

# ixnews

IXBLUE | MARCH 2022 | OI SPECIAL ISSUE

## AUTONOMOUS SURVEY

Enhanced  
with FlipiX ROTV

## WIND INDUSTRY

Solutions for  
the whole life cycle

## UNCREWED VEHICLES

Demonstrating  
collaborative capabilities

## DEEP-SEA EXPLORATION

Empowering Ifremer  
new 6,000m rated AUV



The ocean represents about 70% of our Planet and was certainly home to the first signs of life, some thousands years ago. Playing a critical role supporting life on Earth, its vast majority still remains uncovered and keeps triggering mankind curiosity. With Space, the Ocean now represents the next frontier that mankind seeks to explore.

An exploration that has been made possible by the sheer amount of incredible technological innovations that have taken place for the past 20 years across all our markets: numerical data, automation, robotics, artificial intelligence, uncrewed solutions... All have been profoundly transforming our day to day lives and we are now witnessing a remarkable shift in the way we work, driven by the need to build a safer and more sustainable world.

These incredible breakthroughs have opened a sea of possibilities that were previously out of reach. We can now dive deeper into the unknown world of our ocean, cover wider areas at a fraction of the time that was previously needed, and we can better understand the Earth subsea geology, ocean dynamic and marine life, all of which can help us understand the Planet we live on and help mankind thrive while also protecting the Earth.

All stakeholders involved in our industry must now work hand in hand to reach this common goal. We all need to take our industry further, and help it in its transition, by empowering profound and durable changes.

Animated by a pioneering spirit and a culture of innovation, all men and women working at iXblue are thriving to push back the limits of what is possible to help our customers in their exploration of the ocean.

“

**WE NEED TO TAKE OUR INDUSTRY FURTHER, AND HELP IT IN ITS TRANSITION, BY EMPOWERING PROFOUND AND DURABLE CHANGES.**

”

Strongly believing in collaboration, we have been working in close relationship with our customers and partners to bring about disruptive solutions to help solve their challenges. We have been developing robust and advanced technologies able work in much deeper and severe subsea environments; We've also been designing and deploying highly reliable uncrewed solutions and high-end sensors able to survey wider areas at a much faster rate with no compromise on performance. All of this helping lowering operations costs and overall carbon footprint, while also increasing safety by reducing men exposure at sea.

In the next few pages, you will be able to discover those innovations and all the amazing projects they have been deployed on. We hope reading those pages will help you get a sense of what animates us at iXblue and that they will give you a glimpse of all the great projects our customers and partners achieve every day!

Olivier  
Cervantes  
VP Energy Markets



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Solutions for the whole life cycle

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Powered by iXblue subsea INS

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DriX conducting a bathymetry survey on Gwynnt y Môr Offshore Wind Farm off the coast of Wales

# BRINGING OPERATIONAL EFFICIENCY TO THE OFFSHORE WIND INDUSTRY

**With hundreds new offshore wind projects in development around the world and a growth of nearly 30% per year, offshore wind is a rapidly maturing renewable energy technology that offers great potential. Bolstered by national policies and decreasing technological costs, the global offshore wind market is set to expand strongly in the coming decades, whether in Europe, Asia or the U.S. and is forecasted to “increase fifteen-fold to 2040, becoming a \$1 trillion industry over the next two decades”.**

Leveraging decades of offshore energy expertise, iXblue is a trusted partner in this transition towards more sustainable offshore energy. Already used on offshore wind farm projects around the world, the company innovative technologies (inertial navigation systems, subsea positioning and imagery solutions, as well as uncrewed autonomous platforms), offer proven performance and reliability within the challenging environments of offshore wind energy posed by shallow waters and high winds. Requiring less equipment to be put at sea, and offering disruptive, yet proven, uncrewed solutions and advanced subsea sensors, iXblue helps operators achieve operational efficiency by bringing down costs and reducing hours spent

at sea, while also improving workers safety and lowering operations carbon emissions. From environmental studies, UXO surveys and site investigation, to construction, operations, and predictive maintenance, iXblue is a trusted technology provider for every stage of wind farm development and operating life.

#### **Unique versatile uncrewed platforms for more flexible operations at sea**

As a major provider of advanced marine and autonomy technologies, iXblue is playing a central role in the advancement of operational efficiency within the Offshore industry. With its DriX Uncrewed Surface Vehicle (USV) and FlipiX Remotely Operated Towed Vehicle (ROTV), the company provides comprehensive

1. IEA (2019), Offshore Wind Outlook 2019, IEA, Paris <https://www.iea.org/reports/offshore-wind-outlook-2019>

autonomous survey capabilities that offer improved performance and greater operational efficiency for various applications including environmental, geophysical, UXO and as laid survey, Inspection Maintenance and Repair (IMR), as well as biomass assessment.

Offering outstanding seakeeping capabilities (up to sea state 5) thanks to its unique design, the DriX USV is perfectly suited to the challenging offshore wind environments. Able to host a wide range of different payloads for multi-mission capabilities (MBES, SBP, USBL, INS, FLS...), its high stability ensures to collect high quality and accurate data, even in high sea-state – recent operations using DriX have incidentally shown that data cleaning could be reduced from 90%. Combined with the FlipiX ROTV, a unique conveyance platform for Side Scan Sonars (SSS) and magnetometers, this global uncrewed solution enhances the autonomous survey scope, enabling to conduct bathymetric, geophysics and UXO survey in a single run. This drastically reducing survey time and removing the need for costly support vessels.

Deploying iXblue autonomous platforms on offshore wind farms sites also means conducting operations with a reduced impact on the environment. Consuming only 50 liters of fuel per day, the DriX USV can indeed replace ships of about 60 meters whose daily consumption is about 5000 liters of fuel. This means that the ecological footprint of operations at sea can be reduced by a factor of 100 compared to traditional vessels.

Finally, as pioneers in uncrewed maritime solutions, iXblue further helps ensure the safety of personnel, reducing their global exposure at sea. The company uncrewed solutions can indeed be supervised from Remote Control Centers (located either onshore or on a Mother Vessel) using reliable Over The Horizon capabilities thanks to advanced communication means and obstacle avoidance systems.

### **Advanced sensors offering unrivaled performance and reliability in shallow waters**

Increased efficiency can further be reached when combining iXblue's uncrewed solutions with the company's trusted subsea positioning and imaging solutions such as the Gaps Series of USBL Systems, the company's complete range of Inertial Navigation Systems (INS), as well as the Sams Synthetic Aperture Mapping Sonars, Echoes sub-bottom profilers, and SeapiX 3D multibeam echosounders. Compatible with third-party assets for better interoperability, all iXblue sensors can be deployed from a wide range of platforms, from traditional vessels to uncrewed surface and subsea vehicles, and are easy to integrate into existing pools of equipment and operational fields with no compromise on performance or reliability, ultimately bringing increased flexibility and efficiency.

Compact and lightweight, the Gaps Series of USBL subsea positioning systems have incidentally already been selected within the renewable energy industry to conduct various operations such as UXO pre-survey and structure deployments. Easy to deploy the Gaps USBL systems embed their own motion sensors and do not require any on-the-field calibration. Offering unmatched accuracy in very shallow waters and horizontal tracking conditions, they are especially suited to the environments encountered on wind farm development sites. Coupled to iXblue subsea Inertial Navigation Systems (INS/AHRS), that already equip over 80% of the subsea vehicles used in the Energy and Geoscience industries, the Gaps Series will power highly accurate positioning and tracking of subsea assets such as AUV, ROV or Towfish. It will also be the perfect technology for cable laying and touch down monitoring operations that require highly robust horizontal tracking capability.

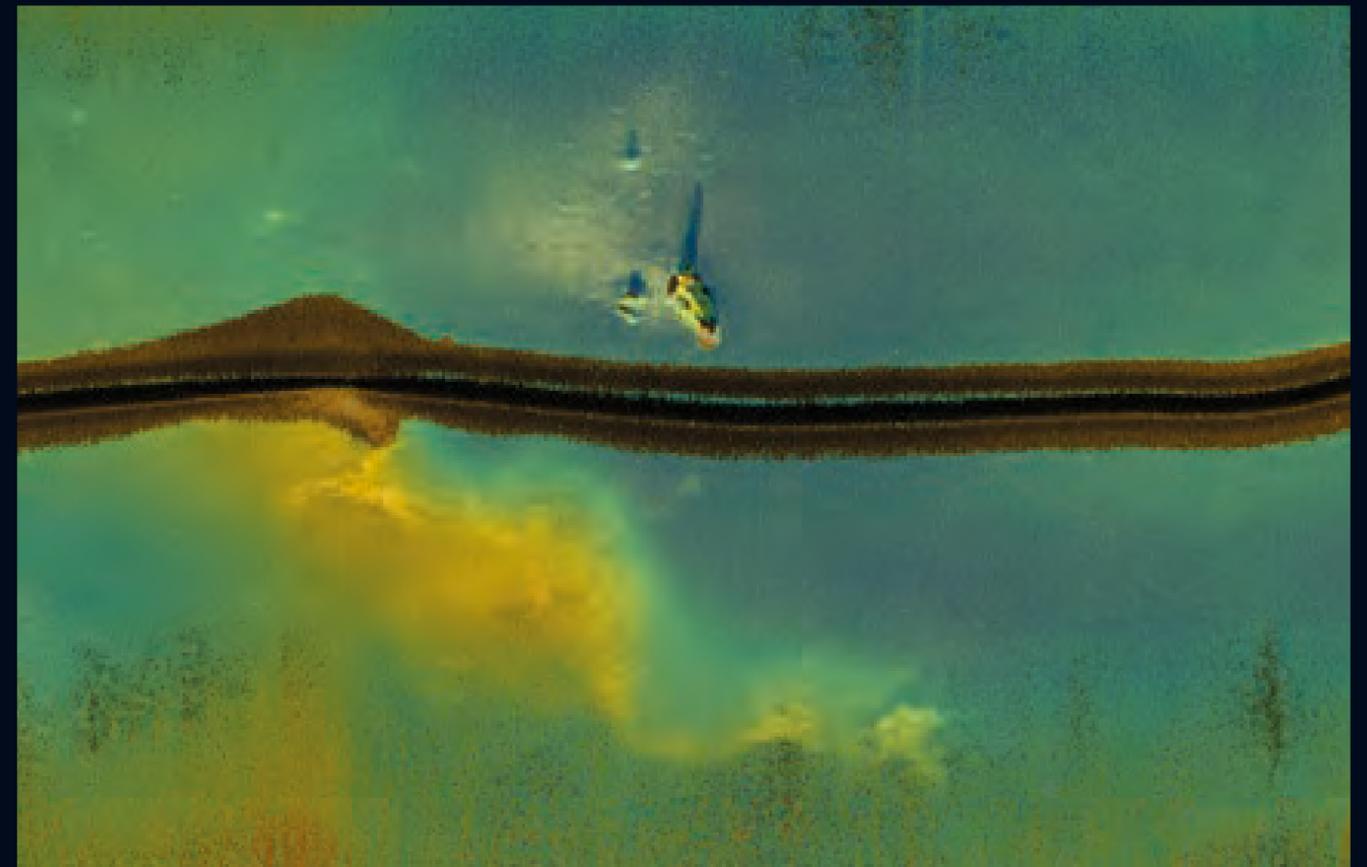
iXblue unique subsea imagery solutions such as the Sams Series of Synthetic Aperture Mapping Sonars (SAS), Echoes sub-bottom Profilers and SeapiX 3D multibeam echosounder are also perfectly adapted to wind farms applications. Relying on 20 years of field proven technologies, the wide range of iXblue subsea imagery solutions extends from water column analysis to seabed

mapping and monitoring and meets all renewable energy installations and surveillance needs.

The Sams Synthetic Aperture Mapping Sonars provide unprecedented performance compared to conventional side scan sonars even in the very shallow waters encountered within wind farms environments. They deliver, in real time, both high-resolution images of the seabed and interferometric bathymetry required for site and route survey. The Echoes Series of sub-bottom profilers will highlight the sedimentary deposits architecture and gas release, as well as high reflective buried objects, such as cable, pipelines and boulders. The iXblue Sams and Echoes Series will therefore be particularly useful for field extension phases, cable route surveillance and inspection and maintenance operations.

Finally, the company's SeapiX 3D multibeam echosounder will enable highly accurate classification of marine ecosystems and quantification of biomass, fish and shoal dynamics. This real-time biomass monitoring in a static position thus enables the study of the natural resource evolution throughout the whole offshore wind project lifecycle.

Overall, iXblue comprehensive set of technologies, from sensors to autonomous conveyance platforms, offer unmatched performance, reliability, and versatility, allowing operators to conduct accurate but efficient operations in a reduced timeframe and with increased safety. Smaller and smarter technologies that do not require large vessels and big crews to be deployed, they reduce the hours spent at sea, and will play a central role in the transition of the offshore energy industry towards a more sustainable future. ■



Merging of high resolution SAS imagery and bathymetric data produced by Sams 150.



# POWERING UNRIVALED NAVIGATION PERFORMANCE FOR ROV AND AUV

Equipping over 80% of the subsea vehicles used in the Energy and Geoscience industries, iXblue FOG (Fiber-Optic Gyroscope)-based Inertial Navigation Systems (INS) and Attitude Heading and Reference Systems (AHRS) are accurate and maintenance-free navigation systems that offer unrivaled performance and power robust navigation for Remotely Operated Vehicles (ROVs) and Autonomous Underwater Vehicles (AUVs).

Graph 1

**I**Xblue complete range of subsea Inertial Navigation Systems have been designed to meet operators' various needs in terms of performance and depth rating. Offering AHRS and INS in OEM and titanium versions, iXblue subsea navigation solutions cover the full spectrum of performance needed for subsea projects, from navigation to survey grade. A performance that can further be enhanced with the company's INS/DVL tight-coupling solutions, as well as Delph INS post-processing software. A trusted partner on which to rely for highly reliable and accurate navigation, iXblue boasts over 3,000 subsea navigation systems in operation worldwide.

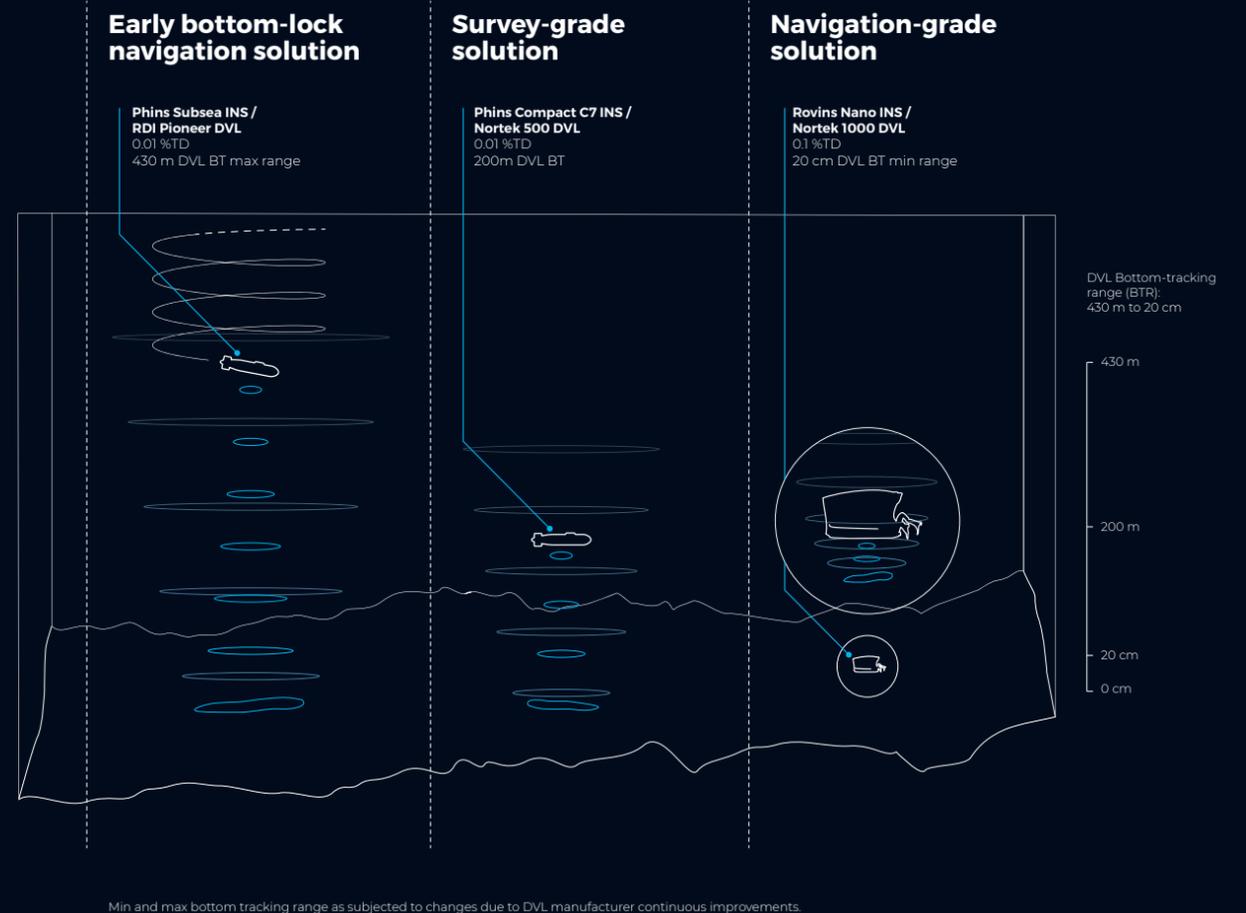
iXblue Inertial Navigation Systems equip over 80% of the subsea vehicles worldwide

## POWERING UNMATCHED PERFORMANCE

### Increased performance and flexibility through INS/DVL tight-coupling

Striving to always bring increased efficiency to companies operating in the subsea world, and to enhance its Inertial Navigation Systems positioning performance, iXblue partners with DVL manufacturers Nortek and Teledyne RD Instruments to offer INS/DVL tight-coupling solutions. Benefitting from iXblue's field-proven FOG technology and from the latest DVL developments that Nortek and Teledyne RD Instruments have been working on, this solution combines the best navigation technologies available today and offers a scalable, plug & play solution which performance and characteristics can be best suited to the user's needs. (See graph 1)

Offering modularity and flexibility, it enables users to choose the INS and DVL combination best suited to their needs in terms of accuracy, volume, weight and altitude, without compromising on the solution's ease-of-use. Additionally, integration on the vehicle is made flexible thanks to the possibility to separate both the INS and DVL and individually place them anywhere and in any convenient orientation.



Min and max bottom tracking range as subjected to changes due to DVL manufacturer continuous improvements.



**IXBLUE NAVIGATION SYSTEMS HAVE BEEN OPERATED, IN THE MOST CHALLENGING ENVIRONMENTS SUCH AS SUBSEA OR LONG DURATION SPACE APPLICATIONS.**

An ROV being deployed for a scientific mission

## **WORLDWIDE LEADER IN HARSH ENVIRONMENTS**

### **Benefiting from FOG technology**

iXblue gyrocompasses and Inertial Navigation Systems all benefit from the Fiber-Optic Gyroscope (FOG) technology that iXblue pioneered. Offering solid state, strap-down systems with no mechanical or moving parts, iXblue FOG technology offers maintenance-free solutions with very low cost-of-ownership.

### **Complete mastery of the technology**

Mastering the full value chain of the inertial navigation technologies it develops, iXblue designs and manufactures, in-house, every component that are integrated into its systems, from its FOG gyroscopes to its own accelerometers, electronics and Kalman filters. This vertical integration allows iXblue to push the limits of its INS and gyrocompasses technology to enhance their performance to the best of their possibilities.

### **Advanced algorithms and Kalman filter**

Leveraging this unique mastery of all its navigation systems components, iXblue, acting as both a system manufacturer and integrator, is able to develop the best-in-class real-time and post-processing algorithms for its inertial navigation systems. This translates into the design of the most advanced navigation systems available on the market today.

### **A robust inertial technology**

Reliability is key when operating in the extreme environments of the subsea sector, and iXblue comprehensive range of subsea gyrocompasses and Inertial Navigation Systems is trusted

worldwide for its high accuracy and reliability. iXblue navigation systems have thus been operated, for the past 20 years, in the most challenging environments such as subsea or long duration space applications.

iXblue systems have furthermore been qualified to withstand the extremely harsh environments of land defense, with its extreme vibrations, shocks and temperature changes and are now operated by over 60 navies and armies worldwide, testifying of the robustness and reliability of iXblue solutions.

### **150 000 hours of MTBF**

iXblue INS and AHRS have cumulated over 3 million functioning hours. Using standard telecom technology components with proven lifetime and reliability, iXblue navigation systems – including their three fiber-optic gyroscopes, three accelerometers and system electronics – have demonstrated over 150 000 hours of Mean Time Between Failure (MTBF), with the FOG itself boasting an MTBF higher than 500 000 hours, making iXblue navigation systems highly reliable solutions.

### **Low-power consumption**

iXblue continuously works on the power consumption of its INS systems. This is especially important for AUV manufacturers and operators who seek to save watts, while keeping high data processing power.



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## AN OPEN ECOSYSTEM FOR EASY INTEGRATION

### Interfacing

Integration of external sensors (DVL, pressure sensors, Sound Velocity Probes...) is made easy thanks to a wide range of protocols offered, both in inputs and outputs. Ascii, NEMEA, and binary telegrams are available through a system embedded web-based Graphical User Interface (GUI) or accessible through control command for AUVs.

### Third-party friendly

As per the company's open philosophy, iXblue inertial navigation systems all benefit

from an open format protocol, making them compatible with third-party products and solutions. This results into INS/AHRS that are easy to integrate into existing pool of equipment and operational fields.

### ITAR-free

iXblue in-house manufacturing of all its INS/AHRS ensures the navigation company's independence in relation to strategic suppliers and allows iXblue to offer ITAR-free products that are easy to export worldwide.

## A SOLUTION FOR ALL SUBSEA VEHICLES

### Scalable navigation solutions

Offering a complete suite of scalable AHRS and INS which performance and characteristics cover the full spectrum of users' needs and requirements, iXblue subsea navigation solutions can easily be integrated into various subsea vehicles such as Remotely Operated Vehicles (ROV), Autonomous Underwater Vehicles (AUV) or Tow-fish.

### Flexible vehicle integration

iXblue subsea navigation systems offer integrators and operators a versatile solution available either in titanium housing or in EM version for applications requiring bespoke vehicle integration.

### A powerful post-processing suite

iXblue subsea INS performance can further be enhanced using Delph INS post-processing and batch productivity tool. Offering powerful data editing and processing functions together with data export capability, Delph INS is the ideal software for quick and easy navigation enhancement. ■

# Inertial navigation systems and Attitude Heading & Reference Systems

FOR SUBSEA APPLICATIONS



Octans Nano / OEM

Navigation-grade AHRS



Octans Subsea

Survey-grade AHRS



Rovins Nano / Phins Compact C3

Compact navigation-grade INS



Rovins / Phins Compact C5

Survey-grade INS



Phins Subsea / Phins Compact C7

High performance deep-water survey-grade INS

	Octans Nano / OEM	Octans Subsea	Rovins Nano / Phins Compact C3	Rovins / Phins Compact C5	Phins Subsea / Phins Compact C7
<b>Heading accuracy</b>	0.5	0.1	0.1	0.04	0.01
<b>DVL-aided optimal performance in typical conditions (%TD - CEP50)</b>	n/a	n/a	0.04	0.02	0.01
<b>Roll&amp;Pitch accuracy</b>	0.1	0.01	0.05	0.01	0.01
<b>Weight in water (kg)</b>	5.5 (Octans Nano) 1.6 (OEM)	6.2	5.5 (Rovins Nano) 1.6 (Phins C3)	6.2 (Rovins) 4.7 (Phins C5)	13 (Phins Subsea) 3.5 (Phins C7)
<b>Depth rating (m)</b>	4,000 (Octans Nano)	3,000	4,000 (Rovins Nano)	3,000 (Rovins)	6,000 (Phins Subsea)

# CHOOSING THE RIGHT USBL SOLUTION

With units operating worldwide, the Gaps Series of high-accuracy USBL acoustic positioning and communication systems has become a reference for many users across the world. Offering unrivaled horizontal tracking capabilities and high-performance from extremely shallow water depths to 4,000 meters, the Gaps Series is used for various applications such as diver-tracking, work-class ROV surveys, AUV missions or for the most critical dynamic positioning operations. Let's take a look at what both USBL have to offer.



## POWERING ULTRA-PERFORMANCE THROUGH A UNIQUE DESIGN

**G**aps Series USBL positioning and communication systems are compact, all-in one inertial and USBL solutions. Their unique design provides customers with maximum performance. The 3D, 4-hydrophone antenna configuration utilizing differing leg lengths means the USBL horizontal tracking capabilities are enhanced and the maximum acoustic aperture widened, offering more than 200° of omnidirectional coverage.

### High-accuracy

Thanks to its unique design that combines a high-performance ultra-short baseline (USBL) and fiber-optic based (FOG) motion sensor within the same housing, the Gaps Series provides unrivaled subsea positioning accuracy in diverse and challenging environments.

### From shallow to deep waters

Gaps Series embedded gyroscope and 3D omnidirectional acoustic antenna configuration offers the USBL system with an omnidirectional coverage and 200° acoustic aperture. This translates into true horizontal tracking capabilities with no need to tilt the antenna. Covering the full spectrum of medium frequency applications, from the surface to 4,000m water-depths, Gaps Series is extremely efficient in shallow waters and horizontal tracking conditions, especially when multiple subsea vehicles (ROV, AUV...) must be simultaneously located at 360°.

### Multi-beacon tracking

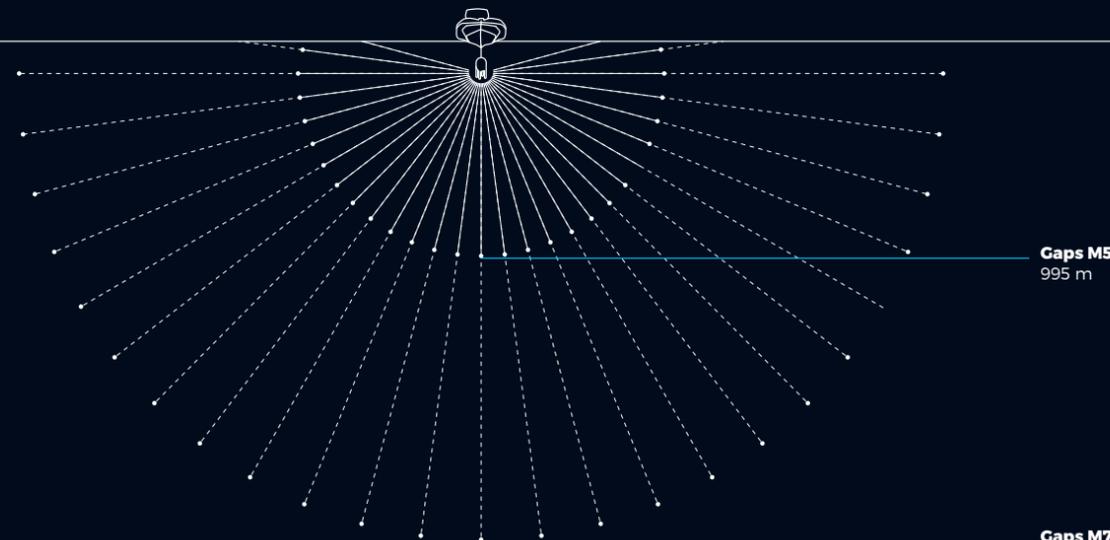
An increasing number of subsea operations require the simultaneous tracking of several targets and assets. This is the case for Mine Counter Measure (MCM) operations during which fleets of multiple AUV need to be tracked and controlled or for the Renewables and Oil&Gas industries for instance, with operations requiring the simultaneous tracking of ROVs and vessel Dynamic Positioning (DP). The Gaps Series offer multiple and simultaneous tracking capabilities for up to 40 beacons (both iXblue and third-party), making iXblue's USBL the perfect fit for all operations requiring highly accurate and reliable tracking and positioning of multiple assets.

Compact and light-weight, Gaps is easy to deploy and operate.



**Gaps M5**  
With embedded Octans Nano AHRS  
—  
Intégrant une AHRS Octans Nano

**Gaps M7**  
With embedded Phins INS  
—  
Intégrant une INS Phins



**Gaps M5**  
995 m

**Gaps M7**  
4000 m



**THE GAPS SERIES ARE  
TRUE CALIBRATION FREE  
SYSTEMS THAT OFFER  
PRECIOUS OPERATIONAL  
TIME SAVINGS AND  
EFFICIENCY ON THE FIELD.**

## VERSATILE AND EASY TO USE SYSTEMS

### True calibration-free systems

Embedding their own gyro and motion sensor in their housing, the Gaps Series of USBL systems do not need to be coupled with external sensors, and do not require any on-the-field calibration. This makes them true calibration free systems that offer precious operational time savings and efficiency on the field.

### One single equipment for positioning and communication

The Gaps Series can not only be deployed to precisely position subsea vehicles, but it can also be used for communication with the underwater asset. Thanks to its telemetry feature, bidirectional communication between the surface vessel and the underwater vehicle is enabled for tasks such as INS re-alignment, sensor data retrieval, LBL array calibration with iXblue Canopus transponder or AUV command & control.

### Third-party friendly for easy integration

Benefiting from an open architecture, the Gaps Series is compatible with both iXblue and third-party transponders for easy integration within existing pool of equipment. Easily interfaced with the most commonly used navigation software, iXblue's USBL are hassle-free systems that are easy to integrate and use.

### Easy to deploy

The Gaps Series are particularly easy to install and operate thanks to their compact size and embedded motion sensors that make them ready to use right away. Quick to deploy, they can be used from over-the-side poles, stingers and confined spaces. Their light-weight allows for the USBL to be deployed from very small vessels with a reduced crew onboard or even deployed on instrumented buoys.

### How to choose between Gaps M5 or Gaps M7?

Offering unrivaled horizontal tracking capabilities and high-performance from extremely shallow water depths to 4,000 meters, the Gaps Series covers a wide range of applications. The Gaps M5 will be especially suited for subsea positioning needs of 1.000m or less - and will thus be ideal for renewable energy related applications - as well as for any tracking operation, from diver- to multiple subsea assets- or inspection ROV- tracking. The Gaps M7 will remain the best asset for highest survey requirements, subsea multibeam and laser scan positioning, as it offers an accuracy that can reach 0.6% of the slant range up to 4000m.

For reservoir dam IMR operations, where a ROV must be positioned below a distance of 100m with sub-metric accuracy, the Gaps M5 will be the best solution. Overall, the Gaps M5 will be the preferred solution for all short distance applications such as rivers, lakes and dam environments. Thanks to its compact size and embedded AHRS, it is easy to integrate and operate and can be used on small vessels with reduced crew onboard or even deployed on instrumented buoys. ■

## Gaps M5 & Gaps M7

USBL ACOUSTIC POSITIONING SYSTEMS



Gaps M5



GapsM7

<b>Operating range</b>	995m	4000m
<b>Absolute accuracy (% of slant range CEP50)</b>	0,5%	0,06%*
<b>Embedded motion sensor</b>	Octans Nano FOG-based AHRS	Phins FOG-based INS
<b>Heading accuracy</b>	0,5% secant lat (RMS)	0,01% secant lat (RMS)
<b>Dimensions (Height x Diameter)</b>	520mm x 296mm	638mm x 296mm

\* In vertical conditions including GNSS error of 0.1m



# DELIVERING OPERATIONAL EFFICIENCY USING LBL TECHNOLOGY

iXblue LBL subsea positioning technology is a simple cost-efficient solution that provides highly performant subsea positioning and monitoring capabilities down to 6,000m. Bringing together Canopus intelligent transponders, Ramses transceivers, Inertial Navigation Systems and Delph Subsea Positioning Software, it offers advanced sparse LBL capabilities that allow operators to reduce the number of transponders deployed on the seabed with no compromise on performance.

**SPARSE LBL MAKES IT POSSIBLE TO NAVIGATE WITH FEWER TRANSPONDERS WITHOUT MAKING ANY COMPROMISE ON PERFORMANCE.**

## Powering advanced LBL capabilities

### High performance

iXblue's 6,000m depth rated LBL positioning solution comprises the Canopus transponders and Ramses transceivers. This absolute subsea positioning system enables highly accurate and reliable deep-sea operations by providing operators with centimetric positioning accuracy in water depths up to 6,000m.

### Sparse-LBL: reduced transponders for higher accuracy

When coupled with inertial navigation systems (INS), the use of iXblue Ramses transceiver offers even greater accuracy and reliability thanks to data redundancy. This is iXblue concept of "Sparse-LBL", that powers cost-efficient subsea operations by reducing the number of transponders deployed on the seabed, thus decreasing the time spent on transponder deployment, calibration and maintenance. The sparse LBL system works as explained on figure 1.

Following this principle, each range measurement helps in computing a new position, as opposed to classical triangulation algorithms, for which at least three simultaneous range measurements are required to establish a position. It is therefore possible to navigate with fewer transponders without making any compromise on performance.

Figure 2 gives the performance that can be reached depending on the number of transponders used.

### Robust acoustic communication

In addition to the precise positioning of subsea assets, most subsea applications require robust acoustic communication links to be established between the surface, the subsea vehicles, and the deployed transponders. iXblue transceivers thus offer two different communication modes:

#### TELEMETRY

A robust and low bit rate acoustic communication link at 500 b/s that can be used during tracking operations. Telemetry allows for AUV control/command.

#### MODEM

A high bit rate acoustic communication link at 3 kb/s that allows end users to recover measurements that have been logged by the Canopus transponder over long periods of time.

It is worth noting that, thanks to its hundreds of acoustic codes for interrogation and reply, iXblue Canopus transponders can be used in the most complex environments without any acoustic interferences, ensuring highly reliable subsea operations.

Figure 1  
Sparse LBL  
principle

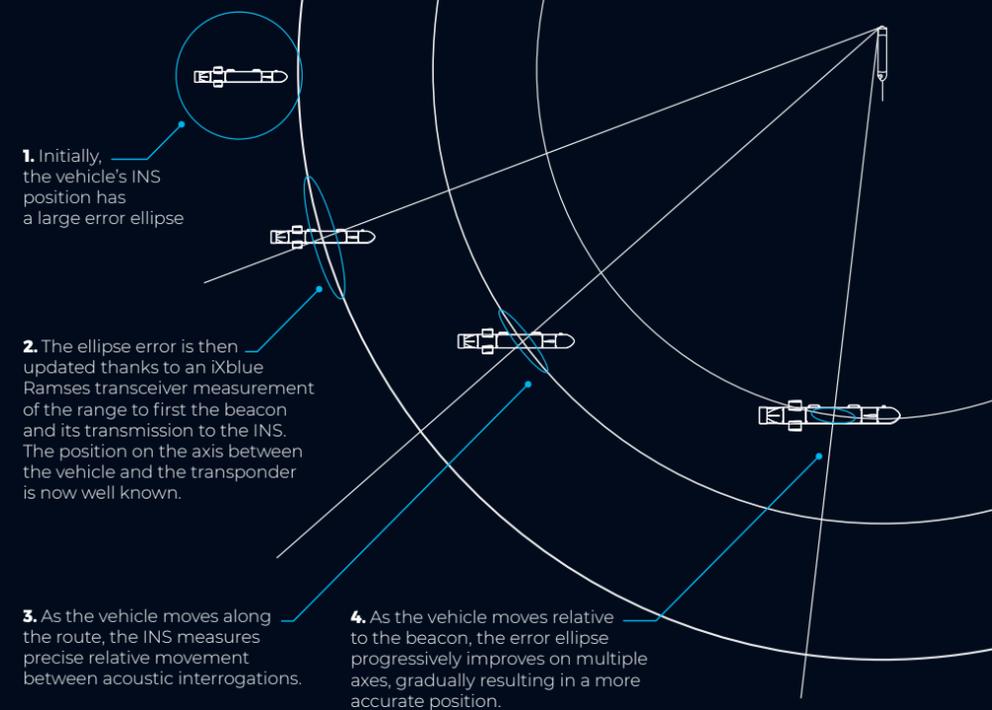


Figure 2  
Performance achieved  
with Sparse LBL

	Mode	Positioning accuracy
<b>4 transponders</b>	LBL or sparse LBL	< 0.1 m
<b>3 transponders</b>	LBL or sparse LBL	< 0.2 m
<b>2 transponders</b>	Sparse LBL	< 0.5 m
<b>1 transponder</b>	Sparse LBL	< 1 m

# THANKS TO THEIR ADVANCED FEATURES THE CANOPUS TRANSPONDERS CAN BE CALIBRATED USING NOVEL TIME-EFFICIENT METHODS.

## Embedded Environmental Sensors

On top of featuring underwater acoustic communication between transponders and transceivers, Canopus and Ramses embed their own environmental temperature, pressure and inclinometer sensors. Canopus transponders can further be enhanced with other optional sensors such as Digiquartz depth sensor, sound velocity sensor or other external sensors for increased operational efficiency.

While able to send all recording to the surface in real-time thanks to a robust and reliable acoustic link, both Canopus transponder and Ramses transceiver offer a data logging feature that allows the recording of internal or external sensors on the beacon internal memory for more occasional data retrieval.

## Multiple operating modes

Operating the Canopus and Ramses LBL solution on subsea operations will give operators greater flexibility thanks to multiple operating mode capabilities. This unique feature brought by iXblue solution allows users to adapt their LBL operation procedures to the level of performance required for each of their application.

## CALIBRATION

- Time travel acquisition during box-in process
- Baselines acquisition during mutual calibration process

# Unrivaled operating life

## Low power consumption

With their extremely low power consumption, the Canopus LBL transponder and Ramses LBL transceiver offer unrivalled battery life. A standard Alkaline battery pack will provide up to 70 months or 1,600,000 pings of battery life in listening mode, while a Lithium battery will ensure up to 140 months of battery life or 2,800,000 pings for long duration subsea operations.

## An intelligent ping management system

An intelligent ping management feature further extends the LBL solution's battery life, greatly reducing, if not eliminating, beacon

- SLAM (Simultaneous Localization and Mapping) - Simultaneous vehicle positioning and fixed-transponders calibration

## POSITIONING

- LBL  
Positioning of the transceiver or positioning of a mobile transponder in an array of 3 transponders (min)
- LBL/INS  
A more robust positioning solution than LBL thanks to data redundancy
- Sparse LBL  
Reduced number of transponders deployed (1 min)

## MONITORING

- Real time monitoring of transponders internal/external sensor
- Download of data recorded by the transponder over long periods of time

## Disruptive calibration techniques

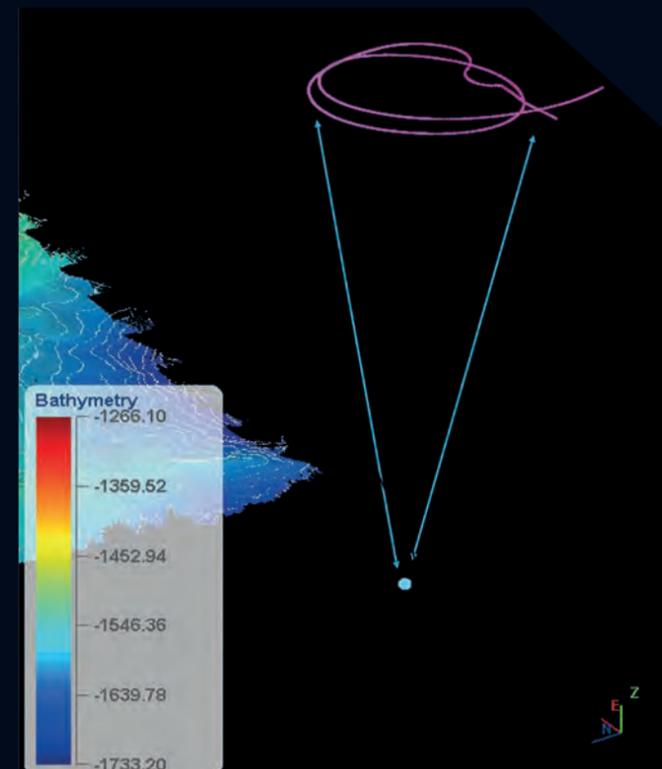
Thanks to their advanced features combining the best of acoustic and inertial technologies, the Canopus transponders can be calibrated using either traditional or novel time-efficient methods, including:

- USBL tracking
- Surface box-in
- Baseline calibration and LMS adjustment
- SLAM technique
- ROV box-in

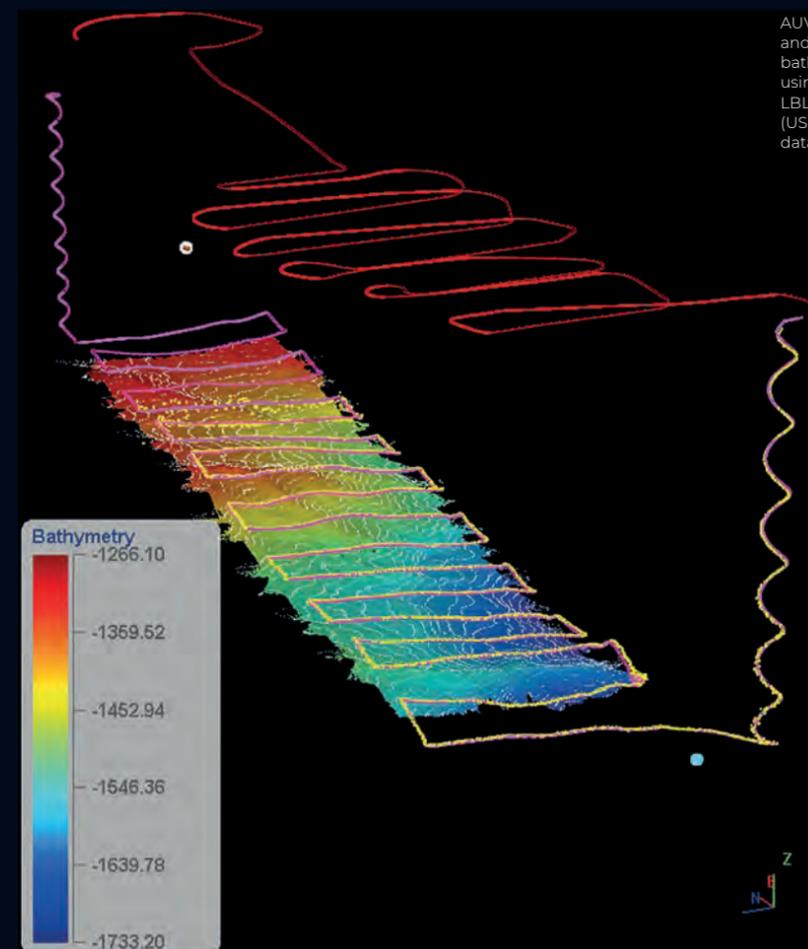
maintenance requirements for subsea projects. iXblue's coupling between acoustic and inertial technologies indeed reduces transponders interrogation rate compared to traditional LBL systems, with which transponders are simultaneously interrogated every few seconds.

## Corrosion-free beacons

The Canopus transponders and Ramses transceivers are highly reliable equipment able to endure the harsh conditions of subsea environments. Fitted with a cathodic protection (anodes located on the upper and lower parts of the transponders) they are resistant to corrosion and can be deployed at sea for long duration operations.



Surface Box In of single Canopus transponder.



AUV navigation and collected bathymetry using a single LBL transponder. (USBL cross check data in Yellow)

**DELPH SUBSEA POSITIONING (DSP) SIMPLIFIES THE PLANNING, SIMULATION, OPERATION AND POST-PROCESSING OF SUBSEA POSITIONING TASKS.**

## A user friendly LBL solution

### A third-party friendly positioning solution

The Canopus LBL transponders and Ramses LBL transceivers offer inter-beacon and inter-product acoustic communication and are compatible with all major third-party acoustic positioning solutions used on the market. This makes them easy to add on existing fields of operation and existing pool of equipment.

### An efficient Supervision Software Suite

To manage the increasing complexity of subsea operations and to offer a solution that is easy to deploy and use, iXblue developed a global supervision software that integrates the full range of iXblue subsea systems: Delph Subsea Positioning Software.

An intuitive and dynamic software used to plan, operate and post-process iXblue subsea positioning products, Delph Subsea Positioning (DSP) simplifies the planning,

simulation, operation and post-processing of subsea positioning tasks. Comprising four intuitive and user-friendly core modules, DSP is an easy-to-use yet powerful tool enabling even the most complex subsea operations by making each step of the subsea positioning operation simpler, error-free and faster, saving vessel and man time.

### Remotely controlled operations

iXblue solutions being based on web technologies, the whole Canopus, Ramses and Delph Positioning Software ecosystem can be remotely controlled using a low bandwidth satellite communication link.

A “remote access kit” gives surveyors and support engineers remote control over the whole solution by directly accessing the devices IP addresses. A solution that, contrary to simple screen sharing or remote desktop access, requires less data to be transferred over the satellite communication link.

## A LBL solution covering all applications

The Canopus and Ramses LBL solutions, along with iXblue subsea INS, are being operated worldwide for diverse applications in the energy, geoscience, marine civil engineering and defense markets. Applications include:

- ROV positioning
- AUV navigation
- Metrology
- Underwater geodesy and seismics
- Environnemental monitoring
- Structure monitoring
- Structure placement
- Subsea construction
- Drilling
- Mining (crawler positioning)
- Hull inspection
- Mine counter measures (MCM) ■

# Ramses transceiver & Canopus transponders

LBL SOLUTIONS



**Ramses**  
Sparse-LbL transceiver



**Canopus**  
Intelligent LBL transponder

	Ramses	Canopus
Depth rating	6,000	6,000
Accuracy (mm)	< 10	< 10
Autonomy (pings at max sound level)	n/a	2,800 000 (alkaline)
Transducer beam shape	Omnidirectional	n/a
Data telemetry	Yes	Yes
Data logging (Gb)	32	32

SEAPIX-FLS:

# SAFETY OF NAVIGATION WITH UNMATCHED ENVIRONMENTAL AWARENESS

The SeapiX-FLS Series is a range of scalable 3D multi-beam Forward Looking Sonars that are particularly suited for obstacle avoidance, real-time seabed mapping and rapid environmental assessment (REA) applications. Offering obstacle detection from the seabed to the surface, they offer unmatched situational awareness for increased safety of navigation.



# A unique design for real-time obstacle detection

The SeapiX-FLS Series, which embeds its own Inertial Measurement Unit (IMU), provides a clear and precisely georeferenced picture of the surrounding environment. Thanks to its unique, three-dimensional coverage of the water column and bathymetric profile, the SeapiX-FLS Series offers extremely accurate, real-time obstacle detection, as well as object analysis (based on position and kinematic, target strength index, acoustic measurements, etc.), ensuring vessels safe navigation.

## Obstacle detection from the surface to the seabed

Thanks to its innovative electronically steerable Mills Cross antennas, the SeapiX-FLS Series provides unrivaled coverage of the entire water column, from surface to sea bottom. Each detection is then mapped in real-time within the surrounding environment, and autonomously provided to external systems, or is displayed in 2D/3D within iXblue's operator oriented MMI. This ultimately provides crews with a clear picture of what lies ahead, both at the surface and subsea.

Having a long detection range and high accuracy is one thing. But SeapiX-FLS goes even further by providing a detailed scan of everything within its range using four different types of swaths. It can even track identified targets for confirmation.

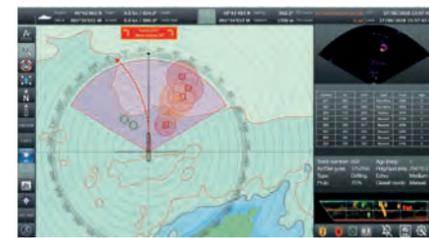
## A fully autonomous detection process

No need to be a sonar expert to operate SeapiX-FLS. Fully dynamic, the detection, tracking, classification, and avoidance capabilities can run in the background in full autonomy. Should you need it, the process can also be set manually, case by case, allowing for maximum flexibility (see below figure).

SeapiX-FLS detection process



# An intuitive and efficient User Interface



The SeapiX-FLS Series comes with a highly intuitive User Interface

## Providing real-time obstacle detection probability map

Another key feature of the SeapiX-FLS Series is the ability to generate a real-time obstacle detection probability map. This information is crucial for crew decision making, allowing them to adapt their speed according to their underwater environment, and thus navigate with more safety both for the crew and the platform.

## One single interface for efficient multiple FLS operations

Increased detection coverage can be reached by combining multiple SeapiX-FLS on the same vessel, with no further hassle for the operator thanks to the SeapiX-FLS user-

friendly MMI. This MMI can centralize and simultaneously display information gathered by the multiple SeapiX sonars.

## A FLS for all vessels and drones

The SeapiX-FLS Series offers a scalable solution that can be mounted on all crewed and uncrewed surface and subsea vehicles. It can be integrated on hulls, hoisting systems or within gondolas. Specific integration can be discussed between integrator, ship builder and iXblue.

The SeapiX-FLS Series can also be installed on fixed platforms (buoys, tripods on the seabed...) for port and subsea infrastructure monitoring operations. ■

# SeapiX-FLS Series

FORWARD LOOKING SONARS



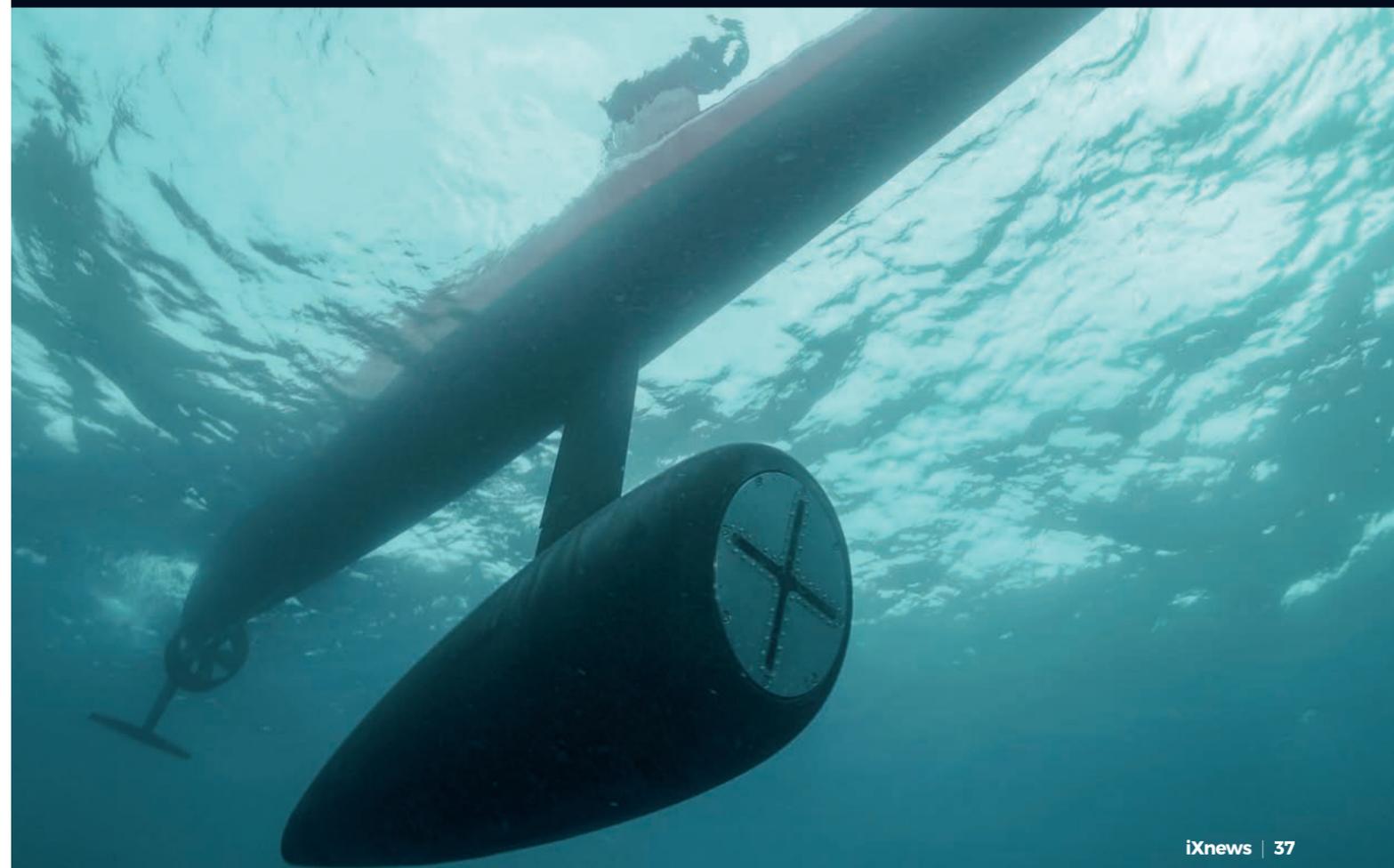
SeapiX-FLS 5



SeapiX-FLS 7

<b>Volume coverage</b>	120°x120°	90°x90°
<b>Object in the water Column (-15dB)</b>	>300m	>600m
<b>Drifting Object (-15dB)</b>	>300m	>450m
<b>Object on the bottom (-15dB)</b>	>200m	>350m
<b>Low Target Strength object in the water Column (-25dB)</b>	>250m	>520m

SeapiX-FLS 5 mounted on iXblue DrIX USV during an operation off the Coast of France





**NEW** OCEANO R1  
**ACOUSTIC RELEASE**  
ENHANCED COASTAL  
FEATURES FOR OPERATIONS

**SPECIAL CARE HAS BEEN GIVEN TO THE OCEANO R1 RELEASE MECHANISM TO OVERCOME THE CHALLENGES POSED BY CONCRETION OR BIOLOGICAL DEPOSITS**

With thousands of units delivered worldwide, iXblue's Oceano Series of acoustic releases have proven their reliability and safety with decades spent deploying and recovering critical subsea instrumentation. Meeting the most demanding needs of scientific campaigns and offshore and marine works, the Oceano Series addresses a wide range of applications from coastal to ultra-deep offshore operations. It is to meet customers' evolving requirements that iXblue has revamped its trusted coastal release, the Oceano 500, with the arrival of its new Oceano R1.

**Enhanced Command and Control features**

The Oceano R1, that now replaces the previous Oceano 500, provides bi-directional communication capabilities, offering users with the ability to get acknowledgements of receipt and execution of acoustic commands. All enhanced acoustic commands available on the deep-sea versions of iXblue Oceano Series have also been made available on the new Oceano R1 dedicated to coastal operations: Pinger mode, diagnostic function to know the verticality status of the device as well as the residual battery voltage, are all new features of this upgraded acoustic release.

**Extended deployment capability**

Durability being a key feature for any acoustic release, the new Oceano R1 benefits from years of developments on iXblue complete range of acoustic releases. With a depth-rating extended to 1,000m (against 400m for the Oceano 500), the Oceano R1 not only offers excellent robustness to corrosion, reducing maintenance and reinforcing its endurance in harsh environments, but also provides very low consumption and unrivaled battery life for extended deployment periods (up to 30 months at 0°C using alkaline batteries). Users can furthermore increase the release's overall autonomy by replacing the standard alkaline batteries by lithium ones without requiring any hardware modifications.

**Improved design for increased reliability**

Safely deploying and recovering seabed equipment and their collected data is critical to many scientific and offshore operations. Acoustic releases are thus key instrumentation that need to offer the utmost reliability. With the new Oceano R1, the previous Oceano 500 has been redesigned to offer operators with the most dependable acoustic releases. Special care has been given to the Oceano R1 release mechanism to overcome the challenges posed by concretion or biological deposits and to offer highly reliable releases. A new screw-off release mechanism, associated with a disposable releasable nut, has thus been designed. Shocks and corrosion prevention is also ensured thanks to a hard-anodized aluminum housing, covered with a protective sleeve and fenders. The Oceano R1 acoustic release also benefits from a simplified closing system using Teflon rods instead of a nut to remove potential jamming issues. All these new features, already proven on iXblue other acoustic releases, ensure the system's reliability, whatever the conditions encountered.

**A secured Universal Command and Control System**

The new Oceano R1, like all iXblue acoustic releases, can be actuated using one single universal telecommand unit: the compact, portable, versatile, and lightweight, Oceano TT801 low frequency band acoustic telecommand. Easily operated from large research vessels or very small rubber boats, this universal deck set unit enables operators to calculate and display slant distances to target, monitor remote instruments status and manage command codes. ■

# Oceano R1

ACOUSTIC RELEASE

## General

<b>Operating temperature</b>	-5°C to +40°C
<b>Storage temperature</b>	-20°C to +70°C
<b>Acoustic commands</b>	Ranging, release, release with pinger ON/OFF, diagnostic (verticality status and battery voltage)
<b>Shipping</b>	Plywood transit case, 665 x 250 x 225 mm, 13,5 kg

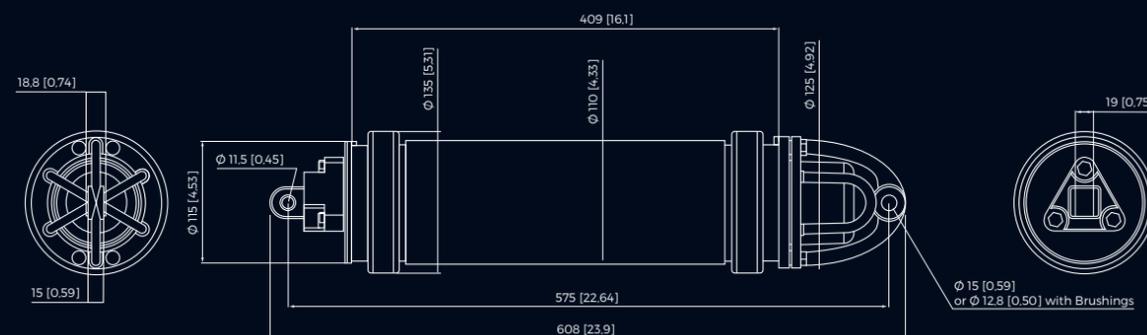
## Mechanics

<b>Load characteristics</b>	500 kg SWL* / 200 kg RL** / 1 000 kg TL***
<b>Overall dimensions (dia x L)</b>	135 x 660 mm
<b>Overall weight (air / water)</b>	7.5 kg / 3 kg

## Acoustic

<b>Operating frequency</b>	Low frequency (8.0 to 16.0 kHz)
<b>Transducer beam pattern</b>	Omnidirectional (horizontal plan) / Hemispherical (vertical plan)
<b>Operating life</b>	30 months @ 0°C (Alkaline)
<b>Range</b>	More than 2,000 m depending on ambient noise and acoustic propagation conditions

## Mechanical drawing



\* SWL - Safe Working Load. The maximum static or dynamic load that can be supported by the instrument in normal operating conditions with no release command in progress.

\*\* RL - Release Load. The maximum load that can be supported while release command is activated (DC motor rotating).

\*\*\* TL - Test Load. The maximum load that can be supported by the instrument without permanent damage or water ingress (not to be used in normal operation mode).



# PROVIDING REAL-TIME STATIC BATHYMETRY FOR HIGH ACCURACY MARINE WORKS

SeapiX-C is a solid-state multibeam sonar that provides unique highly accurate and real-time georeferenced static bathymetry capabilities for high-precision marine works. Providing more efficient and flexible operations, as well as increased safety, SeapiX-C is a valuable seabed mapping solution that enables instant monitoring and situational decision-making. Perfect for marine works, it already benefits from a track record in challenging jack-up barges deployments and dredging operations.

## Industry's only real-time static bathymetry

SeapiX-C is a solid-state multi-cross volumetric Multibeam Echosounder (MBES) with no moving parts. Where most of the MBES on the market have a dedicated antenna to receive and another to transmit, SeapiX-C unique design allows to transmit and receive from both antennas. This allows for each of the detected points on the seabed to be measured in two different arrays without requiring any movement of the sonar, resulting in unique static bathymetry capabilities.

### Unmatched trade-off between resolution and range

SeapiX-C delivers the best balance between resolution and range, allowing high-precision and safe marine works. Its double steerable multibeam swaths capability

allows real-time monitoring of station-based bathymetry. SeapiX-C can cover a wide area, up to 10,000 m<sup>2</sup> at 30m depth, and provides high-resolution (1.6° beam angle, 7.5 cm in range) bathymetry. The relatively low central frequency of 150 kHz provides robust bathymetric data in turbid waters, a key feature for dredging applications.

### Unique real-time monitoring

iXblue has developed an intelligent and robust algorithm that enables SeapiX-C to automatically determine, in real-time, the configuration that offers the most accurate measurement possible, rejecting side lobes and multi-travel echoes which often limit the performance of standard MBES. Thanks to these powerful algorithms and its unique

design, the 3D multibeam echo sounder offers real-time georeferenced static bathymetry capabilities to marine works operators for instant monitoring and situational decision-making. SeapiX-C ultimately brings higher efficiency and safety to operations by removing the need for time-consuming and costly bathymetric survey or diving inspection, as well as removing time spent on post-processing.

## Increased operational flexibility & safety

### Multi-mode capabilities

Operational flexibility and efficiency are further enhanced by SeapiX-C multi-mode capabilities. This 3D Multibeam sonar can be used in various modes:

- Real-time static bathymetry mode for real time seabed monitoring
- Classic bathymetry for regular seabed survey
- Scanning mode for real time structure and object monitoring within the water column

### Multi-head configuration

SeapiX-C offers operators the choice to use the echo-sounder system either in a single head or in a multi-head configuration (up to 4 heads) to get wider imagery coverage of the seafloor. With this multi-head capability, operators get increased operational efficiency with no

further hassle in the use of the system. All sonar heads can be controlled and monitored together using one single command for easy and straightforward operations.

### Robust and easy to operate

Made of stainless steel, SeapiX-C is a sea-proven and rugged sonar which robustness has already withstood the harsh maritime environment of the North Sea. Embedding its own Inertial measurement Unit, SeapiX-C attitude and orientation are always known. This allows for quick and easy installation and removes the need to couple an external attitude sensor to the sonar, ultimately saving precious vessel time.

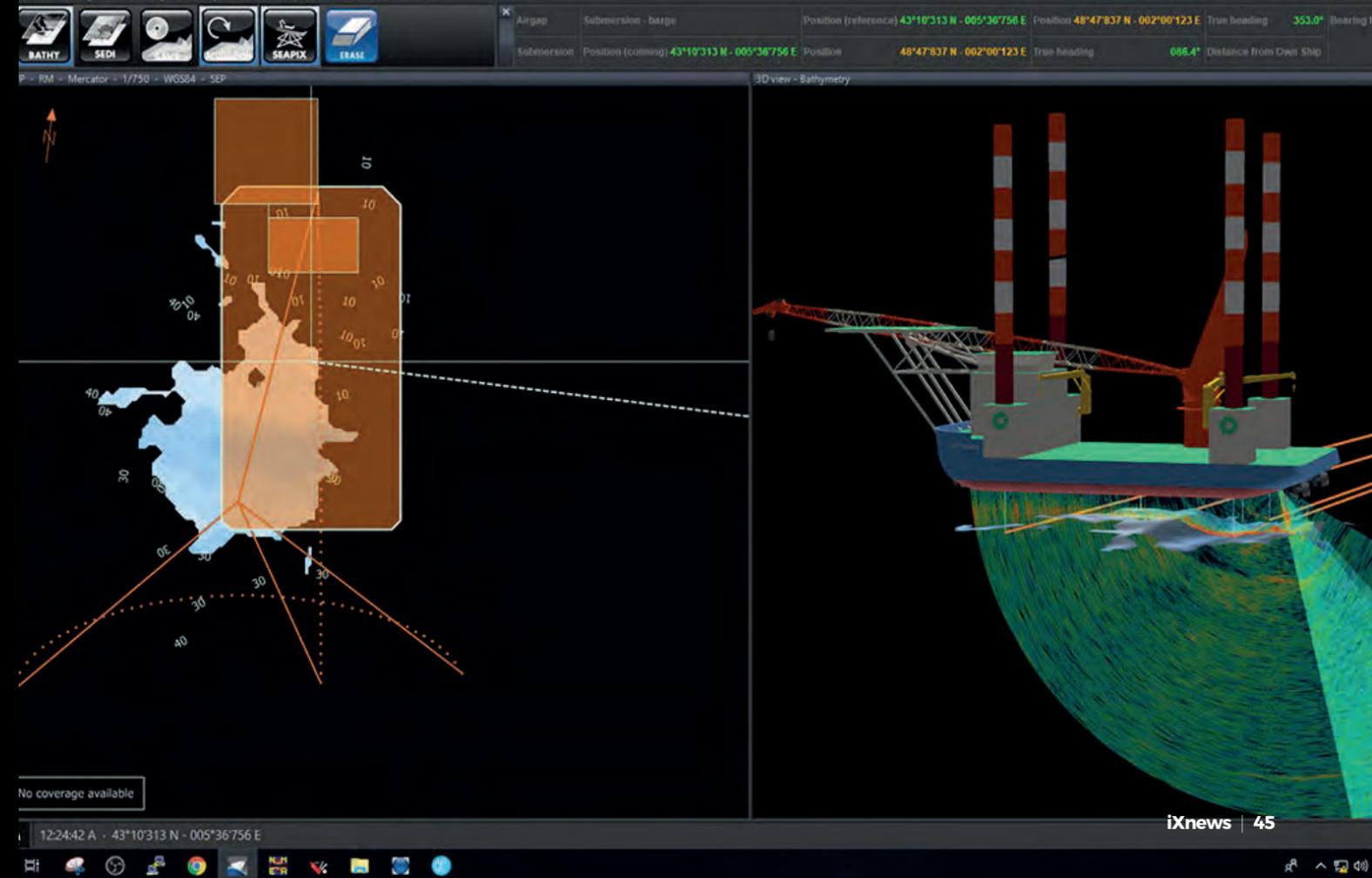
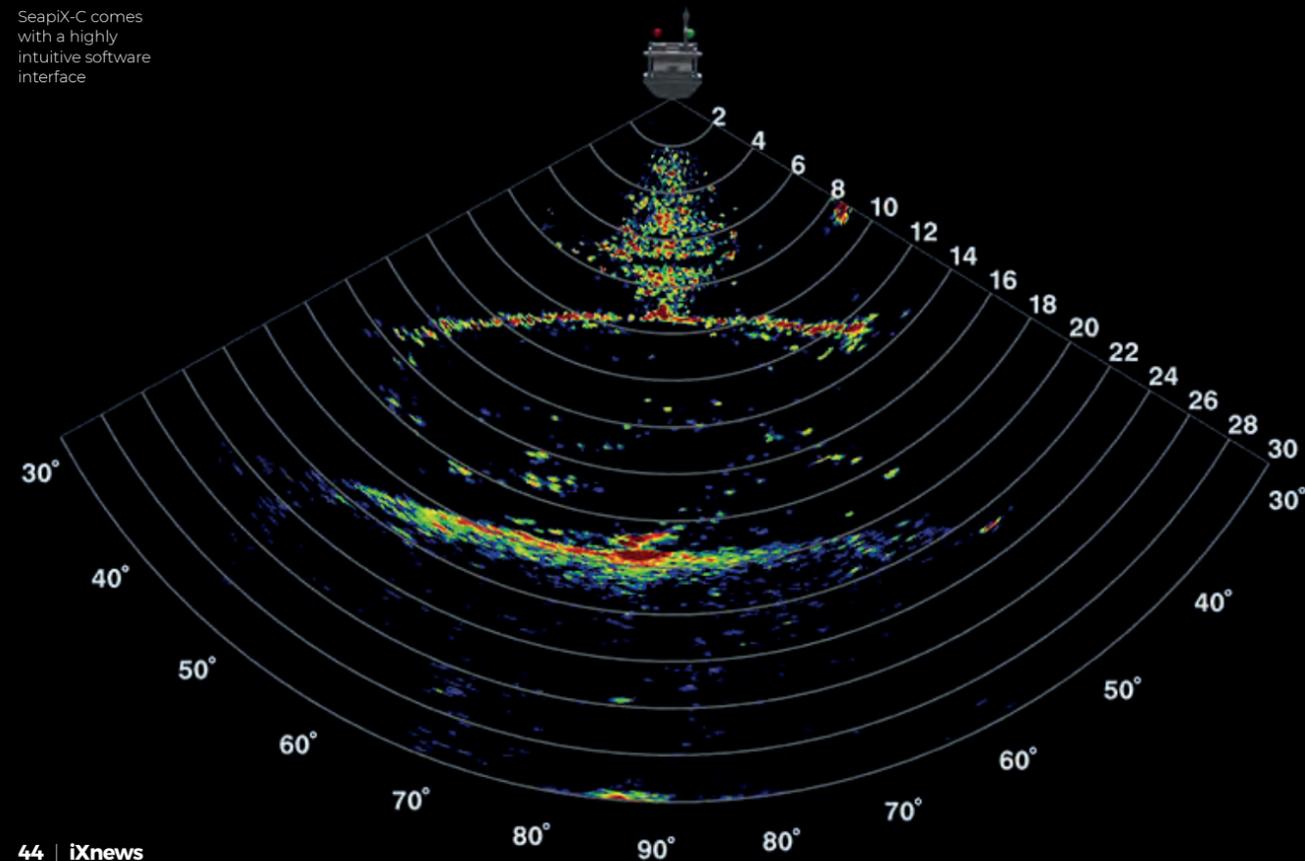
The SeapiX-C 3D multibeam sonar comes with an intuitive software interface that makes the sonar system easy to operate by the end-user,

with no need for a specialized surveyor to operate the sonar. The SeapiX-C software displays all measurements provided by the sonar system, along with the information from the ship/platform (legs position, displacement, height when rising above the waterline...) as well as other critical information. This user-friendly interface enables operators to easily switch between the three available modes (static bathymetry, standard bathymetry, scanning).

### Mitigating operational risks

Smartly positioned, SeapiX-C provides a valuable real time overview of the area of interest, removing the need for hazardous diving or survey operations and ultimately mitigating operational risks.

SeapiX-C comes with a highly intuitive software interface



# One system for multiple applications

SeapiX-C is a scalable system available in two versions. Its stainless-steel version is particularly suited for permanent hull installations, while a lighter and portable (24 kg transducer) composite material-version, is the perfect fit when looking for more operational flexibility.

## Marine civil engineering

The SeapiX-C sonar is perfectly suited for marine civil engineering operations such as dredging. The sonar reduces overall dredging time and increases operational efficiency by enabling real time monitoring of construction

or maintenance operations. SeapiX-C provides real-time and georeferenced static bathymetry of the seabed on a wide area (120° aperture), allowing operators to directly observe and monitor their work without the need to wait for a survey sweep.

## Jack-up barge installation and rig move operations

By providing a station-based 3D imagery solution able to display the seabed in real-time and covering a wide area, SeapiX-C completely removes the danger when positioning jack-up barges legs using seabed information

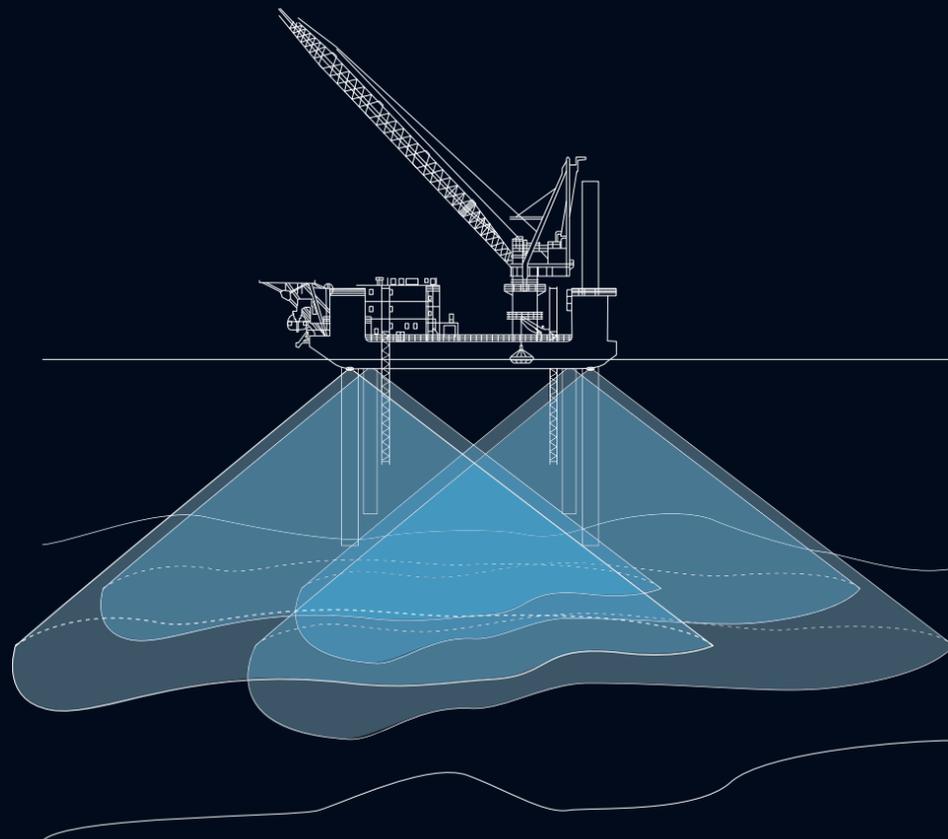
obtained from pre-lay survey maps that may not accurately reflect the actual subsea area. SeapiX-C enables operators to directly see where they are exactly positioning the legs during the deployment with up-to-date measurements. Using SeapiX-C increases the safety of deployment and brings higher efficiency to the operations by removing the need for time-consuming and costly pre-lay diver operations. ■

# SeapiX-C

3D MULTIBEAM SONAR

<b>Aperture</b>	120° x 120°
<b>Frequency</b>	146khz to 155khz
<b>Number of beams per swath</b>	256 beams along track and 256 beams across track
<b>Single element beam opening</b>	1.6° x 1.6°
<b>Array</b>	Steerable symmetrical dual multibeam. No moving part.
<b>Multi-head capability</b>	Up to 4 simultaneous heads managed by a single interface
<b>Modes</b>	Classic bathymetry. Static bathymetry. Scan
<b>Acoustic processing with navigation</b>	Realtime acoustic data fusion with navigation GIS system
<b>3D acoustic presentation</b>	2D and 3D acoustic presentation
<b>Bathymetry</b>	Bathymetry from all swath, dynamic and static bathymetry
<b>Navigation &amp; chart system</b>	Embedded ECS Navigation and charting system
<b>Recording / Export</b>	RAW Data, S7k
<b>Motion sensor</b>	Embedded
<b>Network</b>	Copper Gigabit Network (Optical Fiber in option)

Seapix-C multi-head configuration offers wider imagery coverage of the sea floor



FLIPIX ROTV: ENHANCING  
THE **AUTONOMOUS**  
**SURVEY** SCOPE



As a world-leading developer of industry-changing autonomous technologies, iXblue is enhancing its uncrewed ecosystem with its first Remotely Operated Towed Vehicle (ROTV): FlipiX. Designed to be operated autonomously from iXblue DriX Uncrewed Surface Vehicle (USV) or from a light vessel, FlipiX enhances autonomous survey capabilities and allows to conduct multi-sensor operations in a single run, ultimately offering unmatched operational efficiency.

### Enhancing the autonomous survey scope

FlipiX ROTV enhances the autonomous survey scope by allowing to conduct autonomous bathymetry, geophysics and UXO operations in a single run. A versatile and unique conveyance platform for Side Scan Sonars and Magnetometers, FlipiX is the ideal complement to uncrewed surface platforms able to deploy MBES and SBPs. Benefiting from a positive buoyancy, the ROTV can easily be interfaced with uncrewed surface vehicles to offer operators a complete ecosystem for autonomous survey.

### Providing best in class motion control for increased measurement quality

FlipiX altitude, pitch and roll are autonomously controlled to maintain measuring instruments at a fixed altitude and constant attitude with no human intervention. This results in best-in-class platform stability in the harshest conditions, providing enhanced measurement quality in the most challenging maritime environments. This active motion control capability bestows the ROTV with increased stability and enhanced maneuverability during U-turns, further enhancing data quality.

Offering tow-speeds up to 7 knots with no compromise on data quality, FlipiX can be operated a few meters above the seabed (3m) providing a unique environment for data measurements.

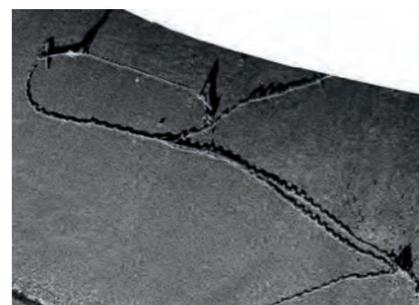
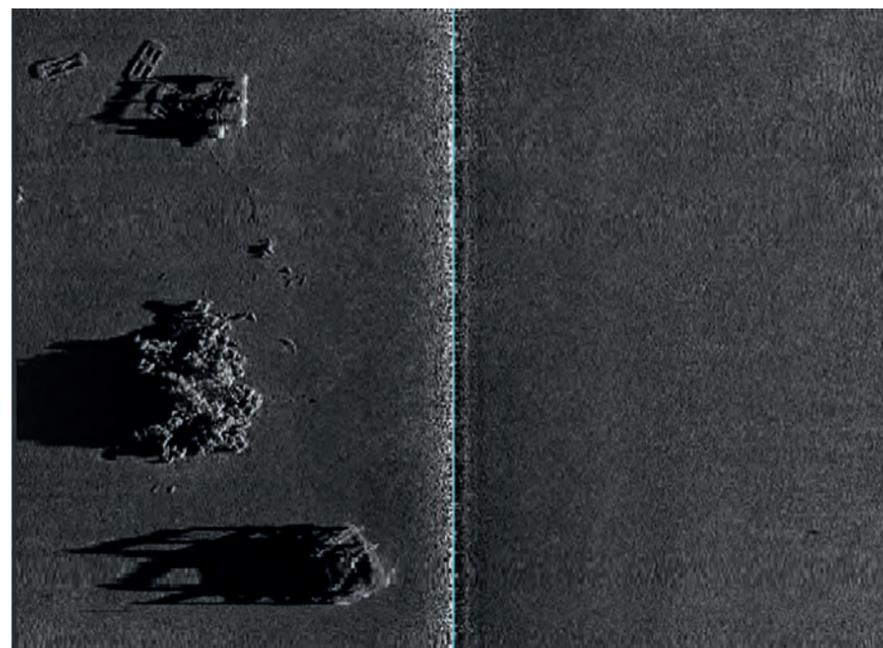
### Reducing operational footprint

One of the most compact ROTV solution on the market, FlipiX, using its ruggedized Launch & Recovery system, can easily be deployed from RHIBs or light vessels with a reduced crew onboard. Benefiting from Over The Horizon (OTH) capabilities when deployed from a USV, and enabling bathymetry, geophysics

and UXO operations to be conducted in a single run, FlipiX drastically lowers survey time, reduces the need for skilled support personnel onsite, and completely removes the need for costly support vessels, ultimately bringing operational costs down.

“As a key actor of the maritime industry and a pioneer in the field of autonomy, iXblue has the ambition to support the industry in its transition towards autonomous operations, and FlipiX does just that.” Stéphane Vannuffelen, Marine Autonomy Technical Director at iXblue comments. “Leveraging our unique expertise in navigation, robotics and shipbuilding, and benefitting from our extensive return on experience deploying our DriX USV on major projects for energy companies and hydrographic institute worldwide, we are committed to offer operators with a more comprehensive ecosystem for autonomous surveying. We’re convinced that our FlipiX ROTV combined with our DriX USV will bring high efficiency and cost-effectiveness to the industry. It has already gathered a strong interest from major actors from the industry confirming the strong relevance of our new autonomous solution.” ■

Using FlipiX enables to collect high quality Side Scan Sonar data.



# FlipiX

REMOTELY OPERATED TOWED VEHICLE

### DIMENSIONS

- Length: 1,8m
- Height (without payload): 0,4m
- Width: 2,7m
- Weight in air (without side scan sonar): 68kg
- Weight in water: positive buoyancy

### PERFORMANCE

- Depth rating: 300m
- Operational depth: Up to 50m
- Towing speed: 3-7kt
- Dive climb speed: 16-20/min
- Emergency climb speed: 40m/min
- Vertical position accuracy: 0,2m
- Roll accuracy: 0,5°
- Pitch accuracy: 0,8°
- Max slope, terrain-following mode with pitch control: 15%

### PAYLOAD

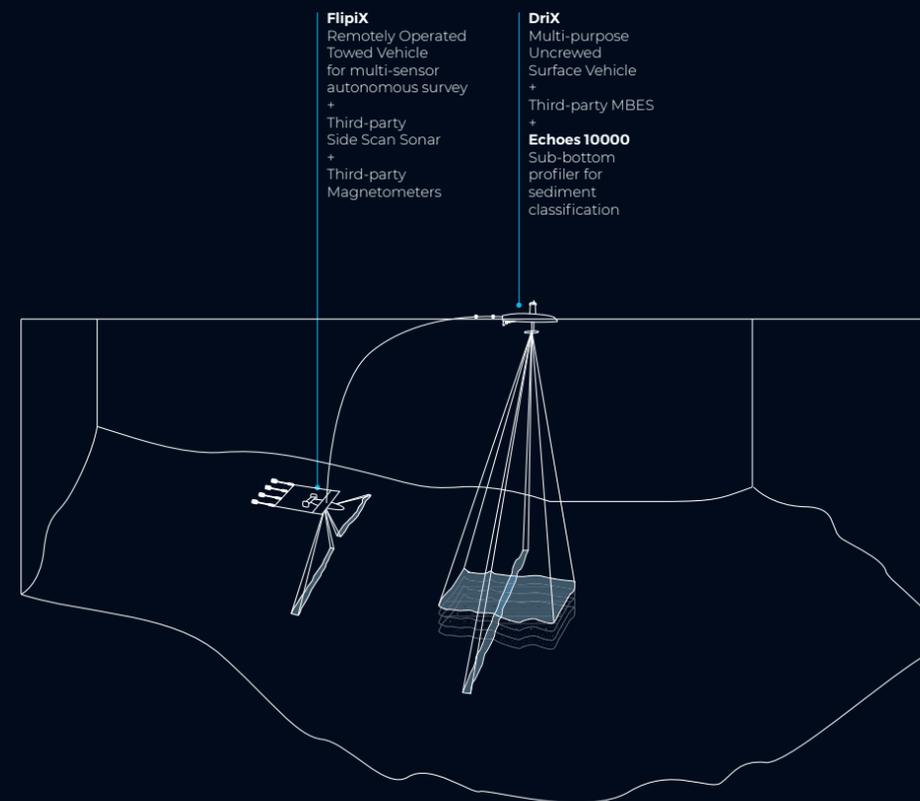
- 1 Side Scan Sonar (Edgetech 4205 or 4200 ROTV)
- 1 magnetometer (Geomatrix G882)

### OPTION

- Positive buoyancy 300m tow cable
- DriX connexion kit
- Top side Unit (Rackable or pelicase)
- Positioning: embedded MT9 USBL

### APPLICATIONS

- Hydrography
- Geophysics
- UXO and Wreck detection
- Cable & Pipe Pre-lay, Post-lay, As-built, inspection
- Dredging
- Environmental assessment





# REMOTE HYDROGRAPHY

## TRANSITIONING TO A 4.0 INDUSTRY

Hydrography is changing. The current pandemic made it very difficult to go at sea and mobilize vessels and crews. The use of traditional research vessels is furthermore rapidly getting obsolete as environmental regulations are introduced and getting increasingly difficult to meet financially. At the same time the blue economy is booming. International initiatives like SEABED 2030 are implemented and never in history did we have such a dire need to monitor not only seabed dynamics, but also seabed ecosystems and water columns. This involves collecting, processing, interpreting, plotting and archiving a massive amount of data in a more efficient and cost-effective manner. That, in turn, requires a global change in the way hydrography is conducted. And while technology has evolved in that direction in the past decades, with major breakthrough made in the fields of subsea monitoring and mapping systems, covering large areas of our seas and oceans in a timely fashion and within budget still remains a challenge. This can now be solved by the advance of new purpose-made supervised autonomous platforms and remote hydrographic operations, that make it possible to use sensors to the best of their capabilities, providing ideal acquisition environments through enhanced stability, speed and reduced radiated noise.

# THANKS TO THE ADVANCEMENT OF NEWLY DEVELOPED AUTONOMOUS PLATFORMS, HYDROGRAPHY IS NOW ACCELERATING ITS REVOLUTION TOWARDS A 4.0 INDUSTRY.

MBES data acquired using Kongsberg Maritime EM2uO deployed from iXblue DriX USV

## The hydrographic industry obligations and responsibilities

In addition to the environmental responsibilities the hydrographic industry faces, it is also important for its societal role to be taken into consideration. Keeping surveyors out of harm's way must indeed be a permanent goal, just like keeping the environment, that we are serving, away from irreversible impacts. The transition towards the use of uncrewed surface platforms brings just that. Not only do they reduce human exposure to hazardous environments, but they also bring about more sustainable operations by consuming less fuel than traditional survey vessels and by reducing operations greenhouse gas emissions.

The rise of autonomous platforms furthermore allows operators to either enhance the capability of their exploited assets by acting as force multipliers, or to benefit from a single low investment and low operating cost asset for those who cannot afford large investments.

The hydrographic industry societal role also extends to granting easier and less expensive access to assets and acquired hydrospatial data<sup>1</sup> to a larger community including scientists (marine biologists, oceanographers, archeologists, geologists...), fishermen, and other actors of the blue economy. This should be among the industry priorities and is now possible to meet through the increased deployment of advanced autonomous survey platforms that widen operating windows, enabling much larger amounts of data to be collected.

## Solutions and challenges to a successful transition towards remote hydrography

Thanks to the advancement of those newly developed autonomous platforms, hydrography is now accelerating its revolution towards a 4.0 industry. With the deployment of uncrewed surface vessels that remotely conduct recurrent tasks such as data collection, human skills and expertise can now be put to a better use such as exploiting and qualifying the collected data,

<sup>1</sup>"Hydrospatial is the branch of applied sciences which deals with the analysis, understanding and access to static and dynamic marine geospatial digital and analogue data and information, digital signals, measurement and description of the physical, biological and chemical features of oceans, seas, coastal areas, lakes and rivers from all possible available data sources in near-real time and real time, including their history and the prediction of their change over time. This for the purpose of: timely access to a standard, high-quality and the most up-to-date marine spatial data infrastructure; safety and efficiency of navigation; and in support of aquatic and marine activities, including sustainable blue environment and economic development, security and defence, and scientific research." Denis Hains - What is 'Hydrospatial'? October 27, 2020 - <https://www.hydro-international.com/content/article/what-is-hydrospatial>

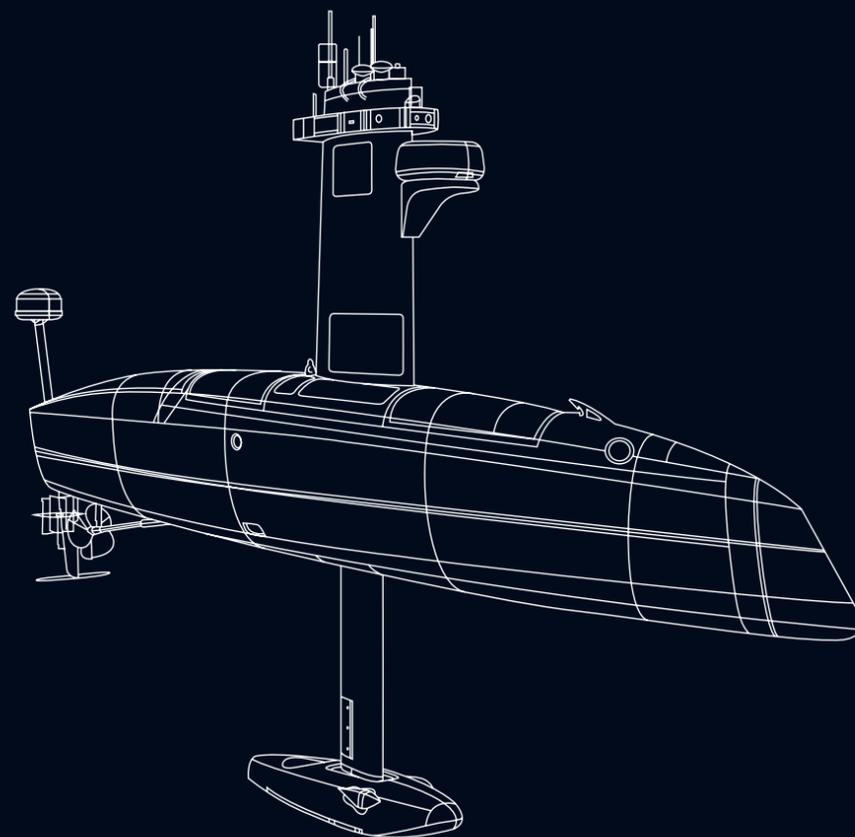
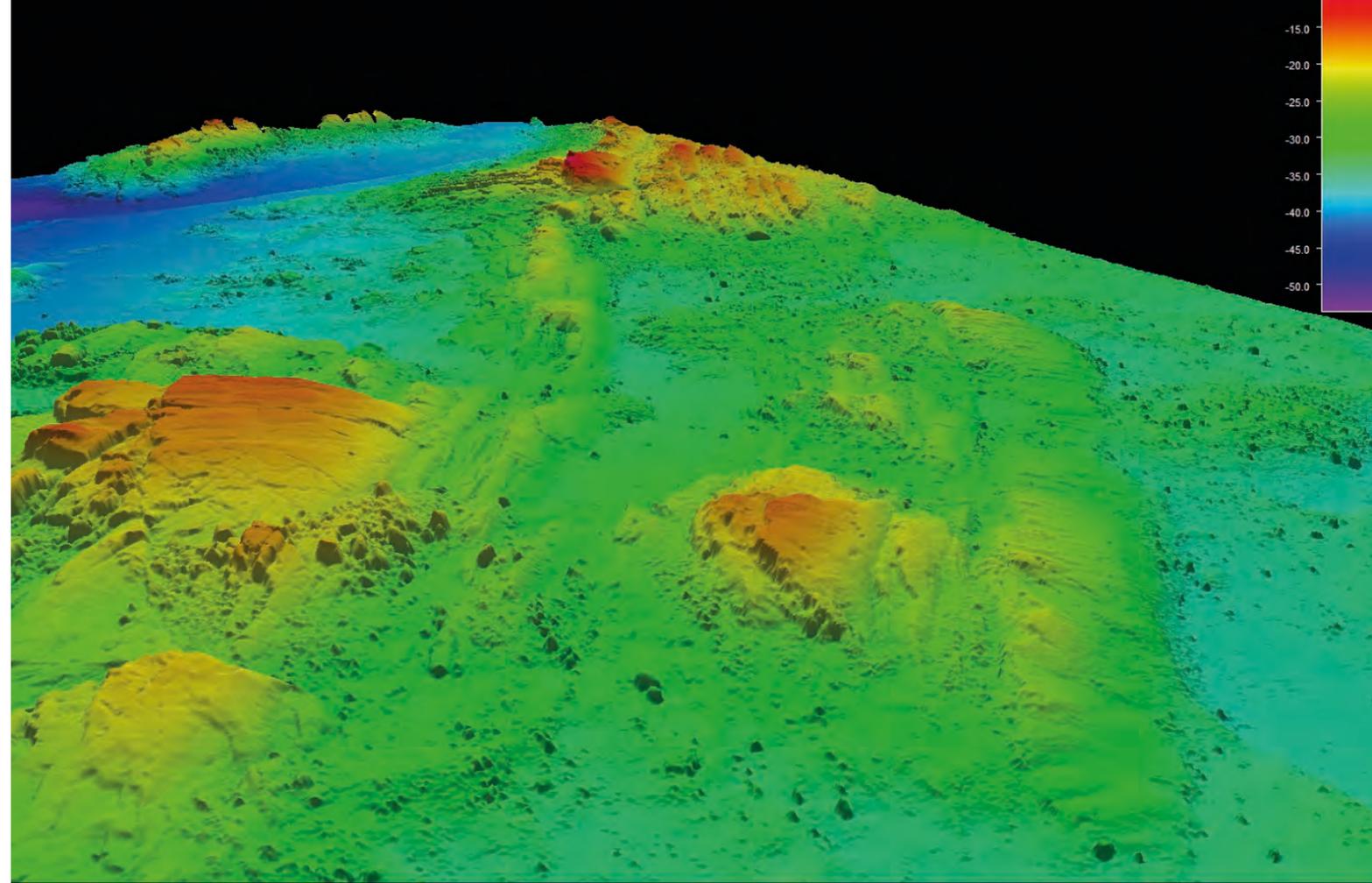
all from the safety of a remote control center, either on a mother vessel, or within an inshore location.

This evolution does not only involve technology, but also requires rethinking the whole concept of hydrographic "operation" itself. Greater progress will indeed be made once developers and services providers adapt their survey methodology to the use of those new remotely supervised platforms.

Autonomy is key in the response to the previously made observations. Making use of purpose-built platforms, which design has been thought solely around their end function (data acquisition), plays a big role into this transition. Leveraging purely hydrodynamic designs that do not have to be constrained by human presence onboard the vessel, uncrewed surface platforms benefit from high stability which allow them to work at greater speeds and in higher sea states than traditional survey platforms, while still acquiring better data quality. Among the possibilities brought about by uncrewed vessels, modular gondolas, such as the ones developed by iXblue for the DriX USV, indeed provide unique low noise level environments, away from hydrodynamic acoustic turbulences and guarantee cleaner acoustic data.

Developing an ecosystem around autonomous platforms is also key to the smooth transition towards remote autonomy as it will enable efficient deployments and successful missions without creating new operational constraints. Aware of this challenge, iXblue has incidentally been developing a full ecosystem around its DriX USV, consisting of functional launch and recovery systems, as well as purpose-made Remotely Operated Towed Vehicle (ROTV), gondola adaptations and shallow water supportive tools.

Overall, uncrewed survey platforms, able to cover extensive areas at a fraction of the time and costs of traditional survey methods and keeping downtime to a minimum, have



- Length: 7,710m
- Breadth: 0,824m
- Draft: 2m
- Displacement: 1,4 t
- Mono-hull material: carbon Kevlar-reinforced composite
- Weight: 1,380 kg
- Propulsion: 38HP Diesel engine
- Fuel capacity: 250L (consumption average: 2l/h)
- Drive: 1 straight shaft with 1 fix pitch propeller

DriX being deployed from NOAA's Thomas Jefferson hydrographic survey vessel

become a leading-edge survey technology that force-multiplies data acquisition and helps optimize survey productivity, efficiency and safety as a whole and define the essence of remote hydrography itself.

### Supervised autonomy as a way to achieve remote hydrography

Supervised autonomy is defined as the ability to operate unmanned surface platforms autonomously to achieve high level mission goals while being supervised by a remote operator who can take over control whenever the circumstances require it. In the context of hydrography, mission goals are usually defined by an area to be surveyed, as well as by measurement objectives (coverage, measurement density...). A mission consists in the sequential execution of autonomous behaviors that represent elementary tasks. Most uncrewed platforms operate with deterministic behaviors such as following run lines or predefined survey patterns. One of the challenges to reach the next level in terms of autonomy will now be to develop reactive autonomous behaviors that use the data collected by the payload to optimize the platform mission plan.

The need of supervision is driven by the technology readiness and societal acceptance. Like for self-driving cars, the path toward full autonomy will consist in multiple steps. Autonomous systems indeed use advanced communication systems to provide pilots with a high level of situational awareness and communication in the maritime environment remains a challenge. Uncrewed surface vessels have to rely on very heterogeneous communication infrastructures depending on the operation scenarios (WiFi, radio, LTE or Satellite). Managing the User QOE (Quality Of Experience) also remains a significant challenge. The performance of marine communication systems can indeed vary greatly depending on the environmental conditions.

To respond to the challenge of optimizing the use of available communication channels, iXblue has been working on an adaptative strategy in terms of managing the transfer, remote processing and access to data according to users' priorities. Another choice made by iXblue to offer an adaptative strategy is its developments on the DriX USV command and control. Built as an open platform, it supervises third-party software to use on-board

data processing and management to its best capabilities, while continuously accessing and integrating the right amount of data required to make decisions that support supervised autonomous operations.

The flexibility provided by this kind of open platform allows to best adapt to the constraints linked to communication channels to support supervised autonomy, while keeping a very high level of on-board autonomy and responsiveness to potential working environment and situational changes.

### A chance for new generations of seamen and scientists

Overall, the transition to remote hydrography will call for a new generation of marine technicians and scientists that will need to be trained to support uncrewed platforms mobilization, operation and maintenance, as well as to support the increasing need to interpret the massive amount of data collected. While traditional survey vessels were crewed with seamen in charge of navigation and deck operations, as well as with onliners and offliners for data acquisition, mission planning, data processing, pre-interpretation and charting, uncrewed survey platforms will now require a smaller team of a new kind of technicians. True specialists of autonomous platforms and remote operations, they will organize field mobilizations, liaise with local authorities and communities and will be able to maintain autonomous platforms.

And because autonomous surface platforms provide higher datasets quality – iXblue DriX remote operations have indeed shown a reduction to a factor 10 of the required cleaning and processing of hydrographic data – more time will be given to onliners and offliners to concentrate on much added-value QC, interpretation and charting tasks. Globally, using uncrewed vessels such as iXblue DriX USV, supported by a strong ecosystem, will not only save precious time during those phases, but also during all other stages of the survey operation, including mobilization, thanks to smaller pre-calibrated and normalized platforms, and during the operation itself, thanks to the development of efficient mission planning algorithms and autonomous data acquisition. All of this allowing onliners and offliners to work remotely on multiple assets and missions at the same time, bringing much added value to the industry. ■



Remote multi-DriX USV operation conducted from iXblue inshore Control Center

# 02

# CUSTOMER STORIES

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On and O2G project

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FROM DE-RISKING TO VALUE CREATION:

# FIRST CANOPUS & RAMSES LBL SOLUTIONS DEPLOYMENT

ON AN O&G PROJECT

Deploying a new technology for the first time is always challenging. But, with careful planning, teamwork and a drive to deliver customer satisfaction, these challenges can be overcome. This is how UTEC, the lead brand for Acteon's Geo-services segment, approached the deployment of a new sparse Long Baseline (LBL) positioning system using iXblue's proprietary technologies. Working in partnership, the companies successfully delivered the first deployment of iXblue's Canopus and Ramses positioning system on a commercial project in the energy industry.



In the summer of 2021, UTEC and iXblue collaborated to successfully provide deepwater remotely operated vehicle (ROV) positioning services for a complex pipelay and structural installation offshore East Africa for a major subsea contractor. The project was unique for two reasons. This was the first time that UTEC had used the iXblue sparse LBL solution to position ROVs. Moreover, the project saw the first deployment of iXblue's proprietary sparse LBL technologies for a commercial project in the energy market.

### Sparse LBL: Innovative subsea positioning

Sparse LBL is a method that uses inertial navigation system (INS) equipped subsea vehicles and achieves similar or better positioning performance than traditional LBL while using fewer transponders. This is made possible by merging the precise range measurements to an acoustic transponder with the very precise short-term movements from an INS to optimise navigation accuracy.

UTEC has 15 years of experience providing positioning and survey support for hundreds of pipeline and structural installation projects around the world, and has developed industry-leading knowledge and capabilities in subsea positioning systems. This has included supporting the development of sparse LBL positioning, including the use of prototype systems, because UTEC recognised its potential to provide clients significant cost savings over conventional LBL positioning systems.

Sparse LBL positioning only became feasible with the development of commercially available INSs. These use gyros and accelerometers to measure motion. When combined with acoustically measured ranges from seabed transponders, this can provide high-accuracy ROV positioning.

iXblue is a leading manufacturer of fibre-optic based gyro systems, subsea acoustic positioning systems, autonomy systems, and sonar systems. The company's subsea inertial navigation systems (Octans, Rovins and Phins Subsea) have become standard fit on many ROVs and autonomous underwater vehicles (AUV). iXblue is therefore well placed to offer a complete sparse LBL positioning system.

Following this principle, each range measurement helps in computing a new position, as opposed to classical triangulation algorithms, for which at least three simultaneous range measurements are required to establish a position. It is therefore possible to navigate with fewer transponders without making any compromise on performance.

iXblue's sparse LBL positioning system is based on its Canopus transponder and ROV-mounted Ramses transceiver, and their seamless integration with INS. Canopus offers exceptional power efficiency, which enables it to operate for up to three to four times longer than competitors' transponders and thus reduces the time (and money) spent swapping out exhausted units. Sparse positioning also means fewer transponders to be deployed and recovered, with associated vessel time savings.

### A unique project

In 2019, UTEC had the opportunity to propose a sparse LBL solution for a project following an invitation to tender from a major subsea contractor. The tender specified the need for conventional LBL positioning; however, UTEC also presented a proposal based on a sparse LBL solution, which interested the client, as it had also been evaluating the value of sparse LBL systems for future projects.

iXblue supported UTEC's sparse LBL proposal and also met with the client to discuss how Canopus and Ramses could unlock time and cost savings on this and future projects. UTEC evaluated competitor sparse LBL positioning solutions and concluded that the iXblue system had clear technical and commercial

advantages, including the longer battery life, backed up with proactive support. This combination would achieve the most cost-effective solution for UTEC's client.

Through a combination of a good technical proposal, an attractive commercial offer and support from iXblue, UTEC was awarded the contract, now based on the use of sparse LBL positioning. There was a clear stipulation from the client: the choice of the sparse LBL system and its use on the project was UTEC's responsibility. This placed great emphasis on iXblue's technologies to deliver as promised. Although Canopus and Ramses LBL systems had been presented to the industry during trials and demonstrations and used on a North Sea rig move in 2018, neither had been deployed on an actual commercial project within the energy industry, and UTEC would be the first user of the system.

This presented significant risks for both iXblue and UTEC: failure of the system to deliver would result in delays and extra costs for the client, while UTEC would also incur replacement costs and suffer reputational damage and thus potential loss of future work. Equally, failure could damage the reputation of iXblue's new LBL technology such that it could lose market trust.

### Risk assessment and management

Project failure was never an option. Working together, UTEC and iXblue surveyors, engineers and senior management sat down and, in a risk assessment process, identified four key risks that could negatively impact the project: manufacturing delays, the absence of necessary system capabilities, a lack of adequately trained personnel, and design or manufacturing faults leading to system failures.



UTEC ready to deploy iXblue Canopus transponders on their project offshore Africa

### Manufacturing constraints

UTEC was concerned that iXblue would be unable to manufacture the required number of Canopus and Ramses units in time for the project start date. Consequently, a delivery date was imposed so that, if missed, there was sufficient time to change to an alternative supplier and redesign aspects of the project. Despite impacts from the COVID-19 pandemic, the required number of units were successfully delivered by the iXblue teams on schedule.

### System capabilities

Both UTEC and iXblue had concerns that the Canopus and Ramses systems could not perform some of the complex positioning tasks required by the project. UTEC surveyors listed the necessary positioning tasks for comparison with the capabilities of the system and identified the missing capabilities, all of which were already on iXblue's development roadmap. Consequently, iXblue prioritised their development and implementation. The new capabilities were successfully proved in tests offshore iXblue's La Ciotat base in the South of France. UTEC personnel were unable to attend in person owing to COVID travel restrictions but successfully witnessed the tests arranged by iXblue via remote access to the positioning computers and live video streaming from the test vessel.

### Trained personnel

As this was the first time that the Canopus and Ramses systems were being deployed, UTEC field personnel needed training in how to operate the systems. Lockdown and travel restrictions due to the pandemic presented a major challenge, resulting in training having to be done remotely.

iXblue designed a programme consisting of two training sessions, feedback from which identified changes necessary for easier operation. For instance, field staff felt that the user interface for the system was inefficient. They provided a list of improvements that were subsequently implemented by iXblue's software developers. The improvements were then successfully tested by some of the field staff operating the software on iXblue's test vessel via a remote-control link.

Further actions included the deployment of an iXblue engineer on the installation vessel to oversee the initial stages of the programme. Additionally, a satcom link was established between onshore iXblue specialists and the actual Ramses units fitted to the ROVs. This enabled the onshore support team to configure and operate the system directly should the offshore personnel encounter problems. Although the link was not required, it was proved operational and thus provides an option for reducing the number of offshore personnel needed on future projects.

### Reliability

When deploying new systems for the first time, there is always the potential for reliability issues. UTEC and iXblue considered the consequences of multiple failures caused by design or manufacturing faults and implemented several measures to minimise the risk of potential failures; these included ensuring that more spare units than normal were on the vessel.

More importantly, iXblue's design and manufacturing procedures were audited by UTEC using a process more rigorous than that typically used for audits of routinely used equipment. Again, these audits had to be carried out remotely; however, iXblue's electronic quality assurance and control systems enabled the audits to run smoothly and provided assurance of system reliability.

### Project outcome

By undertaking a detailed risk assessment and implementing mitigation measures, UTEC was able to successfully deploy the Canopus and Ramses positioning system on the project. And the system performed excellently: predicted time and cost savings were achieved, and a wealth of experience, to be used on future projects, was gained by all parties.

"Both UTEC and iXblue had to commit the people and time to ensure a successful first-use of Canopus and Ramses. We now have the knowledge and experience that enable us to offer this system for other projects. The risk assessment process will be applied to future first uses of new systems. We anticipate that

this will enable us to provide additional cost-saving solutions for our customers," comments Paul Smith, Group Managing Director at UTEC.

Olivier Cervantes, VP Energy Market at iXblue, concurs. "I agree with Paul and add that I was impressed by the commitment of the UTEC teams in the quality audit of our system and how they have challenged our technical teams. Converting risk taking into value creation through a careful assessment of potential issues was one of the challenge, all of this during an historical global pandemic. Spirit of teamwork, trust and the willingness towards an improved solution, allowed us to push the limits of the technologies, bringing an "open architecture" Sparse LBL to the market standard." ■



iXblue Canopus transponders being deployed for UTEC project

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**SPIRIT OF TEAMWORK, TRUST AND THE WILLINGNESS TOWARDS AN IMPROVED SOLUTION, ALLOWED US TO PUSH THE LIMITS OF THE TECHNOLOGIES, BRINGING AN "OPEN ARCHITECTURE" SPARSE LBL TO THE MARKET STANDARD.**

- OLIVIER CERVANTES, VP ENERGY MARKET AT IXBLUE

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ENHANCING  
HYDROGRAPHIC SURVEY  
USING UNCREWED SURFACE  
VEHICLES



Multi-DriX operation supervised by the Shom during sea trials.

**With over 15,000 hours in operation around the world since its launch back in 2017, DriX has proven to be an invaluable asset and a real game changer on the Energies and Geosciences markets. Offering outstanding seakeeping and speed capabilities, the USV is indeed the perfect uncrewed platform for efficient and high-quality data acquisition. Along with its practical launch and recovery system, DriX - that has received Bureau Veritas very first certification of an Unscrewed Surface Vessel - has now gathered the interest of many hydrographic institutes around the world and is quickly becoming a reference as a hydrographic survey force-multiplier.**

**H**ydrographic institutes have identified USVs as a leading-edge survey technology that force-multiplies data acquisition and that helps optimize survey productivity, efficiency and safety. This is why hydrographic institutes such as NOAA, Shom, the British Antarctic Survey or that of the Polish Navy are now actively developing strategies to integrate the use of USVs into ocean mapping”, explains Guillaume Eudeline, USV and boats Business Development Manager. “USVs are indeed very flexible platforms able to perform extremely well in severe weather conditions. And this of course keeps downtime to a minimum compared to traditional survey vessels.”

“For instance, if we take the example of our own USV being used for a day, first of all DriX can be operated on a 24-hour window, a timeframe that is much higher than a traditional survey launch,” Guillaume adds. “Second, DriX can perform high quality survey at a much higher speed than traditional vessels, covering larger areas in a shorter amount of time, with no compromise on data quality. This means that, to achieve the same seafloor mapping rate than DriX within

the same timeframe, 6 launches would be needed. One can then easily understand how USVs can greatly increase seafloor mapping rate while reducing operations costs.”

“So overall, with USVs, the total vessel time, man hours worked and hours of human at risk for that matter, get drastically reduced, bringing greater efficiency and lowering the HSE impact of survey operations,” Guillaume concludes. “Combine that to reduced fuel consumption and CO2 emissions, and one can easily understand why hydrographic institutes around the world are trying to assess the potential concept of use for such uncrewed platforms.”

#### **NOAA: expanding the footprint and efficiency of ocean exploration**

It is within that context that the Ocean Exploration Cooperative Institute (OECI), funded by NOAA's Office of Ocean Exploration and Research (OER), signed a purchase contract to acquire a DriX USV, along with its novel custom-designed Universal Deployment System (UDS). Developed by iXblue Shipyard division, this UDS is able to launch and recover DriX as well as other

AUVs. The contract comes after a series of sea trials conducted in 2019 with NOAA's iconic Thomas Jefferson hydrographic survey vessel, and that successfully demonstrated DriX hydrographic survey force-multiplier capability in offshore waters.

“The ability to launch and recover uncrewed surface vessels as well as other autonomous systems like AUVs from the same launch and recovery system allows us to support a range of collaborative ocean exploration operations from a single research vessel”, said Larry Mayer, Director of the Center of Coastal and Ocean Mapping and the University of New Hampshire's co-PI on the Ocean Exploration Cooperative Institute. “With these collaborative, multi-vehicle operations we hope to greatly expand the footprint and efficiency of ocean exploration.”

“Along with the innovative Universal Deployment System, other features that led to the selection of DriX by the OECI were its mission endurance, ability to operate at high-speed and excellent offshore seakeeping ability”, explains Marine Slingue, VP at

iXblue, Inc. NOAA is a true reference in the hydrographic industry and being part of their new uncrewed systems strategy is a great endorsement of our USV. We now look forward to our continuous partnership and to helping them expand the development and operations of uncrewed maritime systems in the U.S. coastal and world's ocean waters.”

#### **Shom: understanding the potential concept of use for USVs**

But NOAA is not the only major hydrographic institute to have shown interest in DriX hydrographic capabilities. Shom, the French Navy's Hydrographic and Oceanographic service, also conducted a test campaign of DriX and its launch and recovery system on board the Beautemps Beaupré (BHO) hydro-oceanographic vessel in October 2020.

The DriX USV was indeed tested in line with the “Future Hydrographic and Oceanographic Capacity (CHOF)” program, conducted by the French Directorate General of Armament (DGA) with the support of Shom. DriX assessment consisted in evaluating the added value and hydrographic performance of

Uncrewed Surface Platforms compared to the existing launches and vessels currently in service, as well as in understanding the potential concept of use of such drones.

These tests, carried out under a contract between the French DGA and iXblue, consisted of bathymetric surveys reaching various depths (up to 200 m), with the aim of qualifying the overall performance of DriX. Several Shom reference areas were thus surveyed, attesting of the bathymetric data quality, even at high speeds (up to 14 knots) and in rough seas. Overall, DriX autonomy (up to 10 days) enabled a total of over 2,000 km of survey lines to be completed during these trials.

The multiplication of Shom's hydrographic capacities, thanks, in particular, to the simultaneous use of several USVs, was also successfully tested for the first time. Two DriX were thus deployed simultaneously by the iXblue survey teams within survey areas close to the shore and worked both independently and collaboratively with the BHO Beautemps-Beaupré. DriX intrinsic qualities, such as its positioning



DriX being deployed by NOAA from the Thomas Jefferson using its dedicated launch and recovery system.

and navigation capabilities, were also tested (anti-collision, stability, speed of execution, endurance, ability to navigate and work in high sea states, etc.).

“We are extremely proud to have carried out these DriX tests with the Shom, the DGA and the French Navy as part of the CHOF program, and to have reached new milestones together, in particular the hydrographic work with several USVs,” said Guillaume Eudeline. “We would like to thank the Shom and the crew of the Beautemps-Beaupré for their unfailing investment and for the positive reception given to our USV during these trials, which were, from our point of view, a real success.”

#### **Advancing the Polish Navy hydrographic operations**

And after NOAA and the Shom, another major Hydrographic Office has turned to DriX to advance its hydrographic capabilities: that of the Polish Navy.

“The Hydrographic Office of The Polish Navy having led the way towards the adoption of autonomous solutions within the Polish Navy, we are honored that they turned to iXblue DriX USV as their next reliable and proven autonomous platform for their future bathymetric survey. By significantly increasing both the quality of the collected data and the survey area coverage, the use of this new Uncrewed Surface Vehicle will open up new possibilities for the Polish Hydrographic Office.” Cezary Majchrowicz, Technical Director at Thesta, iXblue local partner, explained.

“We are honored by the choice of the Polish Navy to operate our DriX Uncrewed Survey Vessel for survey applications in the wake of other prestigious international hydrographic services and private companies in the world such as the US NOAA.” Commented Guillaume Eudeline. “Offering outstanding seakeeping and speed capabilities, Our DriX USV will act as a true force-multiplier and will help the Polish Navy acquire high quality data while optimizing their survey productivity, efficiency, safety and environmental footprint. We would like to thank them for their trust and are now looking forward to our continued partnership with them.”

#### **British Antarctic Survey: helping capture data from the extreme polar environments.**

The British Antarctic Survey (BAS), a world-leading centre for polar science and operations, has also more recently chosen to add the DriX Uncrewed Surface Vessel (USV) to its advanced robotic survey means. Deployed from polar research stations and from the British polar research ship RRS Sir David Attenborough, the DriX USV will help BAS conduct multi-disciplinary sciences such as surveying the impact of ocean currents on melting ice flow or mapping the seabed in the polar regions.

A versatile platform able to deploy various sensors with multiple missions’ capabilities, the DriX USV will be equipped with CDT, ACDP, MBES and MetOcean sensors and will help BAS capture data from the extreme polar environments.

Pierre Dutrieux, Ocean and Ice Research Scientist at BAS, explains: “DriX offers a mix of excellent sea-keeping and mission endurance to observe treacherous near-glacier ocean and seabed processes repeatedly with high data accuracy, opening new perspectives for polar discoveries.”

“We would like to thank the British Antarctic Survey for trusting our DriX USV as they turn to uncrewed systems for their cutting-edge scientific operations in the challenging environments of polar regions”, Regis Blomme, Sales Director at iXblue comments. “We’re very proud to have been selected by such a leading-edge research institute and it is an honor for iXblue to be part of the BAS ocean exploration operations.” ■



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**WE’RE VERY PROUD TO HAVE BEEN SELECTED BY SUCH A LEADING-EDGE RESEARCH INSTITUTE AND IT IS AN HONOR FOR IXBLUE TO BE PART OF THE BAS OCEAN EXPLORATION OPERATIONS.**

- REGIS BLOMME, SALES DIRECTOR AT IXBLUE

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# IXBLUE DEMONSTRATES FUTURE HYDROGRAPHIC CAPABILITIES WITH DRIX DURING IHO 100TH ANNIVERSARY

Invited by the International Hydrographic Organization (IHO) to demonstrate the most modern hydro-oceanographic technologies during the celebrations marking the 100 years of existence of the international organization, iXblue demonstrated its DriX Uncrewed Surface Vessel, in the presence of Prince Albert II of Monaco, Dr. Mathias Jonas, IHO Secretary-General, Mr. Laurent Kerléguer, Director General of the French Hydrographic and Oceanographic Service (Shom), and Amb. Peter Thomson, UN Secretary-General's Special Envoy for the Ocean.

Identified by the IHO as a pioneer in the transition of the hydrographic industry towards more efficient and environmental-friendly uncrewed maritime operations, iXblue presented the new methods and strategies deployed for seabed mapping, as well as how autonomous vehicles can collect data in support of the hydro-oceanographic industry.

"We are proud to be recognized by the IHO as a key player of the hydrographic industry and to be able to represent, with our DriX Uncrewed Surface Vehicle, the future of hydrography." States David Vincentelli, director of the Sea Operations division at iXblue. "It was an honor to be a part of this event celebrating 100 years of IHO's missions to serve our oceans and to be able to contribute, alongside them, to the transformation and promotion of our industry."

DriX is an 8m uncrewed surface vehicle (USV) developed and built in France by iXblue. The USV conducts hydrographic surveys in order to map the oceans, 85% of which remain unknown to this day. Equipped with advanced sensors (radar, lidar, cameras...) and its own artificial intelligence, DriX analyzes its environment, avoids obstacles and carries out its missions autonomously. The USV can autonomously map large areas in a reduced amount of time, contributing to the rapid improvement of the understanding of our planet's oceans. Lighter than traditional vessels, and particularly hydrodynamic, DriX helps reduce of hydrographic surveys' environmental footprint. Compared to traditional survey vessels, DriX decreases fuel consumption and greenhouse gas emissions by a factor of 50 and reduces radiated noise for greater respect of marine wildlife.

Since its launch in 2017, DriX has been met with numerous successes around the world, including being selected by the Polish Navy, the British Antarctic Survey and by the U.S. National Oceanic and Atmospheric Administration (NOAA) to create the next generation ocean exploration system. In France, DriX has been tested by the French Navy's Hydrographic and Oceanographic Service (SHOM) via the Direction Générale de l'Armement (DGA) as part of an armament program aimed at renewing its capabilities in 2025. ■



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**WE ARE PROUD TO BE RECOGNIZED BY THE IHO AS A KEY PLAYER OF THE HYDROGRAPHIC INDUSTRY AND TO BE ABLE TO REPRESENT THE FUTURE OF HYDROGRAPHY.**

- DAVID VINCENTELLI, DIRECTOR OF THE SEA OPERATIONS DIVISION AT IXBLUE

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Floatgen floating wind turbine offshore Le Croisic (France).

# POWERING AUTONOMOUS SUBSEA INSPECTION FOR OFFSHORE WIND FARMS

Back in June 2021, Forssea Robotics, a smart ROV asset and visual positioning technologies provider who aims at increasing productivity of underwater inspections and light intervention repeatable tasks, successfully completed the annual underwater survey of the FLOATGEN floating wind turbine using its advanced ARGOS ROV. Anchored 12nm offshore from Le Croisic coast (France) on the Centrale Nantes Offshore test site, FLOATGEN is the only offshore wind turbine to be installed in France.

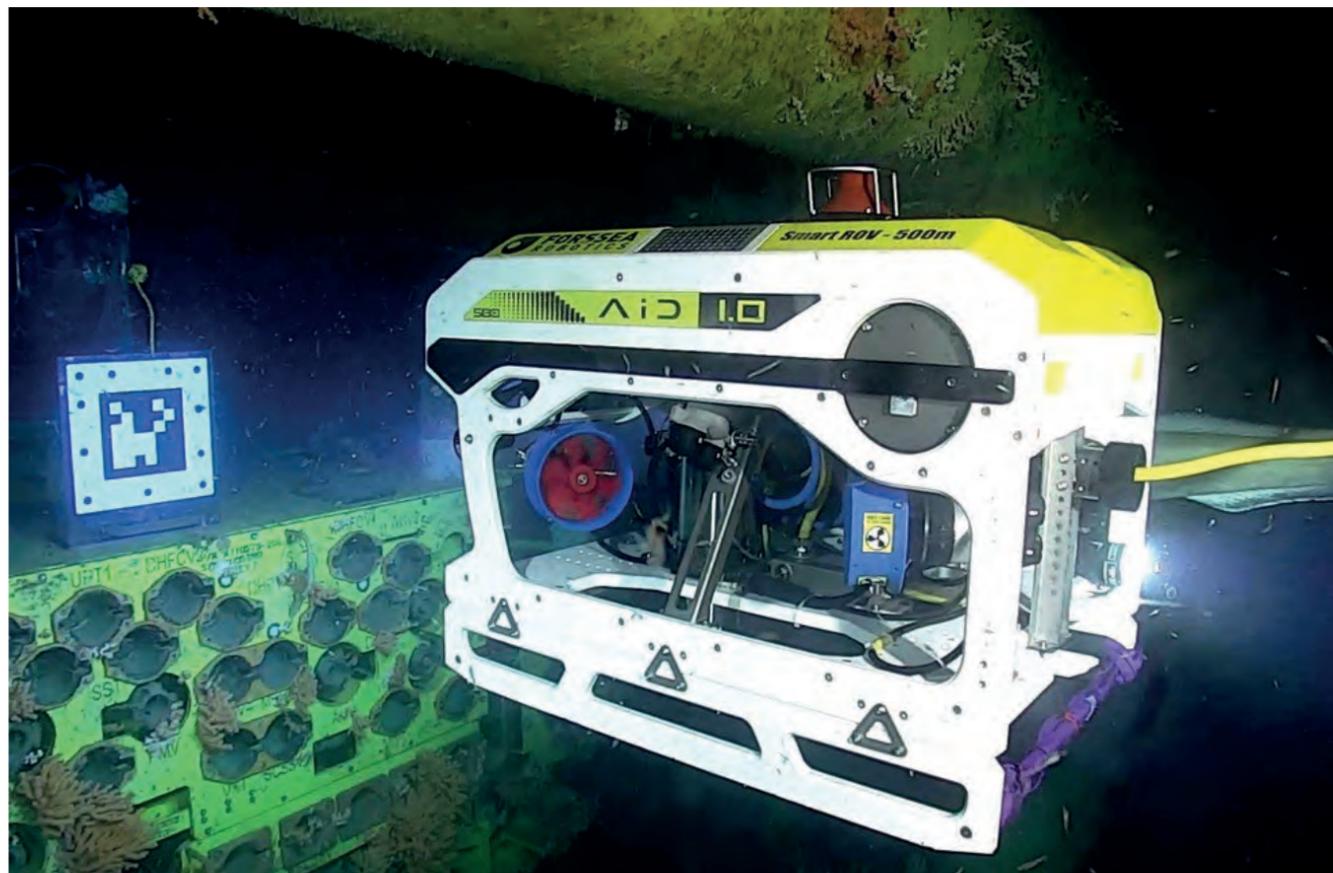
automate windfarms moorings inspections and other light intervention repeatable tasks, Forssea's Light Intervention Class smart ARGOS ROV – a compact yet powerful ROV suited for ORM operations and especially for offshore wind farm O&M work – offers improved performance and greater operational efficiency to meet those requirements. But while deploying advanced inspection means is one thing, accurately positioning them is also critical to conduct successful and efficient subsea operations.

The main goal of this underwater survey was to visually confirm the integrity of the mooring lines and dynamic umbilical system, besides characterizing marine growth on the various components. To do so, Forssea deployed its smart ARGOS ROV, in partnership with Sulmara Subsea, an international survey services contractor, who was responsible for supplying the survey and positioning services during the subsea operation. A long-standing partner of iXblue, Forssea, who is used to relying on iXblue technology for its offshore operations, equipped its ARGOS ROV with the Rovins Nano/Nortek DVL tight coupling solution to get highly accurate navigation information. iXblue new Gaps M5 USBL system was also deployed to precisely position the ARGOS ROV during the 3-day inspection operation.

“One of the key strengths of iXblue positioning solutions such as their Gaps M5 USBL system, is that they are compact and lightweight, and thus easy to deploy from a CTV and other small vessels used in the windfarm industry. And because they embed their own motion sensors, they do not require any on-the-field calibration, which provides precious time savings during the operations. Combined that to their extreme accuracy in shallow waters and horizontal tracking conditions, and you get an ideal positioning solution for wind farms applications,” comments Gautier Dreyfus, Forssea Robotics CEO. “Globally, our client was very happy with the precision achieved by the Gaps M5 USBL system and Rovins Nano/DVL tight coupling solution. Despite challenging deployment conditions, with strong winds and shallow water depths between 0 and 30 meters, the navigation and positioning solution used, combined with the high skills of the Sulmara personnel, offered very accurate and stable positioning, which was a key requirement for the successful autonomous inspection of the FLOATGEN wind turbine. In the end, our autonomous subsea inspection solution, combined to the high technology we deployed, and the top-notch personnel involved, enabled to achieve substantial efficiency, conducting the inspection tasks 8 times faster than what is usually observed using traditional methods.” ■

Reducing operational costs and increasing operational efficiency using Crew Transfer Vessels (CTV) and other smaller opportunity vessels to conduct accurate but efficient operations in a reduced timeframe is key to wind farms developments. The use of smaller and smarter technologies that do not require big vessels and large crews to be deployed and that reduce the hours spent at sea is thus central to the transition of the offshore industry. By providing autonomous survey capabilities that help

The Argos ROV conducts the underwater inspection of the Floatgen wind turbine.





The Pelagic Research Services teams are getting ready to deploy the Odysseus ROV.

# IXBLUE PROVIDES CRITICAL NAVIGATION CAPABILITIES TO PELAGIC RESEARCH SERVICES IN EXTREME SUBSEA ENVIRONMENTS

iXblue renowned Rovins Nano subsea Inertial Navigation System was selected by Pelagic Research Services (PRS), an ocean services company that brings expedition planning, execution and state of the art subsea research tools to the ocean community, to provide critical navigation capability to its Odysseus Remotely Operated Vehicle.

The 6000-meter-rated versatile ROV, designed for research, exploration and complex work tasks in some of the oceans most challenging environments, was recently deployed by PRS on a critical mission for Ocean Network Canada (ONC). ONC is an initiative from the University of Victoria that monitors the West and East coasts of Canada and the Arctic by gathering data in real-time through a cabled network of subsea observatories.

PRS was contracted to provide ROV services for the deployment, repair, and maintenance of two of ONC cabled ocean observatories: the Venus and Neptune, both located in highly challenging ocean environments. For Venus, low visibility and high currents are the norm; while at Neptune, deep-water and major hydrothermal vents create challenging acoustic conditions straining traditional ROV navigation. PRS thus needed a high-grade inertial navigation system for its ROV to perform the mission in these harsh environments and turned to iXblue Rovins Nano for this critical mission.

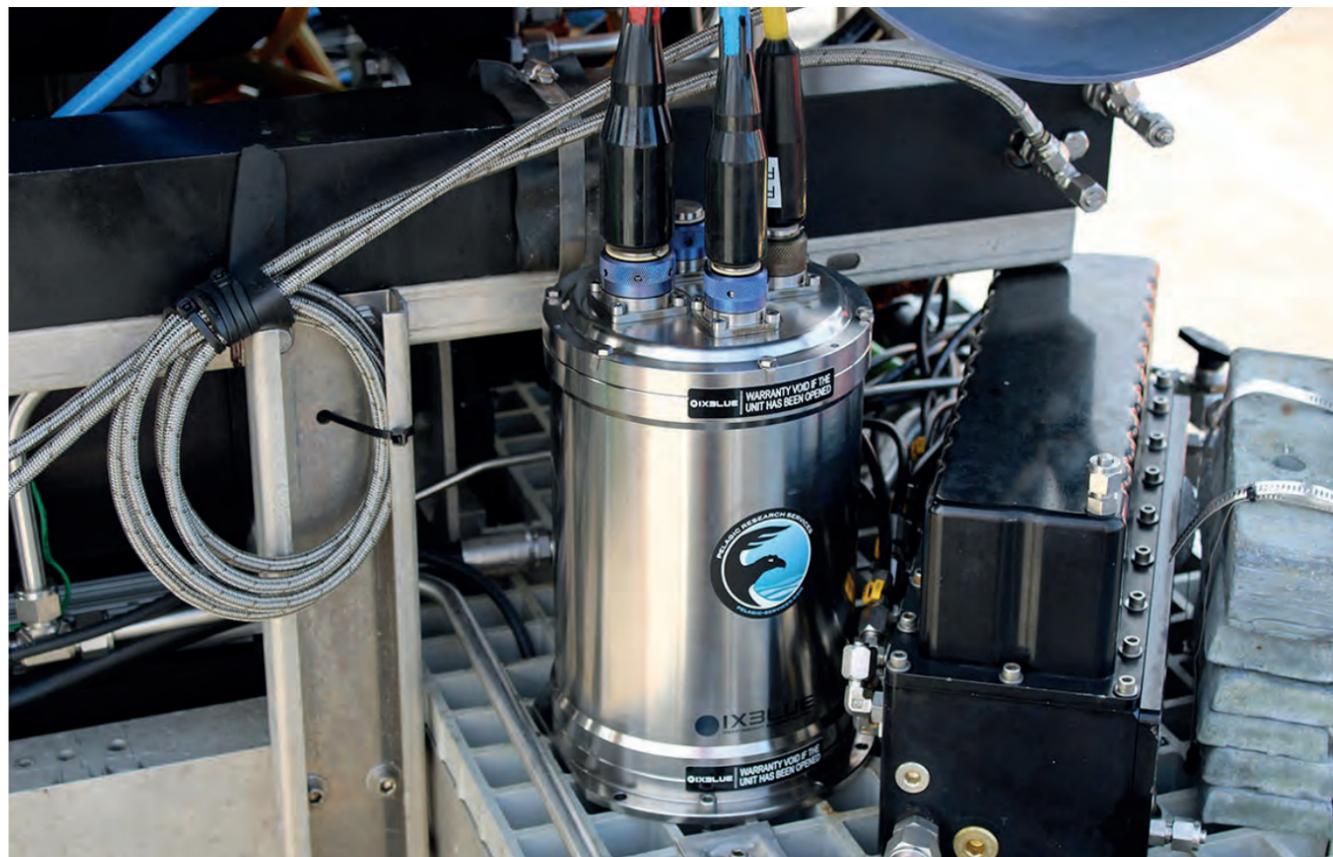
“Pelagic Research Services supports sophisticated subsea science operations for ONC, where precision is critical for subsea positioning and navigation of the ROV”, explains Ed Cassano, CEO of PRS. “For instance, to deploy or inspect the infrastructure (the 800 km fiber-optic and power loop) and

observatories, we need to know exactly our location and be able to come back to that location. The ONC project required high accuracy and repeatability and we were looking for a solution to obtain the desired level of performance. We tested the Rovins Nano, combined with Nortek DVL and the solution met our requirements and ONC’s.”

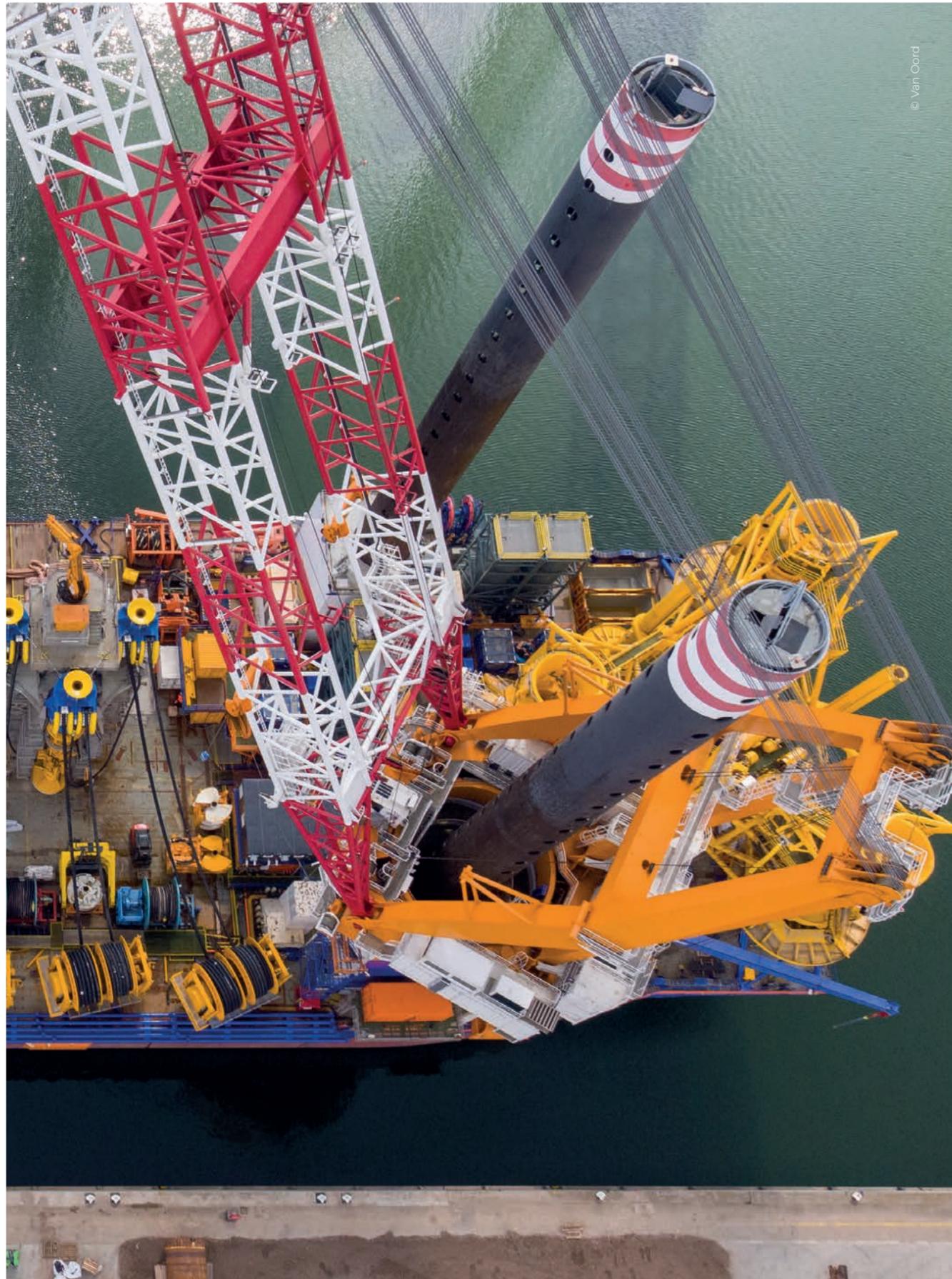
Built on iXblue’s renowned FOG solid state technology and offshore instrumentation expertise. iXblue Rovins Nano offers the unbeatable stability and accuracy of the inertial position while simplifying the operation with its autonomous external sensor management.

An additional dive of the Odysseus ROV with the Rovins Nano also took place along the Endeavor Hydrothermal Vents segment of the Juan de Fuca mid-ocean ridge in the northeast Pacific. There, diving conditions are very challenging, with super-heated water, various water densities which make positioning and navigation very difficult.

“The working environment at Endeavour is extreme, at a depth of around 2,250 meters where the hydrothermal fluids influence the temperature and water density while also creating deep canyons and towering spires. This complex oceanographic environment makes typical ROV navigation using USBL incredibly challenging. We needed a high-performance INS for our ROV navigation in order to achieve our deployment or inspection task and the Rovins Nano perfectly did the job”, adds Ed Cassano. “We are very happy with the INS and the level of technical support and expertise provided by iXblue. Integration was very easy, and the team was always supportive all along the project. We will definitely consider using iXblue INS for future projects”. ■



iXblue Rovins Nano installed on Odysseus ROV.



iXblue LBL solution was deployed from Van Oord Aedus offshore wind installation vessel

# VAN OORD DEPLOYS IXBLUE LBL SUBSEA POSITIONING SOLUTION FOR OFFSHORE WIND FARM PILES INSTALLATION

Global marine contractor Van Oord recently deployed iXblue new LBL subsea positioning solution to conduct the installation of 190 offshore wind farm piles in the Bay of Saint-Brieuc (France). Already used on major Oil&Gas and Renewables projects, iXblue Canopus transponders, Ramses transceivers and Delph Subsea Positioning Software have been used by Van Oord to conduct metrology operations. Those aimed to ensure the laid-out piles had been positioned as per the requested specifications.

Instant pile positioning verification was made possible by installing the Canopus LBL transponders on top of a centering frame which was placed on top of each of the pile that made up the wind turbine foundations. (3 piles per turbine). The Canopus transponders then measured and logged the distance separating them by sending acoustic interrogations to each other. The logged data was then transferred to the Ramses LBL transceiver and sent back to Delph Subsea Positioning global supervision software that generated reports from all received baselines.

“Thanks to our global subsea positioning solution, Van Oord was able to retrieve highly accurate measurement data only 20 minutes after the Canopus transponders had been installed on the piles. This

enabled the overall baseline measurement to be conducted in less than 3 hours for all four piles installed at the time,” explains Hans-Willem Deleeuw, Sales Manager at iXblue.

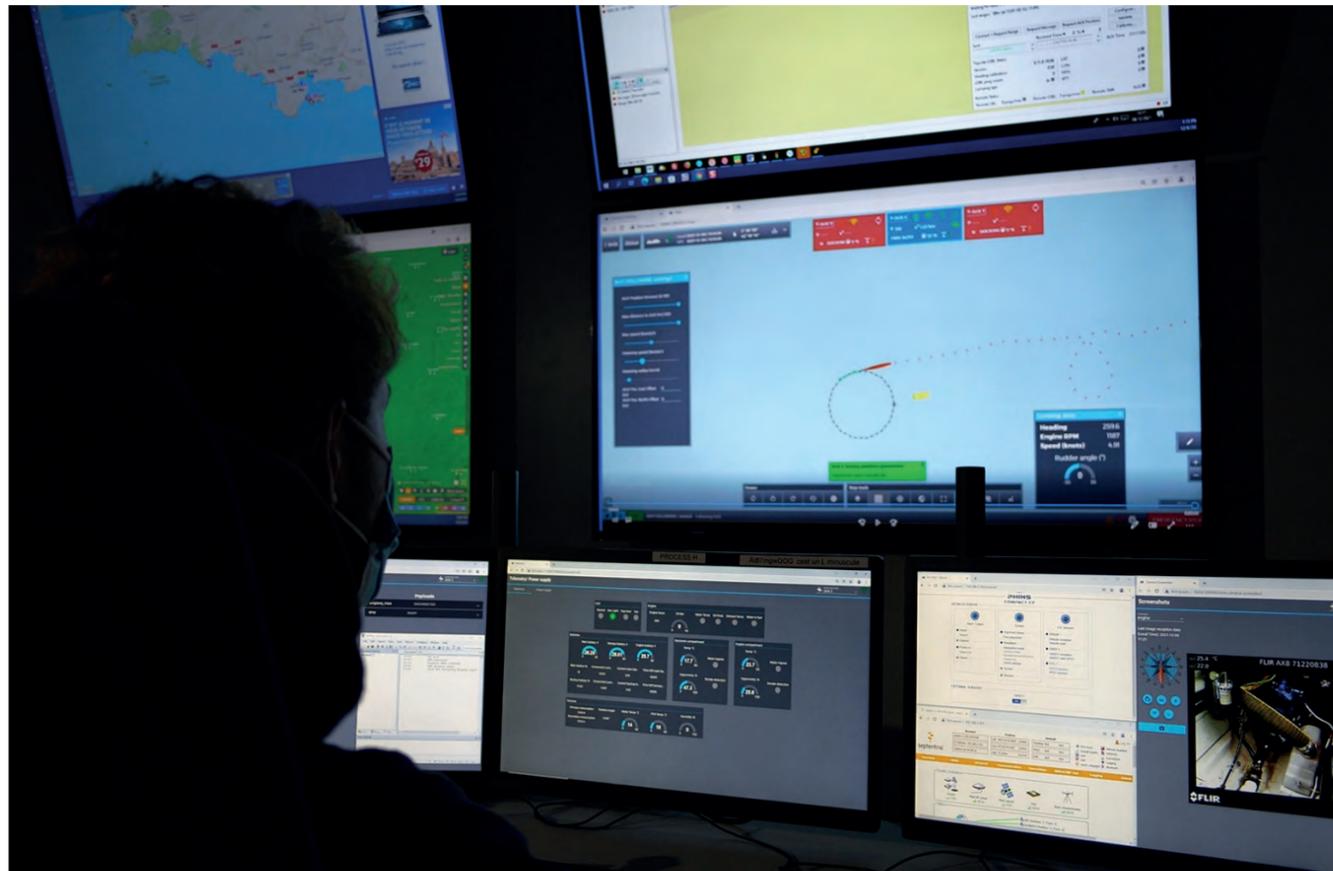
Delivering operational efficiency and flexibility, iXblue LBL subsea positioning solution indeed offers plug & play, easy to deploy and to operate systems. Versatile, they can be used on multiple offshore applications such as metrology or ROV/AUV positioning and are easy to integrate to existing pool of equipment thanks to their open protocols. When used in combination with iXblue Inertial Navigation Systems, innovative SLAM and Sparse LBL modes can be used, deploying a reduced number of transponders, and thus enhancing operational efficiency and cost-effectiveness.

“The intrinsic qualities of our LBL solutions, together with the comprehensive remote training of Van Oord personnel, as well as 24/7 support from the iXblue teams made this wind farm metrology operation a real success.” Hans-Willem continues. “We would like to thank Van Oord for once again trusting our technology and are now looking forward to our next deep water subsea positioning project with them providing cost-effective LBL and sparse LBL operations.” ■



The Gavia AUV begins its dive before being tracked by DriX.

# IXBLUE DEMONSTRATES COLLABORATIVE UNCREWED SURFACE & SUBSEA VEHICLES CAPABILITIES TO TOTALENERGIES



Continuing to enable the use of emerging breakthrough technology, TotalEnergies has partnered with iXblue and Teledyne Marine to demonstrate collaborative uncrewed capabilities for subsea inspection and asset survey operations.

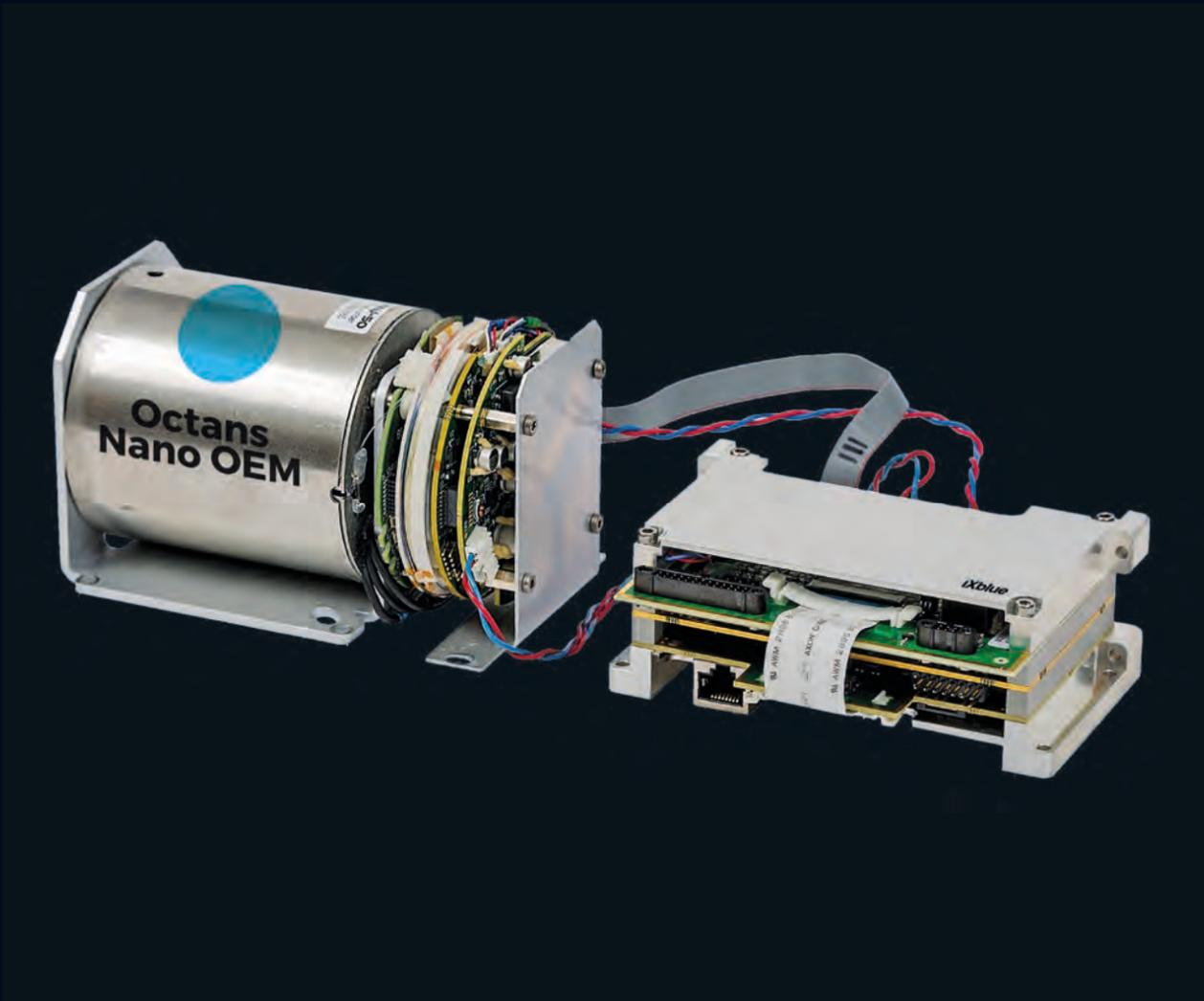
Successful trials were recently conducted off the coast of La Ciotat (South of France), deploying two uncrewed platforms: iXblue DriX Uncrewed Surface Vehicle (USV) and Teledyne Gavia Autonomous Underwater Vehicle (AUV). Both uncrewed platforms were remotely controlled and supervised from iXblue Onshore Control Center, with iXblue DriX USV acting as a communication gateway between the onshore control center and the Gavia AUV. The two drones were able to successfully communicate together, thanks to the Gaps USBL positioning system installed within the DriX gondola, and that tracked the Gavia AUV.

“With these sea trials, we were able to successfully demonstrate the combination of two light drones working in a collaborative mode, remotely controlled and supervised from the shore. Thanks to the DriX USV,

we were able to track the Gavia AUV and send it new mission plans to allow the AUV to closely inspect some defined subsea features, all from the safety of the onshore control center,” explains Mathieu Lardeux, R&D Project Manager at TotalEnergies. “This opens up great possibilities for future multi-energy offshore developments. Replacing the use of conventional large, crewed inspection and survey vessels with uncrewed solutions such as the DriX USV will allow us to reduce offshore risk for personnel, decrease operational costs and lower the carbon footprint of our offshore operations.”

“We are delighted to have been able to demonstrate our capability to conduct collaborative surface/subsea autonomous vehicles operations to TotalEnergies. This broadens the range of applications of our DriX USV, and especially for deeper waters operations, where the use of AUV is necessary. We now look forward to the next steps in our collaboration and to conduct an operational survey on one of TotalEnergies Offshore field in the near future.” adds Olivier Cervantes, VP Energy Markets at iXblue. ■

An iXblue surveyor supervised the operation from a remote Onshore Control Center.



# USING INERTIAL NAVIGATION SYSTEMS TO IMPROVE TOW-BODY SONARS ACCURACY FOR HIGHER QUALITY SIDE SCAN SONAR DATA

Recent years have seen a growing call for more (and better) seafloor data. There are a multitude of reasons for the demand including: the importance for surface and subsea navigation that affect global commerce, trade and defense, rapid transition towards renewable energy from offshore wind and keeping up with today's lightening-speed telecommunications which requires accurate information of the seabed for laying underwater cables, pipelines and other subsea structures. Fisheries and aquaculture conservation and management, also require a better understanding of behavior of ocean currents to improve the models that forecast future climate change. The race is on – deploying uncrewed vehicles and towed platforms – to map the seafloor more accurately, faster and less expensively. AUVs and ROVs are being designed smaller yet more capable. And Side Scan sonars (SSS) and magnetometers, the standard mapping solution for geotechnical and geophysical surveys, are now being expected to provide higher quality data of the seafloor.

**"THIS IS A GREAT EXAMPLE OF INDUSTRIAL COLLABORATION THAT TAKES THE INDUSTRY A STEP FURTHER."**

- SHAYAN HAQUE, BUSINESS DEVELOPMENT MANAGER AT IXBLUE

**W**ithin that context, and to respond to those new challenges, a leading Side Scan Sonar manufacturer was looking to improve the heading, as well as roll and pitch accuracy of their tow-body sonars, with the final aim to reach higher side scan sonar imagery data quality and better operational efficiency for their end-clients around the globe.

Familiar with iXblue products after many years of experience using the company's navigation solutions, the Side Scan Sonar manufacturer approached iXblue to collaborate on solving their challenge in a constraint timeframe.

"Our partner needed to improve the heading accuracy of one of their towed sonar solutions in order to obtain much higher quality imagery data than what they were used to providing as per a specific request from their client, a major survey company," explains Shayan Haque, Business Development Manager at iXblue, Inc. "They were convinced that the MEMS and Magnetometer AHRS technology they were using until then would not be enough. They had to turn towards Fiber-Optic-Gyroscope (FOG) technology and, being familiar with iXblue Phins C3 performance, they asked us if we would be able to meet the required specifications and have a product ready three months later."

Four major factors were specified by iXblue client: the cost of the units, have an ITAR-free product, not subjected to export restrictions, a sub 1° heading accuracy, and a system compact enough to be easily installed on the sonar tow body.

In the span of only three months, a brand-new custom-made navigation solution dedicated to tow body sonars was developed by iXblue engineers in close collaboration with the Side Scan Sonar manufacturer: the Octans Nano OEM, a new highly compact yet highly accurate attitude and heading reference system which answers the call for today's industry demands.

"The level of collaboration and communication with our partner was tremendous; combine

that with iXblue agility and strength in vertical integration and owning all components and know-how of the development process, our engineers and support team were able to develop this new product in no time while also training our partner on their new system," states Shayan. "This is a great example of industrial collaboration that takes the industry a step further."

"As a world leader in Inertial Navigation Systems (INS) and Attitude and Heading Reference Systems (AHRS) based on FOG technology, we specifically developed the Octans Nano OEM AHRS with small AUVs, ROVs and tow body sonars in mind, having already pioneered and successfully delivered INS and AHRS solutions for larger AUVs, work class ROVs and submarines." Shayan adds.

Providing a dynamic heading accuracy of 0.5 deg Seclat, and a Roll & Pitch accuracy of 0.1 Deg seclat, the Octans Nano OEM AHRS is an export-free system that offers unrivaled price-to-performance ratio and gives developers the flexibility to integrate it on a wide variety of small subsea platforms.

"Now the standard heading reference solution on this leading Side Scan Sonar manufacturer towed platform, the Octans Nano OEM not only eliminated repetition of survey lines but has also helped eliminate the need for any post-processing, offering the geophysical survey contractor (and ultimately their end-client) significant cost savings on their survey operations."

Always at the cutting edge of technology development for navigation and positioning solutions with the unmatched ability to meet and deliver on growing industry requirements, iXblue is now offering this new AHRS to improve tow-body sonars accuracy and provide higher quality data of the seafloor. The Octans Nano OEM follows a long line of highly accurate, reliable and durable navigation and positioning solutions that is ready take on today's challenges for small yet highly accurate attitude and heading reference systems. ■

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**NOW THE STANDARD HEADING REFERENCE SOLUTION ON THIS LEADING SIDE SCAN SONAR MANUFACTURER TOWED PLATFORM, THE OCTANS NANO OEM NOT ONLY ELIMINATED REPETITION OF SURVEY LINES BUT HAS ALSO HELPED ELIMINATE THE NEED FOR ANY POST-PROCESSING, OFFERING THE GEOPHYSICAL SURVEY CONTRACTOR (AND ULTIMATELY THEIR END-CLIENT) SIGNIFICANT COST SAVINGS ON THEIR SURVEY OPERATIONS.**

- SHAYAN HAQUE, BUSINESS DEVELOPMENT MANAGER AT IXBLUE

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# POWERING DEEP-SEA EXPLORATION

FOR IFREMER'S NEW STATE-OF-THE ART AUV, ULY<sup>X</sup>

Ifremer, the French National Institute for Ocean Science, has recently unveiled its new-born 6000-meters AUV Uly<sup>X</sup>. Designed for scientific exploration, this state-of-the art submersible vehicle will be able to navigate up to 48h autonomously and will be equipped with unprecedented technologies to uncover the deep sea.

ixblue Sam's real-time pixel georeferenced imaging of a shipwreck (3 cm resolution)

Uly<sup>x</sup> unveiled.  
Ifremer, Dugornay  
Olivier (2020)

**“INTEGRATING IXBLUE’S OUTSTANDING TECHNOLOGY, ULY<sup>x</sup> UNITES A RANGE OF STATE-OF-THE-ART PAYLOAD DEVICES. SCIENTIFIC EXPLORATION OF THE DEEP-SEA ONBOARD CRUISES OF THE FRENCH OCEANOGRAPHIC FLEET, WILL REACH A NEW MILESTONE!”**

- JAN OPDERBECKE, HEAD OF UNDERWATER SYSTEMS UNIT AT IFREMER

**A**ssociating multiple payload devices with navigation capabilities for either long range survey or close-to-bottom hovering, Uly<sup>x</sup> will accomplish wide area acoustic mapping as well as target-based local inspection with optic imaging, photogrammetry and in-situ scientific measurements in a single dive configuration. Part of the small numbers of AUV built for the exploration of the ultra-deep ocean and developed in collaboration with ECA Group, Uly<sup>x</sup> represents a technological breakthrough.

iXblue is taking part in this exciting adventure. Over the past 20 years, the company has developed advanced expertise in combining sonar, inertial navigation and acoustic positioning technologies and offers one of the most advanced and accurate solutions for seabed mapping, imaging and exploration. “iXblue is thrilled to be onboard Ulyx and to provide the most advanced acoustic imagery solutions to Ifremer scientific and hydrographic surveyors. Pushing the limits of the technology and responding to our customers challenges is a driving force for our teams,” states Lionel Fauré, technical and business Manager of iXblue Sonar Systems Division. “Several of our most advanced technologies are onboard the AUV: a Sams-150 Synthetic Aperture Sonar (SAS), an Echoes 5 000 sub-bottom profiler, a Phins C7 Inertial Navigation System (INS), and Delph Geo Software suite for SAS and navigation post-processing.”

“Integrating iXblue’s outstanding technology, Uly<sup>x</sup> unites a range of state-of-the-art payload devices for hydrographic mapping, for visual inspection of local targets and for in-situ measurement accelerating scientific exploration by producing integrated multi-sensor data sets. Scientific exploration of the deep-sea onboard cruises of the French Oceanographic Fleet, will reach a new milestone!” says Jan Opderbecke, head of Ifremer’s Underwater Systems Unit.

Uly<sup>x</sup> AUV, La  
Seyne-sur-Mer.  
Ifremer, Bodenes  
Ambre (2020)



## iXblue high-end sonar systems selected in Ulyx's extensive sensors suit

Ulyx operates an extensive and unprecedented set of payload sensors, including iXblue's synthetic aperture sonar and the Echoes 5 000 sub-bottom profiler, along with a multi-beam echosounder, magnetometers, still photo land laser line imaging as well as a set of scientific bio-chemical and physical parameter sensors.



### Sams-150 Synthetic Aperture Sonar (SAS)

Ulyx will embark a Sams-150 SAS. SAS uses synthetic arrays to capture images of the seafloor, providing much more detailed resolution and high-quality images than conventional side scan sonar. SAS is used for seabed mapping, seafloor classification, sediment characterization, marine habitat observation and seabed features detection. Available as an AUV payload, iXblue Sams-150 expands the capabilities of side-scan sonars for shallow- to deep-sea applications. Its interferometric sonar will deliver co-registered full-swath backscatter and bathymetry data, increasing the achievable resolution and coverage rate from the deep-water surveys performed by Ulyx.

Sams maps are gridded at a resolution of up to 3x3cm. They are fully corrected from geometric and sound propagation distortions and accurately positioned in real-time. The highest pixel's relative positioning precision is achieved through the high level of coupling with the Phins C7 inertial navigation system while the absolute submetric precision is given by the acoustic positioning system solution (USBL, Sparse-LBL, etc.).

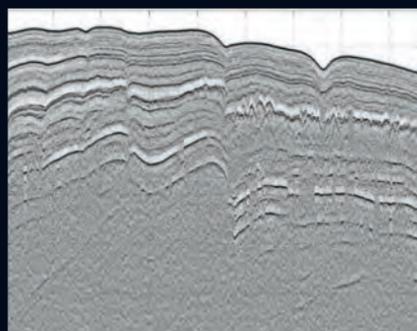


iXblue Sams real-time pixel georeferenced imaging of a shipwreck (3 cm resolution)



### Echoes 5 000 Sub bottom profiler

Operable from shallow to 6000m-water depth, the Echoes 5 000 sub bottom profiler is a complementary payload specifically designed for AUVs and is already deployed on Ifremer's AUVs. Echoes 5000 is a Chirp system with a frequency bandwidth ranging from 1800 to 6200 Hz, allowing about 70 m of penetration with 20 cm resolution, when the AUV is navigating between 50 and 100 m above the seafloor. It will thus provide high-resolution and high-quality records of the sub-surface sediment layers to geologists. All geological information is integrated, processed and georeferenced in Delph Geo software when the interpretation of sub-bottom layers and rock architecture can be done.



Acquired onboard of an Ifremer AUV, this seismic profile shows Echoes 5000 performances to highlight sedimentary architecture at about 1500 m of water depth.

### Delph SAS & Delph INS software

Ulyx will also benefit from iXblue Geophysical Software, Delph Geo. As SAS sonars require dedicated processing software for dealing with the great amount of multi-ping, multi-channel data. To ease the processing workflow, iXblue integrated SAS data processing in the established Delph Geo software where it is managed like conventional side-scan sonar data with all the benefits of SAS technology. This dedicated module – Delph SAS – fully integrates Synthetic Aperture Sonar imaging and its derived bathymetry into the industry proven processing software, complying to survey workflows and data standards.

Delph fully integrates SAS data together with conventional side-scan sonar, bathymetry, sub-bottom profiling, magnetic and other information layers. All existing features available in Delph Sonar Interpretation like batch data processing, sonar mosaicking, target picking and management, interpretation, seabed classification and 3D visualization are

now also available for SAS imagery.

iXblue's inertial navigation post-processing software Delph-INS enables the fusion of surface USBL positioning and the AUV's INS in post-survey. Thus near-perfect line matching will immediately improve map consistency, data interpretation and targeting accuracy.

Coupling iXblue Sams & navigation allows focusing on each pixel in the mosaic, thus rectifying usual distortions and ensuring absolute data positioning. Each pixel's relative positioning precision is almost perfect thanks to the coupling and reprocessing with the INS optimized absolute precision. Motion and acceleration tolerances are 10 times higher than other SAS solutions on market.

As the need for overlapping survey lines is reduced, the Ulyx coverage rate and autonomy will be maximized, thus saving time and cost by increasing the efficiency of operations.

## iXblue's inertial and acoustic technologies providing navigation capabilities to Ulyx AUV



### Phins C7 Inertial navigation system

Based on iXblue Fiber-Optic Gyroscope technology, the Phins compact series offers highly accurate and reliable navigation solution that enhances AUV autonomy. Adopted by all leading manufacturers of AUV around the world, Phins Compact INS does not interfere with sonars and other payloads acoustic noise, while also providing increased autonomy to the subsea platforms thanks to its very low-power consumption. "The Phins C7 on board Ulyx is the most performant system of the Series and will provide very accurate heading, roll, pitch, speed and position ensuring reliable navigation but also contributing to the quality of the data collected by the various sensors" comments Lionel Fauré.



### Posidonia USBL for acoustic positioning

The low frequency Posidonia USBL system developed by iXblue, and already onboard Ifremer's vessel, will be used for acoustic positioning of the AUV. Ulyx is also designed and prepared to host the iXblue Ramses transceiver in a future LF (10-14kHz) version in order to allow for sparse LBL position updating.

"We're very proud for our navigation and imaging technologies to be chosen once again by Ifremer. To be onboard such a disruptive AUV dedicated to ultra-deep ocean exploration is a strong endorsement of our technologies. A whole new adventure awaits, and everyone is looking forward to Ulyx first exploration!", concludes Lionel Fauré.

