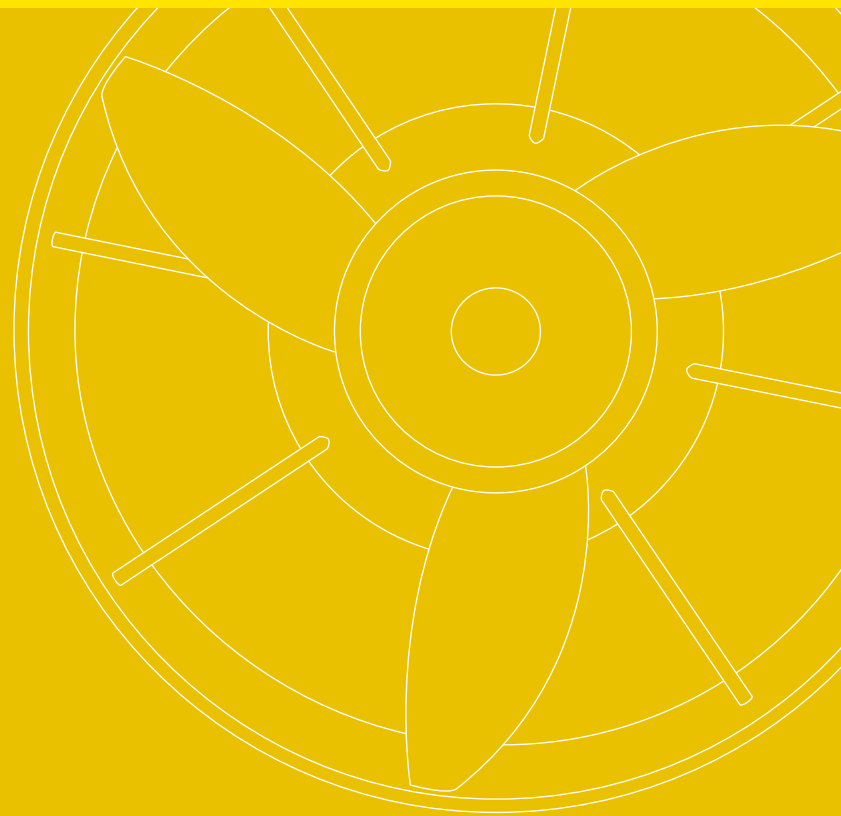




**SUBSEA TECHNOLOGY**

# **MARINE ROBOTICS TRACK, IMAGE NAVIGATE CONTROL**



**POSITIONING  
NAVIGATION  
COMMUNICATION  
MONITORING  
IMAGING**

## OUR COMPANY

# WE TRACK WE NAVIGATE WE IMAGE WE CONTROL

**REMOTE, RESIDENT, AUTONOMOUS OR HYBRID. HOWEVER YOUR UNMANNED SURFACE OR UNDERWATER ROBOTIC PLATFORM IS CONFIGURED, ENSURE EACH AND EVERY MISSION IS A SUCCESS BY EQUIPPING IT WITH SONARDYNE. OUR ACOUSTIC, SONAR, INERTIAL AND OPTICAL TECHNOLOGIES ARE THE PREFERRED CHOICE OF VEHICLE MANUFACTURERS, COMMERCIAL ORGANISATIONS, RESEARCH ORGANISATIONS AND THE MILITARY. WHY? BECAUSE THEY EXTEND OPERATIONAL CAPABILITY, CAN BE ADAPTED TO MEET ANY NEED, AND COME WITH THE BACKING OF OUR GLOBAL SUPPORT NETWORK.**

### GOING DEEPER, DOING MORE

Unmanned robotic platforms open the door to new possibilities across all marine sectors. Tethered remotely operated vehicles (ROVs) allow offshore oil and gas fields to be safely and economically constructed. And with the advent of resident vehicles that live permanently on the seafloor, maintaining and servicing critical seafloor infrastructure can now be controlled from onshore control rooms located anywhere in the world.

Autonomous underwater vehicles (AUVs) carry out multi-faceted missions considered too dangerous, too remote or too deep for divers, towfish and ROVs. They're used to explore, map and monitor our oceans and when used in co-operation with unmanned surface vehicles (USVs), provide surveyors, scientists and the military with a valuable force multiplier.

### ONE SIZE DOESN'T FIT ALL

Each day, marine robotic platforms are becoming more useful, more reliable and more capable. However, one size doesn't fit all and that's why our subsea technologies have been designed to be compatible with vehicles of all sizes and capabilities; from micro AUVs to extra-large AUVs, and everything in between.

### FIT FOR PURPOSE

Whether operating on the surface or down at 4,000 m, one challenge all robotic platforms must overcome is the extreme operating environment. As an equipment manufacturer, we share this challenge.

Our subsea instruments are engineered to withstand the enormous pressures of the deepest oceans; our digital wideband communication signals can penetrate hostile acoustic environments to transfer your data quickly and reliably; and our low power electronics make the most economical use of the available on-board power.

Where off-the-shelf solutions need customising to meet specific space, weight, depth and functionality demands, we have the in-house capabilities to design, test and manufacture solutions that meet your needs on time, and on budget.



### WHY INVEST IN SONARDYNE

- Our track record spans more than 45 years and hundreds of successful installations
- Our technologies extend the operational capabilities of all types of marine robotic platform including AUVs, ROVs and USVs
- We deliver standard or custom engineered solutions on time and budget
- We offer global support to your business, engineers, crew, scientists and mission specialists
- Our company is committed to maintaining a safe, healthy and sustainable working environment, with a goal of zero harm





Image © National Oceanography Centre



## TRACKING

# MICRO, MINI AND RANGER 2 USBL SYSTEMS TRANSPONDERS

**THE SIMPLEST WAY TO ADD VALUE TO YOUR MARINE OPERATIONS IS TO ENSURE YOU KNOW WHERE YOUR UNDERWATER ROBOTIC PLATFORM IS AT ALL TIMES. AND THE SIMPLEST WAY TO DO THIS IS WITH OUR ULTRA-SHORT BASELINE (USBL) TARGET TRACKING TECHNOLOGY. THE HARDWARE YOU'LL NEED IS EASY TO INSTALL AND USE, AND THANKS TO OUR DIGITAL WIDEBAND SIGNAL TECHNOLOGY, IT WILL WORK RELIABLY IN ALL OPERATING ENVIRONMENTS – SHALLOW OR DEEP.**

### MICRO-RANGER 2, MINI-RANGER 2 AND RANGER 2

No matter if your robots operate just off the coast or far from shore, our Micro-Ranger 2, Mini-Ranger 2 and Ranger 2 USBL systems provide you with the capability to know exactly where they are relative to your vessel's or USV's position. Sail to a location, fit a transponder, deploy your vehicle and track it; our USBLs are fast, precise and efficient, meaning that your survey operations will be as well.

Micro-Ranger 2 has an operating range of 995 m and it's extremely portable. Mini-Ranger 2 has the same operating range of 995 m (extendable to 4,000 m) and is ideal for temporary installation on small boats of the type used to deploy micro and man-portable AUVs. Ranger 2 can track ROVs, AUVs, manned submersibles and towed platforms to beyond 7,000 m and has the added capability of providing position reference data for your ship's dynamic positioning system if it's fitted with one.

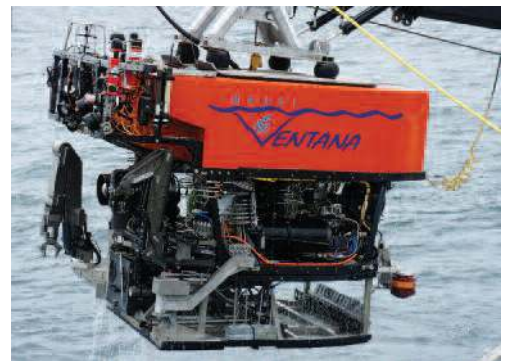
### MRT AND HPT. MORE THAN JUST USBL TRANSCIEVERS

USBL systems typically use a surface-deployed transceiver to measure the range and bearing to your robot. Ours are called MRT and HPT and are available in a range of different array designs to suit your vessel, operating environment and task in hand. The MRT can be dunked over-the-side. With HPT, you can install it permanently through your ship's hull, temporarily over-the-side, or even from a USV to allow over-the-horizon operations using a mother vessel. HPTs can also be used as wireless modems for retrieving data as well as supporting complex survey operations.

### NANO, WSM 6+ AND WMT. SMALL BUT CAPABLE

Payload is a crucial consideration for any robotics mission so it's important to fit the right USBL transponder. Nano is our smallest ever 6G-enabled (sixth generation) transponder measuring just 155 mm long and weighing in at 200 g in water. It's perfect for small AUVs and micro ROVs operating down to 500 m.

With a rechargeable battery, responder mode, choice of transducers and depth ratings to 4,000 m, WSM 6+ represents a step up in capability. It's a popular choice for Work-class ROVs and intervention AUVs. Completing the line-up is WMT; a high power transponder with depth options to 7,000 m and a remote transducer to simplify installation.



### WHY INVEST IN SONARDYNE USBL TRACKING TECHNOLOGY

- Ranger 2 USBL systems are fast, precise and efficient, saving you time and money
- Underwater vehicles can be tracked beyond 7,000 m
- Wide range of deployment options to suit your operation and vessel
- Extensive choice of small, lightweight and versatile transponders for use on any vehicle





## SWARM CONTROL

# MARINE ROBOTICS PACK

**WHEN YOU WANT TO EXPAND YOUR COVERAGE OR MULTIPLY YOUR FORCE, COMMAND AND CONTROL OF YOUR SUBSEA VEHICLE SWARM IS THE WAY TO GO. WHETHER IT'S REMOTELY OR FROM AN UNMANNED SURFACE VEHICLE (USV), WITH OUR MARINE ROBOTICS PACK YOU CAN TRACK, COMMUNICATE AND COMMAND YOUR SWARM ROBOTICS OPERATIONS.**

### TRIED AND TESTED

Our Marine Robotics Pack is a software bolt-on that brings big benefits by combining tracking with modem functionality. Added on to your Ranger 2 USBL system, it gives you the capability to command and control multiple underwater vehicles at the same time.

That's because, used in conjunction with AvTrak 6 and Nano AvTrak 6 OEM transceivers, it adds telemetry to the same acoustic signals that are used by Ranger 2, so that you can track, broadcast positions to targets, and send and receive messages simultaneously, to up to 10 recipients.

Sonardyne Messaging Service (SMS) messages can be used to communicate between unmanned underwater vehicles (UUVs), as well as to allow those vehicles to be tracked and their positions to be shared in a fast and efficient way. Coupled with acoustic time synchronisation, this enables complex long duration missions with real time feedback and reliable time referencing of acquired data.

All this is done without the need for a separate modem. Additionally, it reduces the amount of acoustics in the water as the position is being derived from an encoded message and one message can be broadcast to groups of vehicles.

When you need remote control, for operation from an unmanned surface vessel (USV), the Marine Robotics Pack also has you covered. It provides a remote-control interface to the USBL systems, so your USV can take control of the USBL and your AUVs.

With Marine Robotics Pack, you also have a great tool for aiding your AUV's inertial navigation system (INS) – it's a great complement to our SPRINT INS.

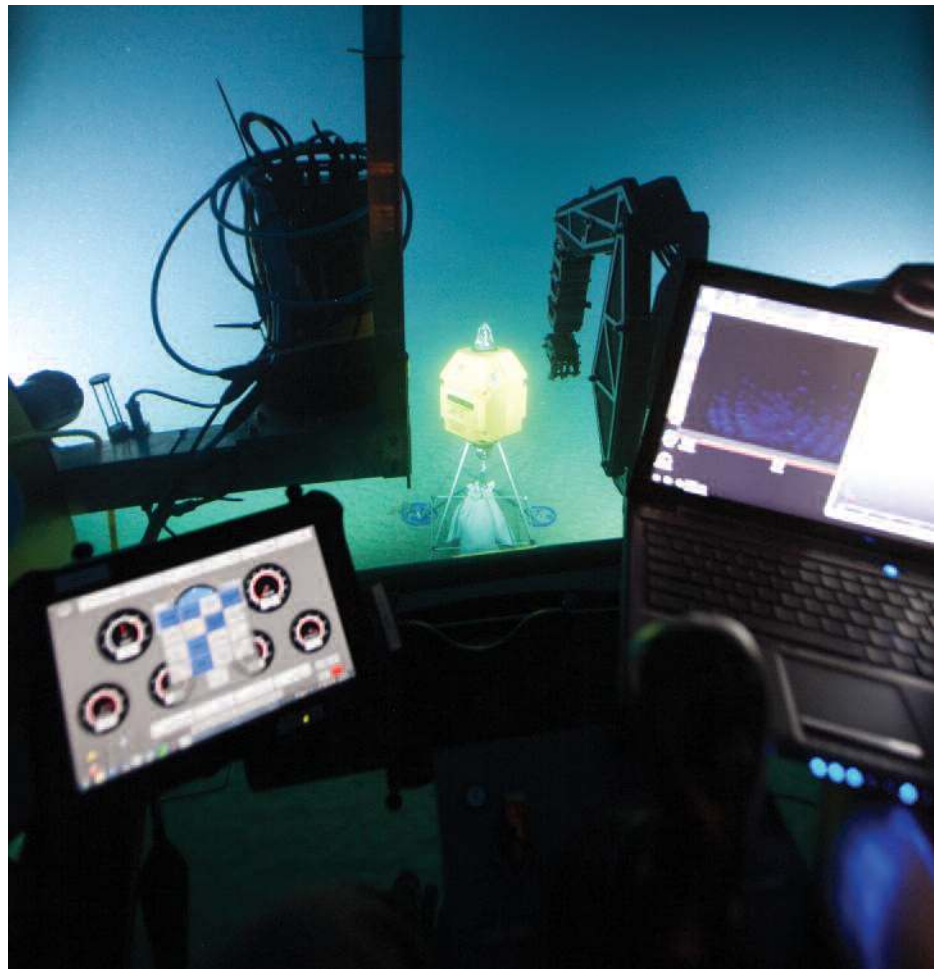
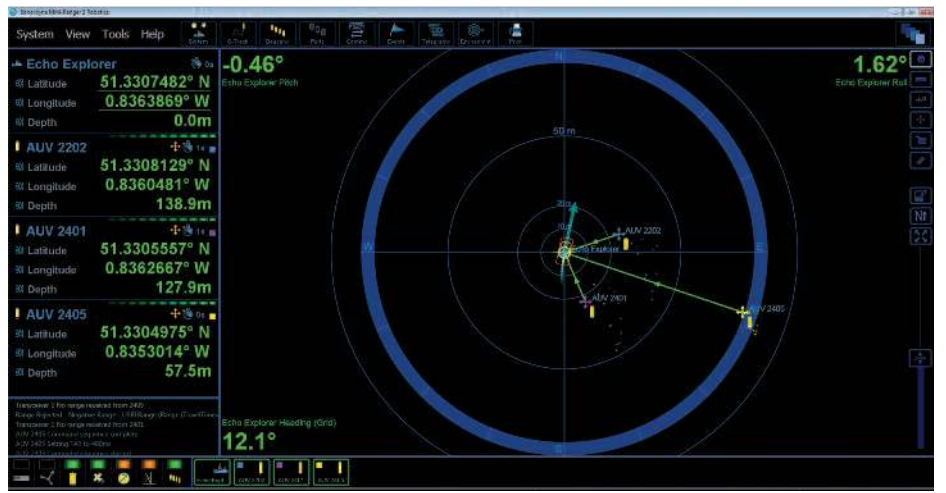
When you add Marine Robotics Pack to your aid your swarm capability, we provide your vehicle developers with access to our powerful telemetry protocol. Built using simple ASCII commands and human readable, it's simple yet very flexible.



### HOW WILL A MARINE ROBOTICS PACK BENEFIT YOUR OPERATIONS

- Combined telemetry and positioning to single or swarms of AUVs
- Time synchronisation of transponders
- Enables complex long duration missions with real time feedback and reliable time referencing of acquired data
- Remote control interface
- Additional aiding for your AUV's INS





## ALL-IN-ONE FUNCTIONALITY

# AVTRAK 6 OEM AVTRAK 6 AND OEM NANO AVTRAK 6

**AUVS USE AN INERTIAL NAVIGATION SYSTEM (INS), AIDED BY A DOPPLER VELOCITY LOG (DVL), TO CONTINUOUSLY WORK OUT THEIR POSITION. HOWEVER, OVER TIME, THE ESTIMATED POSITION OF THE INS SYSTEM 'DRIFTS' AS SMALL DEAD-RECKONING ERRORS ACCUMULATE. PROVIDING USBL AND LBL ACOUSTIC POSITION UPDATES TO THE AUV CAN MITIGATE THIS EFFECT – AND THAT'S WHERE AVTRAK EXCELS. ITS ONE OF THE MOST VERSATILE INSTRUMENTS YOU COULD FIT TO YOUR AUV.**

### LBL, USBL AND COMMUNICATIONS

All models of AvTrak 6 are 6G compatible so not only can they measure ranges to LBL transponders with great precision, they can also exchange data within each range update cycle. This means you can track your AUV over thousands of metres of depth and also let the AUV's INS computer know where it is. This can be done in single cycle updates.

The AvTrak 6 family has been designed with ease of integration in mind and it's a popular choice for many AUV designers and manufacturers. Open interfaces and protocols, access to raw 6G and Wideband 2 ranging and data exchange capabilities means that AUVs can now communicate with surface vessels, transponders on the seabed and other AUVs. With AvTrak 6, AUVs can alter mission plans, provide health status updates and even share mission goals with other AUVs and other underwater platforms operating nearby.

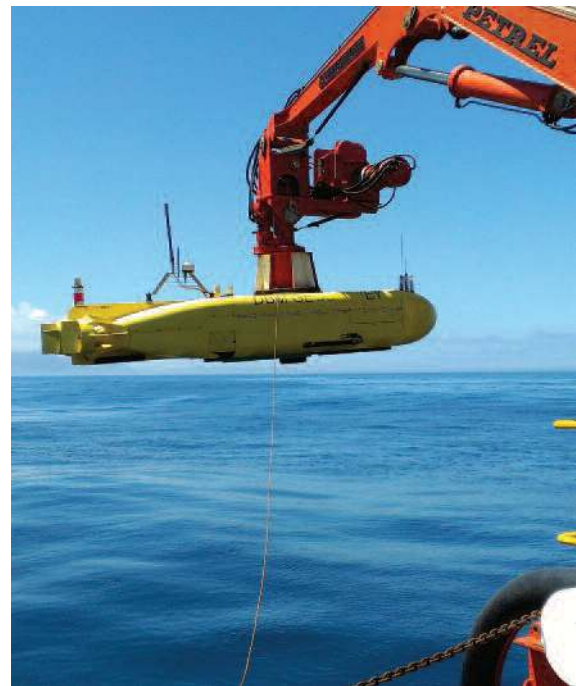
### MODEL CHOICES

Small AUVs need small instruments and they don't get much smaller than OEM Nano AvTrak 6 – it measures just 88 mm by 56 mm. A remote transducer gives you the flexibility to mount it anywhere, whilst the li-ion battery gives you 10 days standby life to help you recover the vehicle if it's lost.

For large vehicles (12 inch and above), we recommend standard AvTrak 6 which is available in depth rating to 7,000 m or in OEM form (no housing) for easy integration within your own electronics pressure housing.

### IT COMES WITH SUPPORT

An Interface Control Document (ICD) enables your engineers to quickly talk AvTrak's language and integrate it into any vehicle. We're flexible and will often adapt functions to your particular needs; our engineers are available to help.



### WHY AVTRAK IS RIGHT FOR YOUR AUV

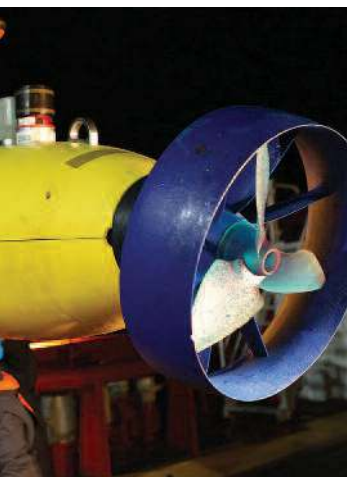
- 3-in-1 instrument; USBL transponder, LBL transceiver and bi-directional communication modem
- Three models available including OEM to suit all vehicle types
- Low power and easy to install
- Emergency relocation mode
- Depth options to 7,000 m







Transducer and PCB shown actual size (56 millimetres x 88 millimetres)



## NAVIGATION

# SPRINT-NAV SPRINT INS SYRINX DVL LODESTAR-NAV

**QUALITY NAVIGATION SOLUTIONS ARE FUNDAMENTAL TO ANY UNDERWATER ROBOTIC OPERATION. 'KNOWING WHERE YOU ARE' ALLOWS ROVS TO PRECISELY HOLD STATION DURING COMPLEX TASKS OR AUVS TO REMAIN ON COURSE OVER MANY KILOMETRES. THE MORE RELIABLY AND PRECISELY YOU NAVIGATE, THE MORE EFFECTIVE YOUR VEHICLE – AND ITS PAYLOAD SENSORS – WILL BE. FROM ALL-IN-ONE NAVIGATION SOLUTIONS TO INDIVIDUAL SENSORS, WE SUPPLY EVERYTHING YOU NEED.**

### SPRINT-NAV

SPRINT-Nav is fast becoming the all-in-one high-performance subsea navigation instrument of choice for underwater vehicles. Built around high-grade ring laser gyros, it combines our SPRINT INS, Syrinx DVL 600 kHz (Doppler velocity log) and a high-accuracy intelligent pressure sensor in a single, compact housing.

The tight mechanical alignment of the sensors in SPRINT-Nav improves overall navigation performance, ensures rapid and easy mobilisation and means you can get to work fast, without the need for calibration routines. Tight, beam-level aiding from SPRINT also means continued operations, even if one or two DVL beams are unavailable.

### SPRINT INS

Improve the speed and efficiency of your ROV and AUV operations with SPRINT. Built around three high-grade Honeywell ring laser gyros (RLGs) and accelerometers, SPRINT provides high-quality inertial measurements aided by your vehicle's DVL, pressure sensor, USBL or LBL acoustic system – even if it's from another vendor. It's available in multiple performance levels to support simple to complex operational scenarios and as an OEM version for AUVs with restricted payload space.

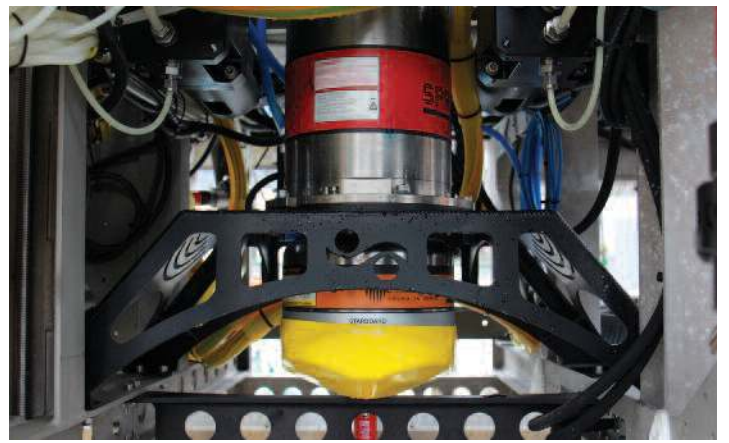
### SYRINX DVL

Our Syrinx 600 kHz DVL is designed to meet the needs of most surface and subsea vehicles that require high integrity, high performance navigation aiding over a wide range of depths and seabed types. It operates at altitudes comparable to a 300 kHz DVL, with the high-resolution performance of a 1200 kHz DVL.

### LODESTAR-NAV

Lodestar-Nav is an all-in-one solution designed for ROV control and guidance. It combines a high-accuracy attitude heading reference system (AHRS), Syrinx DVL and survey-grade pressure sensor. Lodestar-Nav comes pre-calibrated, making it an easy-to-fit turnkey solution that's accurate, robust and reliable in even the most challenging environments. For survey applications, where a true inertial output is required, Lodestar-Nav can be remotely upgraded in the field to a SPRINT-Nav to provide exactly that.





### WHY CHOOSE A SONARDYNE INS, DVL AND AHRs

- SPRINT-Nav is available in three performance levels; 300, 500 and 700
- Low-risk, proven acoustics, DVL and INS, from one manufacturer
- Delivers unprecedented levels of performance for ROV and AUV guidance and survey
- Depth ratings to 4,000 m and 6,000 m
- Lodestar-Nav; great factory-fit solution, easy to upgrade to SPRINT-Nav



## IMAGING

# SOLSTICE NOAS

**UNMANNED PLATFORMS ARE ONLY AS VALUABLE AS THE DATA THEY GATHER. SO, ONCE YOU KNOW WHERE YOUR ROBOT IS, THE NEXT CHALLENGE IS TO GIVE IT THE CAPABILITY TO UNDERSTAND ITS ENVIRONMENT. TOP OF MANY USERS' PAYLOAD REQUIREMENTS IS IMAGING, TO HELP SYSTEMS SEE AND INFORM DECISION MAKING AND ACTIONS. OUR ULTRA-HIGH DEFINITION SONAR IMAGING AND OBSTACLE AVOIDANCE FOR UNMANNED VEHICLES DELIVER.**

### SOLSTICE MULTI APERTURE SONAR

Solstice is our multi aperture sonar (MAS). With input from 32 elements it can dynamically focus along an entire 200 m swath. Compact and low power, it's ideal for low logistic platforms.

Multiple apertures means data is enhanced and the signal-to-noise ratio (SNR) is improved. Solstice's bathy data is co-registered onto the same pixel grid as the side scan imagery, so it can produce stunning digital terrain maps, accurately draped over the bottom topography, making it ideal for hydrography and mine counter-measures (MCM) operations.

In addition, Solstice's onboard processing produces geo-coded side scan imagery, which is available for onboard computer aided detection and classification (CAD/CAC) and automatic target recognition (ATR). The output data files are compatible with leading post mission analysis (PMA) software packages.

### NOAS

An important aid to vessel navigation and collision avoidance, our Navigation and Obstacle Avoidance Sonar (NOAS) images the seabed ahead of a vessel or underwater vehicle to detect potential underwater hazards. Using sophisticated bow-mounted transducers, NOAS displays water depth, subsurface obstacles and features by creating an accurate 3D model of the underwater environment, displayed relative to the vessel, overlaid on nautical charts in real-time. So your remote pilots have an easy to interpret view of the underwater topography ahead.



### WHY INVEST IN SOLSTICE AND NOAS

- Solstice delivers the highest quality imagery available for small AUVs
- Low power consumption extends vehicle endurance
- Solstice delivers the highest area coverage rate (ACR) for any side-scan in its class
- NOAS provides 3D seabed mapping ahead of your vessels up to 600 m
- With sonar navigation mode, you can detect hazards out to 1500 m

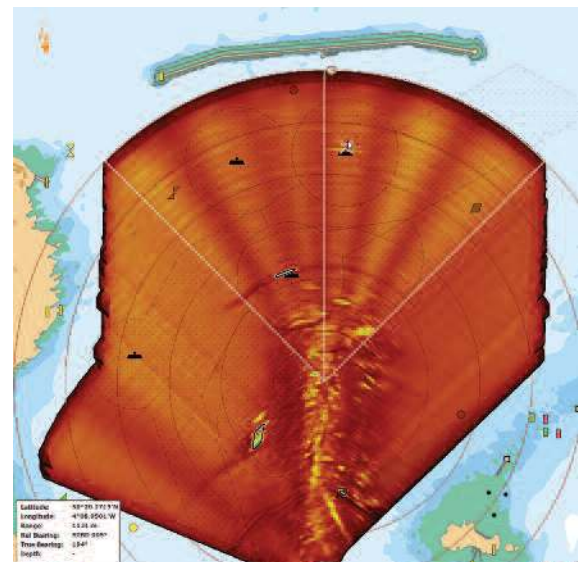
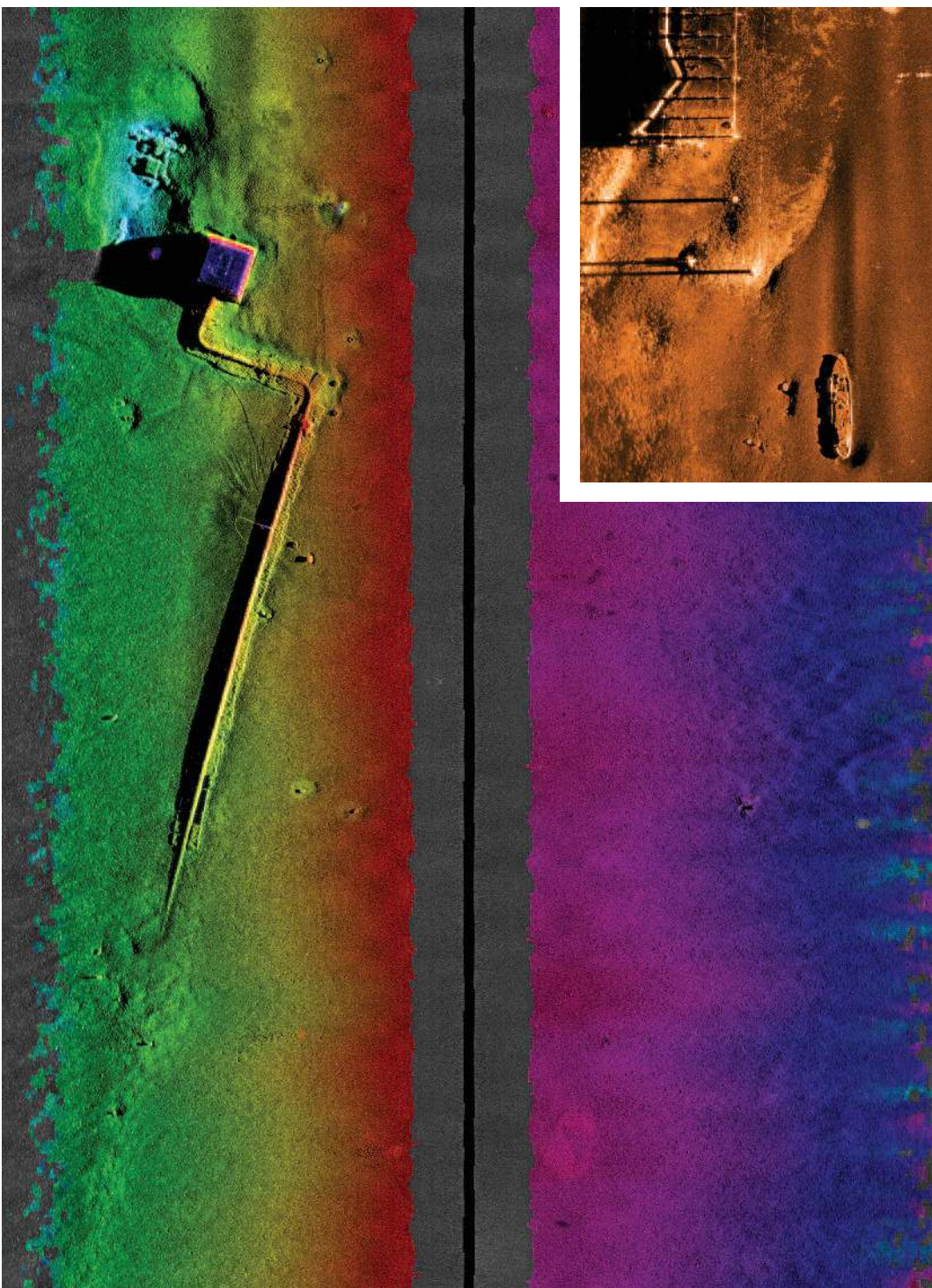




Image: courtesy of General Dynamics Mission Systems



## DATA AND COMMUNICATIONS

# SONARDYNE WIDEBAND<sup>®</sup> 2 & BLUECOMM

**WITH THE SAME INSTRUMENTS YOU USE TO TRACK, POSITION AND COMMUNICATE WITH YOUR SUBSEA ROBOTICS, YOU CAN CONTROL, COMMUNICATE WITH AND HARVEST DATA FROM SUBSEA INFRASTRUCTURE - USING ANY UNMANNED SURFACE OR SUBSEA PLATFORM YOU CHOSE. OUR HIGH INTEGRITY WIRELESS LINKS LET YOU GATHER DATA FURTHER AND DEEPER, UNMANNED.**

### DATA HARVESTING

Data harvest across all ocean depths, from shallow to deep water, over long distances, with the surface or underwater platform of your choice, with our reliable, low bandwidth, bi-directional communications.

With our family of 6G (sixth generation) AUV transceivers (AvTrak 6) and surface-deployed modems (Dunker 6) and transceivers (HPT 3000, HPT 5000), you have all you need to configure your surface or subsea vehicle for unmanned data retrieval from seafloor sensors.

Not only that, with 6G on board and our Wideband 2 acoustic signal architecture, which allows you to combine position updates and telemetry, you can use your unmanned vehicle to configure or reconfigure seafloor sensors and even position them, using our GPS-Acoustic (GPS-A) module.

### BLUECOMM

But what happens when the volume of data you need to transfer isn't just a few megabytes, but several gigabytes? In the past, that's meant bringing your vehicle back up to the surface to retrieve the data – wasting crucial survey time.

Our high speed optical modem, BlueComm, changes everything. Using rapidly modulated LEDs, a pair of BlueComm modems can pass incredible volumes of data (from 5 to 500 Mbps) over hundreds of metres to one another – using very little power, making it ideal for self-powered platforms.

Fitted with BlueComm, an AUV can pass through an area full of data logging instruments and download their data quickly and efficiently. An ROV can deploy a remote camera sled to provide pilots with a second perspective on seafloor operations – removing the need and cost of deploying a second ROV. ROV pilots can take over live control, from the beach, with a live video feed.

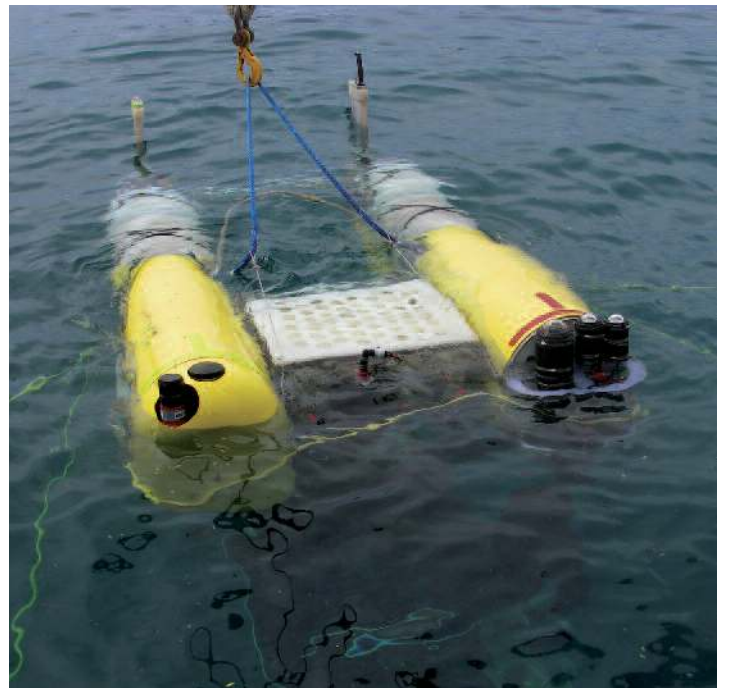
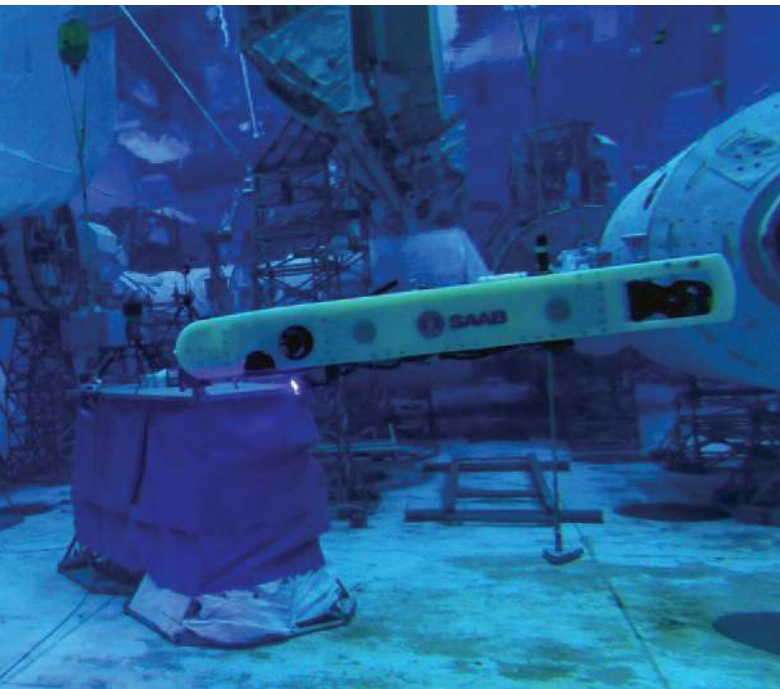
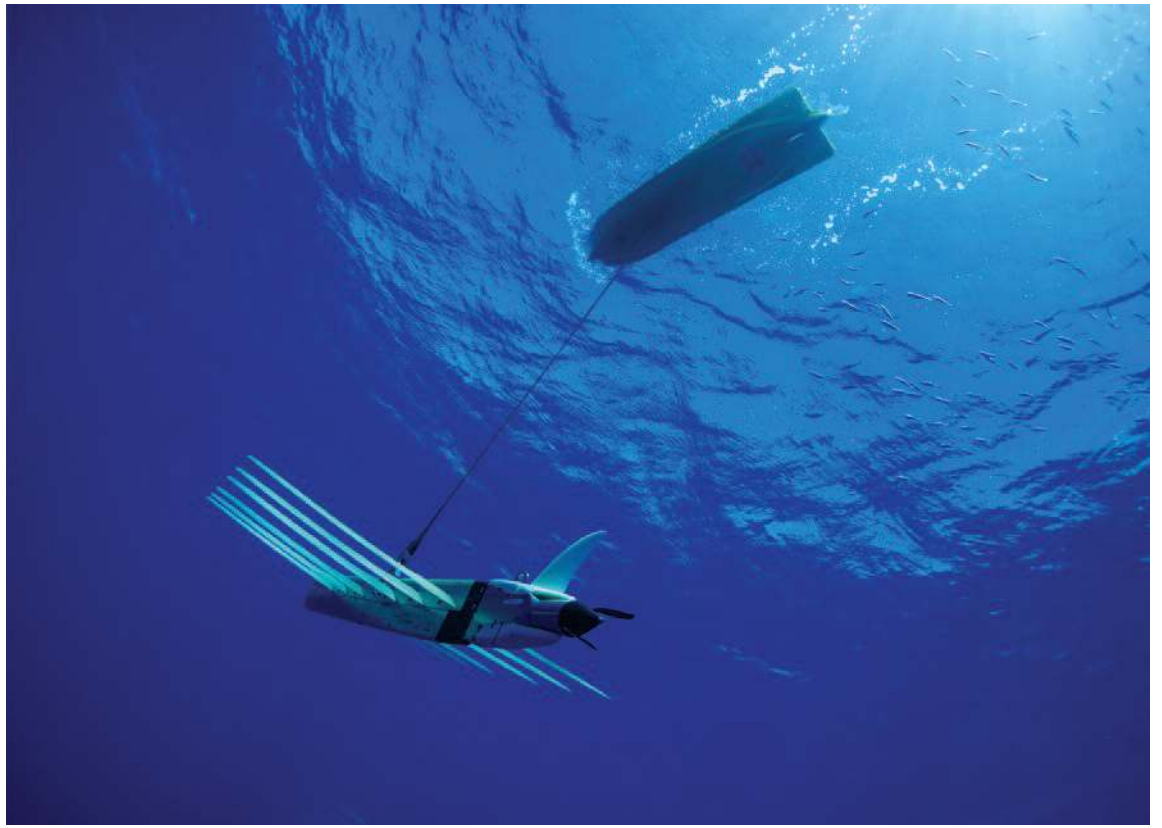
BlueComm is transforming the way we think about the subsea environment. Now every subsea asset can be made a 'connected' subsea asset all the way back to your office.



### HOW WIDEBAND 2 AND BLUECOMM KEEP YOU CONNECTED TO YOUR ROBOT

- Create an unmanned seafloor to surface to data shore link with 6G onboard.
- Control your USV or AUV/UUV and your seafloor sensors, over-the-horizon.
- BlueComm can transfer data wirelessly up to 500 Mbps speeding up the time it takes to harvest data
- Can also be used to stream live video and undertake tetherless vehicle control





## MARINE ROBOTIC SYSTEMS

# AT A GLANCE

### TRACKING > MICRO-RANGER 2 / MINI-RANGER 2 / RANGER 2

When you need to invest in Ultra-Short BaseLine (USBL) acoustic technology to support your underwater operations, Micro, Mini and Ranger 2 have the performance you need, at the investment level you can afford to track your ROVs, divers, sensors and AUVs in any situation.



- Simple and intuitive software
- Tracks multiple underwater robots simultaneously
- Fast position update rates
- Easy to install and configure
- Global record of success on all types of vessel
- Support available globally 24/7



### SWARM CONTROL > MARINE ROBOTICS PACK

With a Marine Robotics Pack software bolt-on you can combine tracking with modem functionality. Added to your Ranger 2 USBL system, you can command and control multiple underwater vehicles simultaneously.

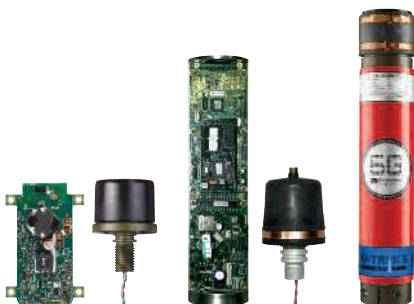


- Provide additional aiding to your AUV's INS
- Supports unmanned vehicles via a remote control interface
- Combined telemetry and positioning to single or swarms of AUVs



### MULTI-FUNCTION > AVTRAK 6

With AvTrak 6, AUVs can alter mission plans, provide health status updates and even share mission goals with other AUVs and other underwater platforms operating nearby. It is also compatible with the Sonardyne 6G systems fitted to many vehicles and ships across the oceans.



- 3-in-1 instrument; USBL transponder, LBL transceiver and two-way acoustic modem
- Models to suit all vehicles
- Low power and easy to install
- Emergency relocation mode
- Depth options to 7,000 m



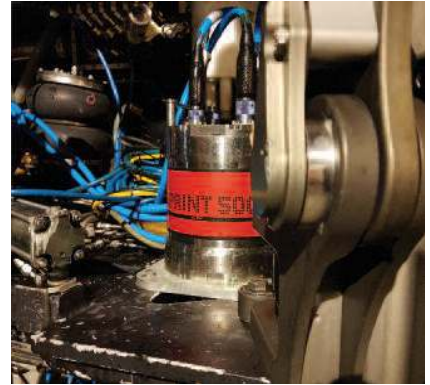


## NAVIGATION> SPRINT-NAV / SPRINT INS / LODESTAR-NAV

Our tightly integrated acoustic inertial systems offer all-in-one navigation, from factory fit solutions to the highest-grade yet compact navigation instrument for the most demanding applications.



- Hybrid acoustic and INS for your ROV or AUV
- Class-leading performance
- Compact, easy to integrate
- AHRS, DVL and pressure sensor in one
- Pre-calibrated and calibration-free during use



## NAVIGATION> SYRINX DVL

Syrinx is a 600 kHz Doppler velocity log (DVL) for surface and subsea vehicles. It combines the high altitude, high resolution features of 300 kHz and 1200 kHz DVLs in a single, easy to install navigation instrument.

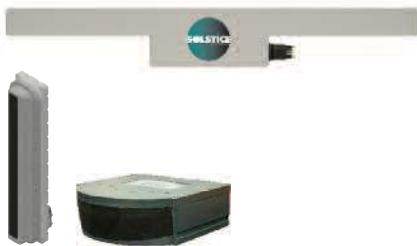


- Class-leading precision
- Easy to set up and use
- Reliable and adaptive bottom lock
- Replaceable transducers
- Water-blocked transducer array

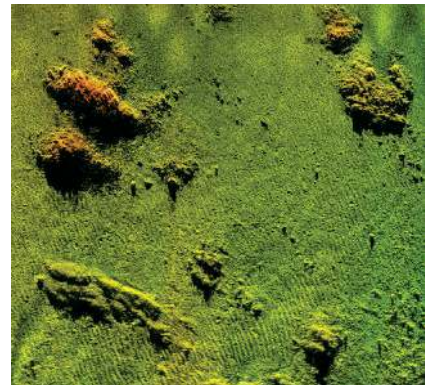


## IMAGING> SOLSTICE / NOAS

Solstice provides ultra-high resolution imagery with low power consumption for AUV operations. NOAS lets you see what lies beneath in the uncharted waters ahead, giving you time to react.



- Multi aperture sonar suitable for low-logistic AUVs
- Suitable for Search, Classify and Map (SCM) operations
- Designed for new-build or retrofit
- Generates automatic user defined alerts of navigation hazards



## COMMUNICATIONS> WIDEBAND® 2 / BLUECOMM

Wideband® 2 acoustics track, navigate and communicate with your vehicle whilst BlueComm optical modems deliver fast and efficient data recovery via AUV, ROV or USV deployed dunker.



- Wideband® 2 delivers robust performance in all environments
- Reliable, low-bandwidth, bi-directional communications
- BlueComm is highly energy efficient
- Up to 500 Mbps data rate
- Compatible with subsea Ethernet networks



## SUPPORT

# WE DESIGN WE ENGINEER WE INTEGRATE

**WITH HUNDREDS OF INSTRUMENTS SUCCESSFULLY DELIVERED AND INSTALLED, WE HAVE THE EXPERIENCE TO WORK SIDE-BY-SIDE WITH YOUR ENGINEERS, SCIENTISTS, VESSEL CREW AND PLATFORM OPERATORS TO MAKE INVESTING IN, AND INTEGRATING SONARDYNE TECHNOLOGY ON YOUR MARINE ROBOTIC PLATFORM STRAIGHT-FORWARD AND SIMPLE. IT'S ALL PART OF THE SERVICE THAT HELPS LOWER YOUR OPERATIONAL RISK, SPEED UP YOUR SUBSEA PROJECTS AND KEEP OPERATIONAL DOWNTIME TO A MINIMUM.**

### EXPERT ADVICE

Our long-term partnership with clients has enabled us to develop a unique and extensive insight into the diverse nature of marine robotic operations and the associated commercial and operational pressures. We understand that the technology investment decisions you take today, will affect your unmanned operational capability for years to come so they need to be right.

That's why you can trust our global commercial and technical teams to give you expert advice on which Sonardyne system is best for you, how to finance it (now including lease and rental options), where and how it should be installed, what customisation it may need, and the typical performance you can expect to see based on how and where you'll be using it.

### OPERATOR TRAINING

Once you become a Sonardyne client, you gain automatic access to our customer care programme. A dedicated email helpline connects you to product engineers ready to answer your questions but if it's more urgent, our 24 hour worldwide telephone helpline is standing by ready to resolve any operational issues you're facing.

Of course, the best way to ensure your equipment always performs as it should is to service it regularly. Book an annual service visit, and one of our field engineers will inspect the health of your vessel and vehicle's Sonardyne technology, including updating software and firmware and inspecting through-hull deployment machines to make sure regular checks are being carried out.





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