on the seabed. As of July 2023, the mission data are currently being analyzed and the return on experience will be unvaluable for future AUV operations.

The A18-D can be embarked on several types of ships. This AUV, which is very versatile and compact, is delivered with a software suite to manage missions, download and start analyzing the collected data. A command-control container is also installed on board the mother ship, providing operators with a dedicated and sheltered space from which to command and control the drone.

Support is an essential aspect of this turnkey solution; the theoretical and operational training provided by Exail's experts is very important for the successful deployment and operation of the AUV.

The first A18-D was built in 2016 by Exail. The aim was to design a high performance AUV able to operate for 24 hours between 3/5 kts at 3,000 m with several sensors for scientific missions. The vehicle is 5,8 m long for a total weight of 750 kg. After its deployment with Exail's Launch and Recovery System (LARS), the A18-D dives at a 70° angle to reach depths of 3,000 m in under 30 minutes. During its mission, the AUV activates its sensors and ensures navigation accuracy using an Exail Gaps USBL subsea positioning system and an inertial measurement unit. Upon completion of its mission, the A18-D can communicate with its mother ship via Satcom or Wifi to determine a rendezvous point for retrieval. The A18-D is currently operated by Exail and other customers for scientific purposes. ∎

© US Coast Guard/Petty Officer 1st Class Michael De Nyse

ADVANCING
US COAST GUARD
KEEPER-CLASS BUOY TENDERS
NAVIGATION CAPABILITIES

Exail has been awarded a $2,244,009.00 contract by the United States Coast Guard (USCG) to replace obsolete gyrocompass systems on the 175-ft WLM Keeper-class buoy tenders. The contract includes Octans gyrocompasses and Netans Navigation Data Distribution Systems (NDDS) and covers a base year and nine options over a ten-year performance period.

This upgrade will provide the USCG Keeper-class buoy tenders with more precise and dependable navigation capabilities. Built on Exail's advanced Fiber-Optic Gyroscope (FOG) technology, the Octans gyrocompass will ensure the vessels' safety during critical naval operations by providing highly reliable and precise navigation data. Complementing Octans, the Netans NDDS will facilitate the sharing of crucial navigation information across various onboard systems. Both systems will enhance the USCG crew's decision-making capabilities, ultimately bringing safety and reliability to their naval operations.

"We are very pleased that the Octans gyrocompass system will be part of the Coast Guard's upgrades to the buoy tender fleet" said Ted Curley, President and General Manager of Exail Defense Systems, Inc. "The supply of these gyrocompasses will add to the 100+ Exail navigation systems already operating in the USCG. It is a testament to our long-standing relationship with the USCG. We are grateful to them for once again placing their trust in the reliability and performance of our navigation solutions".

With over 100+ Octans gyrocompass already equipping the USCG 87-ft Marine Protector-class and 100-ft Island-class patrol boats, this new contract reaffirms Exail commitment to providing advanced and reliable navigation solutions to the USCG and other naval and maritime customers worldwide. ■

>> The supply of these gyrocompasses will add to the 100+ Exail navigation systems already operating in the US Coast Guard. It is a testament to our long-standing relationship with the USCG.

❯ TED CURLEY, PRESIDENT AND GENERAL MANAGER OF EXAIL DEFENSE ACTIVITIES IN THE US

EXPANDING
MCM
CAPABILITIES
TO
SHIPS
OF
OPPORTUNITY

IN MILITARY OPERATIONS, CREATIVITY AND FLEXIBILITY ARE OFTEN TWO ESSENTIAL QUALITIES FOR SUCCESS. THIS IS A WELL-UNDERSTOOD NEED BY EXAIL, WHICH OFFERS ITS MODULAR MCM (MINE COUNTERMEASURES) SYSTEMS TO BE INSTALLED ON CRAFTS OF OPPORTUNITY.

For MCM Missions, it is possible to operate several types of drones and remotely operated vehicles (ROVs) from specialized military vessels, as chosen by the Belgian and Royal Netherland's navies for their rMCM (replacement Mine Countermeasures) program.

However, many customers want to quickly benefit from a turnkey MCM capability that can be adapted on an existing ship.

This is precisely what Exail is currently doing with the Royal Netherland's Navy under the OT&E contract. For the customer, the implementation of a modular solution pending the entry into service of the full rMCM system is a good way to evaluate some components of the future operational system. The rMCM toolbox is a complete mission system based on autonomous underwater vehicle (AUV), unmanned surface vehicle (USV), and remotely operated vehicle (ROV).

> Exail's MCM containers can be based on land, or on a ship

In 2021, the Royal Netherland's Navy leased an offshore civil supply vessel, the Geo Sea, for the implementation of a modular MCM solution provided by Exail. "Our entire system fits into five 20-foot containers", explains Viet Hung Doan, Program Manager at Exail. Equipped in this way, the Geo Sea becomes a fully-fledged MCM vessel. "This modular solution includes a Command and Control (C2) center equipped with UMISOFT mission software and all the necessary communication tools. The other containers are dedicated to the storage and maintenance of Exail's UMIS system vehicles."

"We can tailor our offer according to each client's needs," explains Viet Hung Doan. "For instance, our turnkey solution can include a Command and Control unit, a floating dock, the A18-M AUV, Seascan and K-Ster C ROVs, and an Inspector 125 USV," he adds.

"This plug-and-play solution has several advantages. The first is to provide a quickly available MCM capability that can be adapted to an existing vessel, provided that the vessel has enough deck space to accommodate the containers and is equipped with a crane for the deployment of vehicles. The second advantage of our solution is its ability to be transferred from one vessel to another. Therefore, dry-docking the carrier vessel does not result in temporary loss of MCM capability."

"Lastly, our modular solution can also be deployed from land, if necessary," concludes Viet Hong Doan. This contract allows Exail to have a unique return on experience on the implementation of a containerized drone system for underwater mine countermeasures from a Craft Of Opportunity Program (COOP), a type of ship that other major navies such as the Royal Navy or the Royal Australian Navy are also considering using. ∎
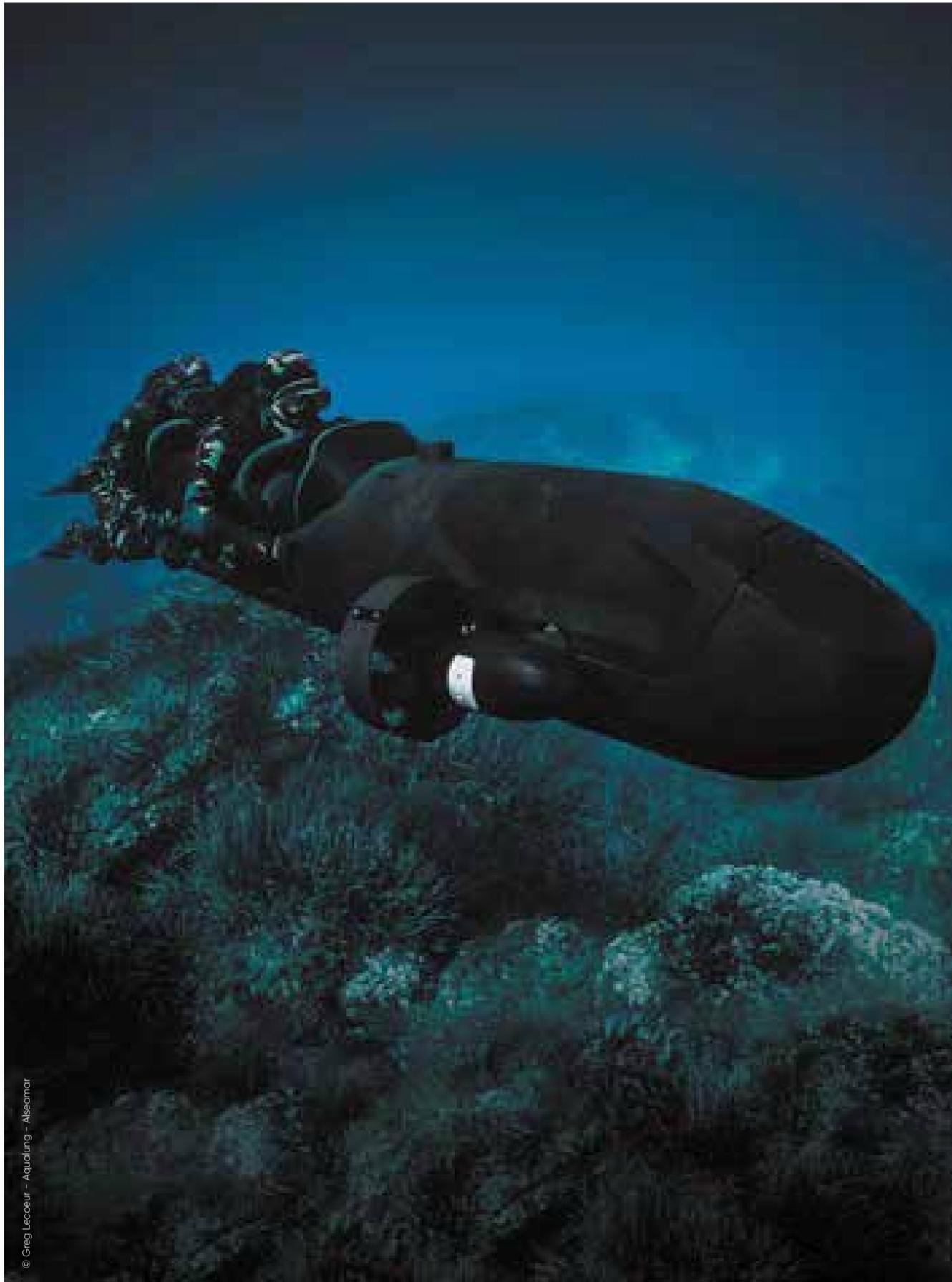
ENHANCING
COMBAT
DIVERS'
INTELLIGENCE
AND
OFFENSIVE
MISSIONS

INNOVATION HAS ALWAYS BEEN THE DRIVING FORCE BEHIND ADVANCEMENTS IN UNDERWATER TECHNOLOGY. IN 2017, ALSEAMAR, A FRENCH UNDERWATER EQUIPMENT MANUFACTURER, EMBARKED ON A MISSION TO PROVIDE COMBAT DIVERS WITH AN INNOVATIVE UNDERWATER SCOOTER. THEIR GOAL WAS TO CREATE A NEW DIVER PROPULSION VEHICLE (DPV) THAT WOULD OFFER UNRIVALED SPEED, AGILITY, PROTECTION, ERGONOMICS AND NAVIGATION ACCURACY TO THE DEFENSE INDUSTRY. THIS QUEST LED THEM TO FORM A FORMIDABLE PARTNERSHIP WITH EXAIL, GIVING BIRTH TO THE MURENE DPV EQUIPPED WITH THE CUTTING-EDGE PHINS COMPACT C3 NAVIGATION SYSTEM.

❯ A key to the need for ultra-high precision

The Murene project was born out of a vision to offer combat divers an unparalleled underwater experience while providing military forces with a tactical edge in underwater missions. The Alseamar development team envisioned a device with a streamlined design and advanced functionalities providing divers with exceptional maneuverability and enabling them to cover larger areas while conserving energy during extended missions. The Murene was designed with swiftness and agility in mind, allowing it to approach maritime targets stealthily and with a compact size to fit into a torpedo launch tube. "Our ambition was to design a new thruster offering the best ergonomics, protection, and performance for two fully equipped combat divers. We wanted the Murene to be deployable from shore, from a semi-rigid inflatable boat, or from a submarine through a torpedo tube," says Rémi Lecomte, Sales Manager Divers & Special Forces at Alseamar.

However, the true potential of Murene could only be unlocked with the integration of cutting-edge navigation systems, and that's where Exail stepped in. "The Murene needed to be easy to handle, and we wanted its performance in terms of speed, endurance, and navigational precision to be far superior to what already existed in the industry," adds Rémi Lecomte.

❯ Confirming Phins Compact C3's superiority

In their pursuit of perfection, Alseamar undertook a rigorous testing phase, assessing various inertial units to identify the one that could deliver the precise navigation performance they envisioned. After conducting several months of testing, including 30 dives with the Murene under diverse conditions and configurations to optimize onboard sensors, one system clearly stood out - the Exail Phins Compact

C3 navigation system. Demonstrating outstanding navigation performance, the Phins Compact C3 became the preferred choice for equipping their Murene. "The results of our tests were unequivocal: the Phins C3 offered significantly better performance and navigation accuracy than the other competing systems," emphasizes Rémi Lecomte.

Enhancing intelligence and offensive missions

Equipping Murene with the Exail Phins Compact C3 elevated the DPV's navigation accuracy to a level that surpasses industry standards in the DPV market. To get even more precise and real-time data on Murene's position, orientation, and velocity, the Phins Compact C3 works in tandem with a Doppler Velocity Log (DVL). This combination ensures that divers can accurately track their position, maintain course, and easily adapt to the ever-changing underwater currents. It offers Murene exceptional stability and unparalleled awareness of its location, enabling divers to concentrate on their mission's objectives without worrying about getting lost or disoriented.

> The combination of the Phins Compact C3 and a DVL allows the Murene's divers to accurately track their position, maintain course, and easily adapt to the ever-changing underwater currents

Moreover, the compactness of the Phins Compact C3 allows for easy and seamless integration into the Murene, while its ability to align in motion significantly enables rapid and flexible deployment. These features enhance the Murene operational flexibility and efficiency during critical underwater operations, making it a game-changer for intelligence and offensive missions. "The Phins Compact C3 in-motion alignment enables divers to align their devices while in transit, regardless of weather conditions. Therefore, alignment can be performed anywhere, whether on the deck of a boat or at sea, which enhances operational adaptability and helps overcome challenging sea conditions," says Pierre-Louis Roudaut, Regional Sales Manager at Exail.

Game-changing collaboration in underwater navigation

The success of the collaboration between Alseamar and Exail demonstrates the power of teamwork and the importance of cutting-edge technology in the field of underwater navigation. By combining Alseamar's expertise in underwater equipment with Exail's world-class navigation solutions, the Murene DPV became a game-changer in the industry.

"We are glad that our Phins Compact C3 systems have helped Alseamar expand their Murene's capabilities, providing combat divers with unprecedented navigation accuracy and efficiency in executing their missions," states Pierre-Louis Roudaut. "But our collaboration didn't stop there. We continue to join forces and exchange feedback continuously to improve our respective technologies, which will not only benefit the defense industry but also fields such as underwater exploration and research." ∎

> The Murene needed to be easy to handle, and we wanted its performance in terms of speed, endurance, and navigational precision to be far superior to what already existed in the industry.

> RÉMI LECOMTE, SALES MANAGER DIVERS & SPECIAL FORCES AT ALSEAMAR

EXAIL'S
AIR & LAND
ROBOTS
SHINE
DURING
FRENCH
ARMY
COHOMA CHALLENGE

ORGANIZED BY BATTLE LAB TERRE* WITH THE SUPPORT OF THE FRENCH DEFENSE INNOVATION AGENCY, THE COHOMA CHALLENGE II BROUGHT TOGETHER 15 TOP-TIER TEAMS TO SHOWCASE THEIR CAPABILITIES IN USING ADVANCED ROBOTIC SYSTEMS IN OPERATIONAL WARFARE CONDITIONS. AFTER A HIGHLY COMPETITIVE BATTLE, EXAIL, ALONGSIDE ITS PARTNERS ISL (FRENCH-GERMAN RESEARCH INSTITUTE OF SAINT-LOUIS), FN HERSTAL, AND SOFRAME, ACHIEVED A REMARKABLE SECOND-PLACE FINISH, SURPASSING MOST OF ESTABLISHED DEFENSE INDUSTRY LEADERS.

* The "Battle Lab Terre" is a French organization focused on experimental R&D for land-based operations

© Exail

> Exail and its partners deployed four robots which had to coordinate to deactivate traps by scanning QR codes on red cubes (representing the traps) from the ground and sky

> **Empowering human–machine collaboration**

The primary objective of the CoHoMa Challenge II is to evaluate the level of collaboration between humans and machines in an operational use case. By executing dedicated tactical scenarios centered around the theme of "Seizing an enemy position", participants were required to demonstrate their drones capabilities in a range of tasks, including reconnaissance missions, security patrols, Explosive Ordnance Disposal (EOD), and combat missions. Teams were tasked with utilizing a combination of aerial drones, ground robots, mission systems, and advanced communication systems to overcome the challenge.

> **Demonstrating seamless robotics systems integration**

Exail, a prominent player in the field, showcased its expertise by effectively deploying a suite of cutting-edge robotic and mission systems. The team seamlessly integrated its Iguana multi-mission Unmanned Ground Vehicle (UGV), two of its IT180-60 aerial drones, and ISL Aurochs ground robot equipped with a teleoperated turret from FN Herstal. This combination of robotic systems was controlled using Exail's advanced mission system, enabling seamless collaboration between human operators and autonomous machines.

> **Facing the challenge with precision and minimal resources**

With only four robots at their disposal, the Exail team navigated the complex and dynamic environments of the CoHoMa Challenge II with precision and using a minimal number of drones and robots. Their strategic decision-making and swift adaptability allowed them to effectively complete the designated scenario, positioning them as serious contenders for the top spots. Exail's mission system played a crucial role in its success, empowering the team to accurately identify enemy threats and rapidly gain a comprehensive understanding of the tactical situation. This real-time situational awareness facilitated seamless coordination between human operators and autonomous machines, resulting in a highly synchronized and effective response.

> **Securing second place and beyond**

Exail team's exceptional performance in the CoHoMa Challenge II led them to an impressive second-place finish. Surpassing internationally renowned defense industry leaders was a testament to their dedication, innovation, and expertise in the field of aero-terrestrial robotics. Notably, their accomplishment was further recognized with the Ubiquity Award, highlighting their ability to overcome challenges through adaptability and comprehensive mission execution.

> **Fostering collaborative breakthroughs**

Exail's participation in the CoHoMa Challenge II alongside ISL, FN Herstal, and Soframe underscores the company's commitment to fostering collaborative breakthroughs. By leveraging their collective expertise in robotics, aero-terrestrial systems, and weapons technology, these three major players showcased their ability to tackle complex challenges and shape the future of defense. CoHoMa II aligns with the French Army's ambitious Vulcain project, aiming to envision the integration of robots and artificial intelligence on the battlefield by 2040. "Exail's outstanding performance and second-place finish solidified our position as a formidable force in the field" stated Lionel Rosellini, Director of the Land and Air robotics division at Exail. "Through our strategic implementation and innovative mission system, we exemplified the possibilities of human-robot collaboration. As we look forward to future editions of the CoHoMa Challenge, we are confident that we will, along with our partners, continue to lead the way in advancing the frontier of aero-terrestrial robotics". ∎
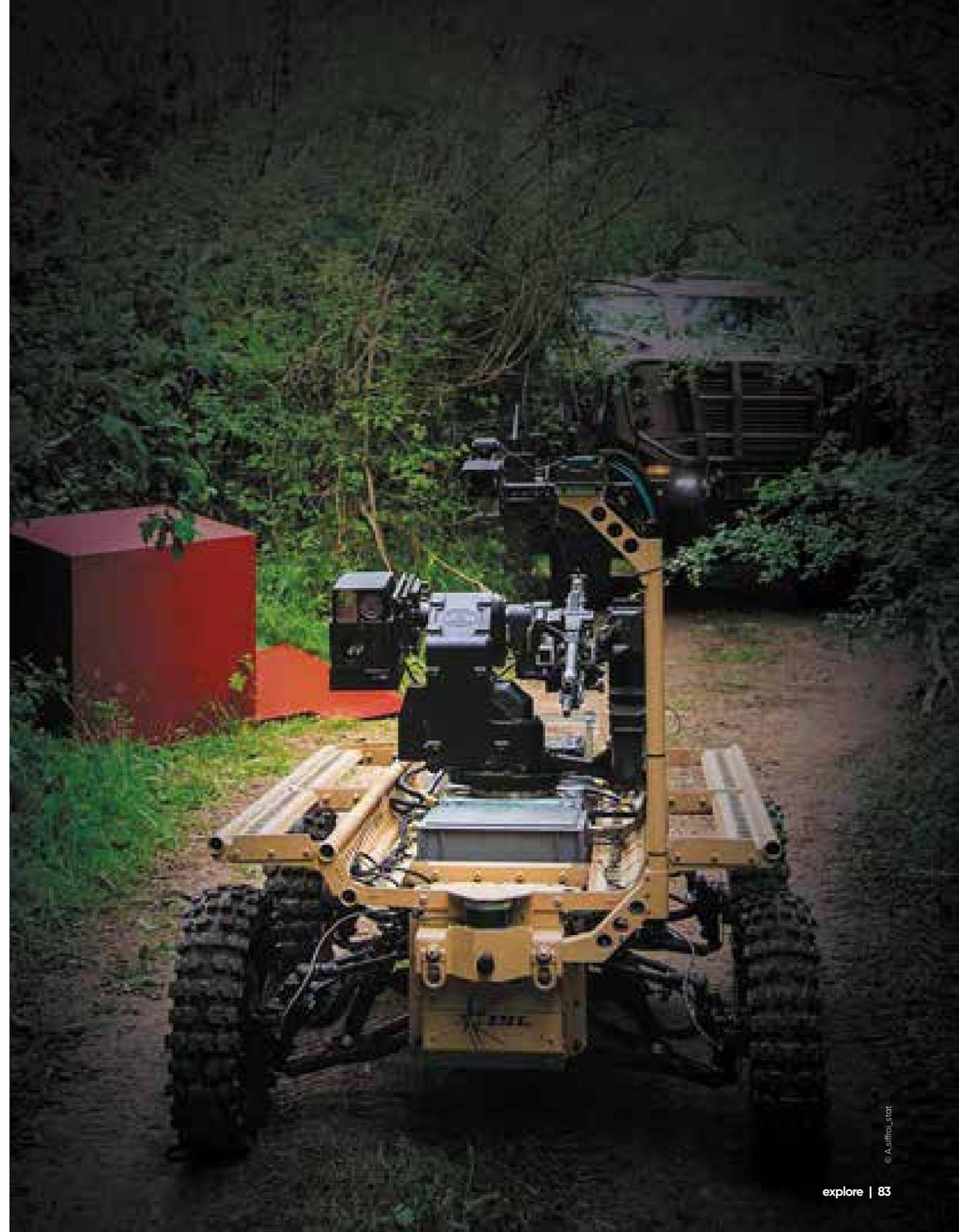
SENIN:
EMPOWERING
FRENCH
NAVY'S NAVIGATION
FOR TWO DECADES

EXAIL HAS BEEN AT THE FOREFRONT OF SUPPORTING NAVIGATION FOR THE FRENCH NAVY FOR THE PAST TWO DECADES. WITH ITS ADVANCED ELECTRONIC CHART DISPLAY AND INFORMATION SYSTEM (ECDIS) SOFTWARE KNOWN AS SENIN* EXAIL EQUIPS ALL FRENCH NAVY SHIPS AND SUBMARINES, CEMENTING ITS POSITION AS A TRUSTED PARTNER THAT ENSURES SAFE AND EFFICIENT NAVAL OPERATIONS.

* Système d'Exploitation Navale des Informations Nautiques, in English Navigation Operating and Information System

20 years of partnership

Exail and the French Navy started working together in the early 2000s. In 2003, the French Navy decided to equip all its vessels with a navigation system that meets international standards, leading to the selection of Exail and Airbus Group (iXblue and EADS at the time) for their advanced SENIN software. From 2004 to 2006, SENIN was installed on 57 different ships after a year of software validation, simulator testing, and initial installation on the Jaguar training ship. In 2008, the first contract for maintenance was signed, and since then, all new French Navy ships have been equipped with SENIN as Government Furnished Equipment (GFE).

Advanced features for enhanced navigational safety at sea

Back then, SENIN revolutionized maritime navigation by replacing traditional paper navigation charts. It quickly became a leading navigation software, fully compliant with the latest IEC-IMO and IHO standards and regulations, ensuring industry best practices. SENIN's advanced features include precise mapping, sensor management, integration of tactical data, and advanced mission planning capabilities. Its user-friendly interface enables navigators to visualize, track, and plan sea missions effectively. "SENIN's proprietary chart engine and highly configurable man-machine interface streamline operations by providing easy access to frequently used functions with a single click," highlights Jérémy Passavan, Product Manager at Exail. By offering a comprehensive overview of the maritime environment, SENIN provides crews with real-time information, enabling them to navigate confidently in challenging conditions, make well-informed decisions and improve the safety of both ships and personnel.

Improving warships' tactical understanding

SENIN not only enhances navigational safety through its ECDIS certification but also provides a significant improvement in understanding tactical scenarios on warships. As a certified WECDIS (Warship Electronic Chart Display and Information System) software, SENIN serves as a crucial strategic tool for the French Navy during military operations at sea. In addition, its tactical features align with NATO's STANAG (Standardization Agreement) standards, promoting coordination and interoperability with naval forces from member countries. By adhering to NATO's standards, SENIN contributes to strengthening the French Navy's position within the organization, emphasizing its commitment to interoperability and international cooperation.

Tailored to the ever-changing needs of the French Navy

SENIN is a software solution specifically tailored to fulfill the requirements of the French Navy. Developed over the course of two decades, it has continuously evolved based on user feedback and needs, benefitting from close collaboration with vessel crews. The successful deployment of SENIN throughout the entire French Navy fleet is a testament to its reliability and quality, with notable integration on major platforms like the Charles-de-Gaulle aircraft carrier, the SNLE nuclear-powered ballistic-missile submarine, and the SNA class nuclear attack submarine.

"Working closely and continuously with the French Navy has allowed us to ensure that SENIN stays at the forefront of technological advancements, constantly adapting to evolving needs and challenges. We are profoundly grateful for the trust placed in us by the French Navy, and we are honored to contribute to the success of the French Navy's mission" stated Pierre-Louis Roudaut, Sales Manager at Exail.

Exail's steadfast commitment to excellence, customer satisfaction, and national security has firmly established the company as a trusted supplier of advanced maritime navigation systems. By offering a comprehensive suite of features and driving innovation in the field, Exail continues to shape the future of marine navigation, contributing to the nation's security.∎

> SENIN empowers the French Navy with a deeper understanding of tactical situations, enabling well-informed decision-making during military operations at sea

© Exail

> Working closely and continuously with the French Navy has allowed us to ensure that SENIN stays at the forefront of technological advancements, constantly adapting to evolving needs and challenges.

> PIERRE-LOUIS ROUDAUT, SALES MANAGER AT EXAIL

KEEPING CREWS SAFE
With the Inspector 125 USV

ASTUTE-CLASS SUBMARINES
Tackling underwater navigation challenges

UMIX SERIES IMU
Unlocking high-precision navigation

MARITIME DOMAIN AWARENESS
Powered by the DriX USV

exail